The Agricultural
EDUCATION
MAGAZINE

January/February 2023
Volume 95, Issue 4

Innovation in Agricultural Literacy

Using Novelty to Enhance Agricultural Literacy Efforts

by Dr. Gaea Hock

Experiencing something for the first time helps us focus and learn. We use novelty in our classrooms to capture attention, make a connection, and enrich the learning process. Agricultural education has used novelty for years by bringing in real objects and animals, taking students on field trips, creating unique competitive events, and encouraging home projects (i.e. SAEs).

I still remember my high school agriculture teacher, Mr. Bill Johnston, bringing chickens and digestive tracks into our animal science class. As a high school educator, I recall several lessons where I tried a more novel approach or utilized real objects to enhance the learning experience. Agricultural literacy programs and events are full of novel strategies and methods. My FFA members went to the grade school to discuss agriculture with the 3rd graders by creating their own personal pan pizzas. Both groups of students enjoyed that activity and hopefully they still remember it even years later.

Now that I have my own children, I really appreciate all the people, organizations, and entities working to improve agricultural literacy. Agricultural literacy is a key component of the Kansas State Fair each fall. Agriland that is a big hit with my kids. They have several educational activities including a cotton gin, soil profile trailer, cab of a combine, life size model milking cow, and tubs with several Kansas commodities. The Birthing Center is another area where students can interact with live animals and learn more about farm animal reproduction. Both locations are big hits with children of all ages and helps to increase the public awareness of agricultural practices.

Another example of a novel agricultural literacy program is sponsored by the Kansas Corn Commission. They have grown their educational outreach efforts the past few years to be a model of innovation in our state. My agriculture teacher, now retired, works for Kansas Corn as an educational guest speaker traveling to classrooms across the state. My children have personally benefited from Kansas Corn STEM when they brought creative activities to the Kansas Children's Discovery Center for a special outreach

(LEFT) Corabel looks forward to our yearly visit to Agriland to milk the cow.
(RIGHT) Jasper is learning about cattle reproduction at a young age with this palpation cow activity at the Kansas State Fair.

(LEFT) Corabel leans about the germination process by making a germination necklace with Kansas Corn STEM.
(RIGHT) Figure 1 . The Pillars of Agricultural Literacy from American Farm Bureau Foundation for Agriculture is a valuable tool in creating and evaluating agricultural literacy programs.

event. Partnering with existing locations and activities is a great way to expand the reach of agricultural literacy programs.

The American Farm Bureau Foundation for Agriculture published the Pillars of Agricultural Literacy. This document serves as a guide for "planning and managing ag literacy programs." It can be used to reflect on what is being taught, what should be taught, how to structure programs, aligning to educational standards, and measuring accomplishments. There is a foundational level which encompasses the knowledge related to history, taxonomy, identification, and production awareness. Then it is organized into six pillars focused on relationships and connections impacting the agriculture industry (see Figure 1).

The Pillars allow us to reflect on the agricultural literacy programs we are planning and hosting. Are there components you are missing that could be added to enhance what you are already doing? Are there more novel and unique ways to connect consumers with the industry? Are you missing components in your agricultural education curriculum that should be added? As you design and evaluate agricultural literacy programs, you can use The Pillars as a tool to make improvements and changes. The document is included on the AFBF website.

There are many more high-quality and novel agricultural literacy programs in Kansas and across the United States. As you read the articles contained in this issue, reflect on the following questions.

- What programs exist in your state and how could you partner with them?
- What novel ways could you help improve agricultural literacy in your community?
- What programs exist that would benefit from partnering with the agriculture teachers' association and FFA in your state?

When you are designing educational outreach programs, I encourage you to review the resources available on the National Agriculture in the Classroom website, your state's Ag in the Classroom website (check out the Virtual Agriland from Kansas AITC), and the Pillars of Agricultural Literacy website. Work to make your outreach efforts purposeful, novel and impactful!

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Innovation in Agricultural Literacy

Front and Back Cover Photos Courtesy of Jacob Rutledge, Chapman FFA, Kansas

Distribution
Beginning with Volume 93, Issue 1, (July/August 2020), *The Agricultural Education Magazine* will be available in electronic format only, free to all, accessed through the website of the National Association of Agricultural Educators at http://www.naee.org/profdevelopment/magazine. All available back issues of the magazines are archived at this web address, also free to all.

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Publication Information
The Agricultural Education Magazine (ISSN 0732-4677), published bi-monthly, is the professional journal of agricultural education. The journal is published by The Agricultural Education Magazine, Inc. at 2525 Harrodsburg Road, Suite 200, Lexington, Kentucky 40504-3358.

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Innovation in Agricultural Literacy

by Dr. Kellie Enns

The term agricultural literacy has been around for a long time, but if you are in a similar situation as we are at Colorado State University, this term is getting a lot of attention these days! The goal of educating the public about agriculture is no small task, and investment in this space is often costly – investments of time, talent, expertise, resources, and especially now – an investment of innovation.

Innovation can be described as investing in tools that will close gaps in an industry, workplace, or educational facility. Innovation is always on trend – and often represents the utilization of technology to make work easier.

Innovation is hard to define clearly, but we often know when we see it, don't we? It is that moment when you have this fantastic conversation with someone, listen to a new idea, and think: "That is genius; why didn't I think of that?" It's more than just a good idea – it tips the scales of difference – it makes us want to think, act and do differently. In this sense, innovation is so profound that we seek to replicate – the best form of flattery!

In agricultural literacy, we see literacy efforts that have been expanded and scaled and those which have innovated and challenged the status quo. Agricultural literacy is not just for our elementary students but for contexts from pre-k to adults. Often innovation happens by accident – a program designed for a middle-school student educates the teacher, and a program designed for an adult is passed on to children. This ripple effect is hard to measure but critical to consider.

This magazine is dedicated to just that – those who innovated across spaces to change the agricultural literacy landscape – and made it better for future generations. Innovation can be in a place, framework, program, engagement strategy, or evaluation method. Innovation often happens because of necessity – and we certainly have seen this in our Covid era of education. Remote learning has allowed us to increase accessibility to various programs through virtual tours, Meet-your-Farmer programs, and virtual badging. Post-Covid, we have seen a desire to engage, motivate, and build understanding and relationships across agricultural values– we all want to be seen and heard and work to solve problems for the next generation.

> "Innovation can be in a place, framework, program, engagement strategy, or evaluation method."

Innovation can even be a person. In agricultural literacy we would be remiss if we didn't note the true accomplishments and advancements of Dr. Debra Speilmaker, a pioneer in agricultural literacy before agricultural literacy was even popular, who has advanced this work in significant ways in extension, as a faculty member, and as the team lead for the National Center for Agricultural Literacy. Dr. Speilmaker announced she is retiring in Summer 2023; many of us are grateful for her persistence and innovation which has changed the agricultural literacy environment and inspired others to do the work! See an example of how she has led and innovated in the article *Making it Easy*. Thank you Deb!

Seek to be inspired by innovation in agricultural literacy – as I have been. I feel lucky that each day I get to work with a team on special projects that try to move the agricultural literacy needle. Every day, at least one conversation around agricultural literacy begins with "You know what we should do...."

So take heart and learn from the experts working in these spaces. This magazine is dedicated to their innovation and hopes to inspire your future work in this space. You will note that this theme starts with a grand overview from a national perspective, and then you will find the articles in pairs – tackling the same idea from two different perspectives, like the facets of a gem. This organization is intentional to help you consider items from differing viewpoints and application opportunities in your own spaces and contexts. Then you will read work that will help broaden and expand your understanding of literacy and consider how literacy works ***in*** agriculture! This issue is building the multi-faceted landscape of agricultural literacy. I hope you will be inspired by the innovation and implement agricultural literacy in your communities!

Kellie Enns is an Associate Professor of Agricultural Education at Colorado State University and is fortunate to work with an innovative team pushing the boundaries of agricultural literacy.

"Making it Easy" with Innovations to Increase Agricultural Literacy

by Dr. Debra Spielmaker

As an agricultural educator, you probably have an agricultural illiteracy story. These stories share shock and humor, typically about what someone doesn't know or understand about agriculture—or the system involved in producing and processing their food, clothing, and shelter.

An agriculturally literate person "understands and can communicate the source and value of agriculture as it affects our quality of life" (National Agriculture in the Classroom, 2022). Agricultural literacy programs exist in nearly every state and some U.S. territories. The National Agriculture in the Classroom Organization (NAITCO) supports state programs and has the mission to "increase agricultural literacy through K-12 education." Member state programs seek to increase agricultural literacy with the vision of "agriculture valued by all."

As communication technologies have advanced, agricultural literacy program professionals have been experimenting with different technologies and modalities to deliver agricultural content more effectively and efficiently. During the COVID-19 pandemic, remote learning accelerated these innovative efforts that continue to be used today.

Agricultural literacy programs work with preK-12 academic core educators as their primary audience. Some programs have staff or volunteers who work directly with students. Research with these educators has identified perceived barriers to using agriculture as a context for learning (Bellah & Dyer, 2009; Edwards, 2016; Knobloch, 2008). With increased emphasis on testing and other curricular requirements, K-12 educators have identified concerns about how agricultural content addresses their curricular standards, their lack of time to incorporate agricultural concepts into the classroom, and their lack of agricultural knowledge (related to their self-efficacy). These barriers keep K-12 educators from incorporating agriculture into their instruction. To address these challenges, the National Agriculture in the Classroom Organization (NAITCO) has partnered with the National Center for Agricultural Literacy to develop content that overcomes these challenges and provide states with easily adapted resources for different delivery methods.

The role of the National Center for Agricultural Literacy (NCAL), housed at Utah State University, is to conduct and support agricultural literacy research, develop engaging K-12 instructional resources, and deliver professional development to improve teaching practices for agricultural literacy professionals and K-12 educators. This partnership provides state program leaders with the resources and skills to develop and implement innovative approaches to address agricultural literacy.

The first hurdle for agricultural literacy professionals is convincing K-12 educators that agriculture can be used as a context for addressing content standards and is not "something extra" they are being asked to add to their curriculum. To address this barrier, the NCAL team has developed standards-based instructional resources, including lesson plans and curated supportive companion resources. Lesson plan development begins with academic content standards and agricultural literacy outcomes (Spielmaker & Leising, 2013) to ensure grade appropriate content. All lessons have a background section—to support educator understanding of agricultural concepts—and use the 5E Model (engage, explore, explain, elaborate, and evaluate) as a format to organize procedures. In terms of pedagogy, research-based student-centered instructional approaches are embedded. All lessons provide hands-on and/or minds-on approaches where agriculture is used as a context for meaningful learning. Supportive or companion resources (kits, books, videos, maps, etc.) are linked to enhance learning. These lessons are then pilot tested and, if need be, revised before being added to the National Agricultural Literacy Curriculum Matrix. These online instructional resources are *free* and address the educator barriers regarding standards (standards are found at the end of each lesson), time (the content has been developed for them), and their knowledge about agriculture (a brief background is provided).

During the pandemic, agricultural literacy program leaders used innovative methods to *make it easy* for educators to use agriculture as a context for learning. Matrix resources were presented at virtual teacher professional development workshops, and content was added to remote learning applications, such as Google Classroom, Nearpod, Seesaw, and Pear Deck, in nearly all states. Teacher-focused podcasts and virtual field trips were developed by several states (Florida, Iowa, Illinois, Kansas, Maine, Min-

nesota, Nebraska, New Mexico, New York, Oregon, and Texas). Some program leaders created direct-to-student resources to enhance learning. Direct-to-student approaches included virtual reality (Illinois, Oregon, Tennessee, and Virginia), 360 videos (Iowa, Illinois, Tennessee, and Virginia), and AgBadging. It is estimated over 150,000 students annually participate in in-person farm field trips nationwide (NAITCO, 2021). Building on the success of face-to-face and virtual field trips, NCAL developed the AgBadging Field Guide (Figure 1) for grades 3-5. The AgBadging Field Guide can be used in the classroom or at home. Students are provided with an opportunity to learn about agriculture and earn badges in five themes—Agriculture & the Environment, Plants & Animals, Food & Health, Technology & Engineering, and Geography & Culture. Students choose the three milestones/activities to complete in each theme. After students complete three milestones in a theme, they earn a themed badge. After completing all five themes, students earn the "Field Scout" badge. They then can go online to report the milestones they completed, unlocking their secret Field Scout Code Name.

There is no doubt that internet communication tools can increase reach and engagement in agricultural literacy. In 2023, NCAL will launch a self-paced online Agricultural Literacy Certification Program. This 12-hour program is designed for educators, preservice teachers, volunteers, and, yes, for anyone else (e.g., high school students) who wants to know more about agriculture. This 24-7 asynchronous resource addresses the needs of state programs and the knowledge and self-efficacy barriers educators have identified.

More on the Matrix

At the core of these innovations is the National Agricultural Literacy Curriculum Matrix, which can be found on agclassroom.org and every state Agriculture in the Classroom (AITC) website. Some state program websites link directly to the NAITCO Matrix website; other states use the Matrix API and database to serve up the same content for their educators on their state website. The lesson-embedded student-centered approaches and important agricultural literacy connections are called-out in ECMs (Educational Curricular Moments) in the lessons. Icons are used for these callouts, and explanations highlight connections to the Next Generation Science Standards (NGSS), phenomena-based instruction, C3 Framework practices, project-based learning, state bridge lesson plans, and career opportunities. These callouts demonstrate to educators, and their administrators, the sound and current pedagogical approaches to these lessons. The innovation of a common database of resources has provided metrics to determine what lesson plans and companion resources teachers are using and what

A middle school student from Tennessee uses a 3-D viewer to learn about beef production.

> School-based agricultural educators are encouraged to use these resources if their students work with elementary students or if they need agricultural content to address middle and high school agriculture education pathway standards.

they are searching for nationwide. These metrics are used to inform stakeholders, including funders, with important data about what is being accessed by teachers and what resources may be needed. The Matrix elevates all state programs and demonstrates to funders a capacity to reach students and teachers with consistent quality resources. While Matrix resources have been developed for K-12 academic core educators, they can be used by Career and Technical Education educators. School-based agricultural educators are encouraged to use these resources if their students work with elementary students or if they need agricultural content to address middle and high school agriculture education pathway standards.

The database lesson plans (450+) are searchable by grade level, content area standards, and agricultural literacy outcomes. In addition, the companion resources (1,000+) are searchable by media type (kits, books, websites, videos, maps, etc.). Kits make it *even easier* for educators to incorporate hands-on activities into their classrooms. While each lesson provides educators with a list of materials needed, kits can also be purchased from agclassroomstore.com, a real time saver (addressing one of the identified barriers), *making it easier* for teachers to use agriculture as a context for their required content. But wait, there's more! To make it *even easier* (a time saver) for educators to "bookmark" the resources they want to use in their classroom, users can create a Matrix account and store these resources in a personal binder, "MyBinder." This feature reduces the need to print the resource and ensures users always have the most up-to-date version of the lesson. If a lesson has an update (statistics or resources) a lesson in MyBinder is also updated. MyBinder users also receive a monthly newsletter about new additions to the

(TOP) Figure 1. Elementary educators are provided with curated theme resources for Grades K-5.
(BOTTOM) Figure 2. Secondary educators are provided curated theme resources for grades 6-12.

Matrix. In addition, social media has been seamlessly integrated into the Matrix, *making it easy* for educators to share what they use with others.

Recently, the NCAL team made it *even easier* for educators to get started with agricultural literacy by curating specific themes and topics to *save time* for busy elementary and secondary educators. Elementary educators are provided with Themes for Learning (Figure 1) on school gardens, pollinators, hatching chicks, and literature. Secondary educators are provided Course Topics (Figure 2) highlighting relevant content for integrated science, biology, environmental science, American history, geography, and family and consumer sciences.

The Matrix has fueled, energized, and empowered agricultural literacy program leaders to innovate, *making it easier* for K-12 educators to use agriculture as a context for learning. What ideas do you have for increasing agricultural literacy with your students or others you work with? Feel free to share your ideas by sending a message to aglitera-cy4me@gmail.com.

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Making the Most of Formative and Summative Agricultural Literacy Assessment

by Dr. Rose Judd-Murray

The National Center for Agricultural Literacy (NCAL) is a collaborative effort between the USDA, National Agriculture in the Classroom, and Utah State University. The full scope of their work includes the development of evaluation tools that can be used to both formatively and summatively assess the content knowledge of youth and adults. The use of their assessment instruments not only moves the needle forward toward their mission to affect how the world critically thinks about agricultural systems, but also directly assists with the National Research Agenda for Agricultural Education (Roberts et al., 2016) and the W3006: Multistate Agricultural Literacy Research projects. The three (soon to be four) assessments stand apart from other agricultural literacy efforts because they were developed and validated by using the National Agricultural Literacy Outcomes (NALOs) (Spielmaker & Leising, 2013) as standardized benchmarks. Furthermore, NCAL offers the instruments free to educators, stakeholders, and program evaluators to assist them in determining the agricultural literacy proficiency of students or adults.

The NALOs as Benchmarks

The NALO benchmarks are related to agricultural literacy and academic achievement. Their development was guided by influential research, published agricultural literacy frameworks (American Farm Bureau Federation, 2017; Leising et al., 2000; Powell & Agnew, 2011), and grade-level benchmarks aligned with national education standards in science, social studies, and health. The benchmarks are organized by grade-level bands (K-2, 3-5, 6-8, 9-12) into five themes: Agriculture and the Environment; Plants and Animals for Food, Fiber & Energy; Food, Health, and Lifestyle; Science, Technology, Engineering & Math (STEM); and Culture, Society, Economy & Geography. The NALO Booklet provides detail about each theme, the purpose of the standard, and shows how specific benchmark outcomes align with national education standards. All were critical in the development of the agricultural literacy assessment instruments.

Agricultural Literacy Assessment Instruments

Beginning in 2016, NCAL sponsored the development of the K-2nd and 3-5th grade Longhurst-Murray Agricultural Literacy Instruments (LMALI). Following their completion, the Judd-Murray (JMALI) 9-12th grade instruments were validated in 2018. Currently, the instruments for a middle school-level assessment (6-8th grade) are being finalized. Each of the agricultural literacy instruments is designed to measure a baseline of understanding (Longhurst et al., 2020) by asking participants to answer three questions in each of the five NALO themes. The intent is not to deliver a comprehensive score that covers the full spectrum of agricultural knowledge. Rather, it is to offer an evaluator data that indicates an individual level or average lev-

Agricultural literacy assessment instruments use the five NALO themes to determine a baseline of content knowledge proficiency.

el of agricultural proficiency from a participant or population.

The agricultural instruments measure agricultural literacy by using a sliding scale of proficiency. The lowest level of proficiency is measured as exposure, the middle level is *factual literacy*, and the highest level is *applicable proficiency*. Proficiency is determined by the number of questions answered correctly by the participant. For example, in the JMALI 9-12th grade instrument, participants that score ≤ 7 correct are recorded at the exposure level of understanding. This score does not indicate that the person "failed" the assessment, it simply shows that the individual has the most limited amount of understanding regarding the NALO benchmarks. Participants scoring ≥ 8-11 correct answers are *factually literate*, indicating they have a level of knowledge consistent with recalling information, ideas, and principles associated with the benchmarks. Participants scoring ≥ 12-15 correct answers are *applicably proficient*. These individuals can answer the most difficult questions on the assessment, those that relate to more advanced outcomes within the NALOs for that grade band.

Using the Instruments for Formative Assessment

Developers of the instruments recognized the value of a sliding scale evaluation that could offer educators the opportunity to use an assessment across grade levels and over time—even beyond high school, into adulthood. Additionally, the grade-banding within the NALO benchmarks allows evaluators a pathway for formative instruction and assessment. Each of the four assessments has a grade-band (such as 3-5th grade) that was validated by students at the highest grade level within that band (level was validated by 5th grade students). An educator can formatively use the instruments in each grade level, by examining the results as a measure of progress. For example, a K-2 instrument can be used by kindergarten teachers as a formative assessment by anticipating that students will score at the *exposure level* or improve to the *exposure level* over time. It should be expected that first graders could answer the *exposure* questions and some of the *factual literacy* questions or improve over time. By the time students reach the end of second grade, stakeholders would hope to see that all participants can score at an *applicable proficiency* level—as this would indicate that students understand the content knowledge for NALO outcomes in all five themes for that grade band. Moreover, the instruments are not just for students. The JMALI 9-12th grade instrument was validated with young adults that were post-high school graduates. The intention was that this instrument could serve as a formative guide for literacy throughout high school, but also be used as an indicator of adult agricultural literacy as well.

When youth and adults do not meet the expected literacy levels, it provides formative feedback that can inform immediate or future instruction. Educators who take the time to look beyond the "total correct" may be able to determine differences in the content knowledge for each theme. The instrument instructions offer information on how the results can be interpreted by total score and by understanding between themes. Examining thematic results offers insight into agricultural topic areas that may be stronger or weaker for participants. The identification of these needs sets the stage for the right information at the right time.

Using the Instruments for Summative Assessment

The K-2nd grade, 9-12th grade, and soon-to-be-completed 6-8th grade bands all have two separate, valid instruments. The 3-5th grade band only has one instrument. Educators interested in performing pre-post intervention or summative evaluation may find this information helpful. It is also important to note that each instrument is only valid when used in the format presented in the download. Educators who mix-and-match questions between instruments should not rely on the scoring structure to accurately indicate their results.

Multistate Research for Impact Measures

Educators or stakeholders interested in tracking agricultural literacy in participant groups over time benefit from using LMALI/JMALI instruments because they are focused on using standardized benchmarks to provide a unified evaluation across education platforms. At the core, they are a compilation of all past and present agricultural literacy efforts and experiences, which allow evaluators the opportunity to collect data within similar populations for comparison. Recently, a multistate effort between Kansas, New Mexico, and Utah used a JMALI instrument to determine the agricultural literacy proficiency levels of Cooperative Extension employees and primary volunteers. Those results showed a great deal of consistency in agricultural literacy, not only between states, but in specific deficiencies for all participants in the STEM theme. Results from the assessment and brief demographic collection revealed that younger employees and volunteers in Extension were equivalent in agricultural literacy to older employees and that some of the highest scorers were not associated with those individuals who reported active roles in agriculture and natural resources extension or volunteer work. Multistate efforts like this show that there is still much to learn when we work together using a common instrument.

The W3006 Multistate Agricultural Literacy Research Project supported by USDA Agricultural

Experiment Station funding is just one avenue for engaging in collaborative agricultural literacy assessment. Driven by three objectives that require the assessment of agricultural knowledge of diverse populations; the assessment of attitudes and perceptions of diverse populations; and the evaluation of programs to determine impact, the greatest degree of progress can be made by employing projects and partnerships in all 50 states. If you are interested in participating in multistate youth/student or adult agricultural literacy research, contact Dr. Rose Judd-Murray (rose.juddmurray@usu.edu) to find out how you can connect with local or regional research partners. Educators from land-grant universities are eligible to join the project team and directly assist with conducting multistate work.

Individual Steps Forward

Agricultural educators can use the assessments to determine how they can improve their instruction among their high school or middle school students. The elementary assessments may be used in programming that involves elementary students. The results could be used to determine a baseline, and later to determine the long-term impacts of agricultural literacy efforts within a community. The assessment instruments provide a way to obtain real-time data that is easy to acquire. Only the K-2nd grade instrument must be administered in paper/pencil format (so that it can be given orally if necessary); the other instruments are offered digitally and can be completed in under 15 minutes. The results are reported in an easy-to-download Google Form. All the instruments are free and available on the National Center for Agricultural Literacy website.

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Agricultural Literacy: Using Proficiency Measures in School-Based Programs

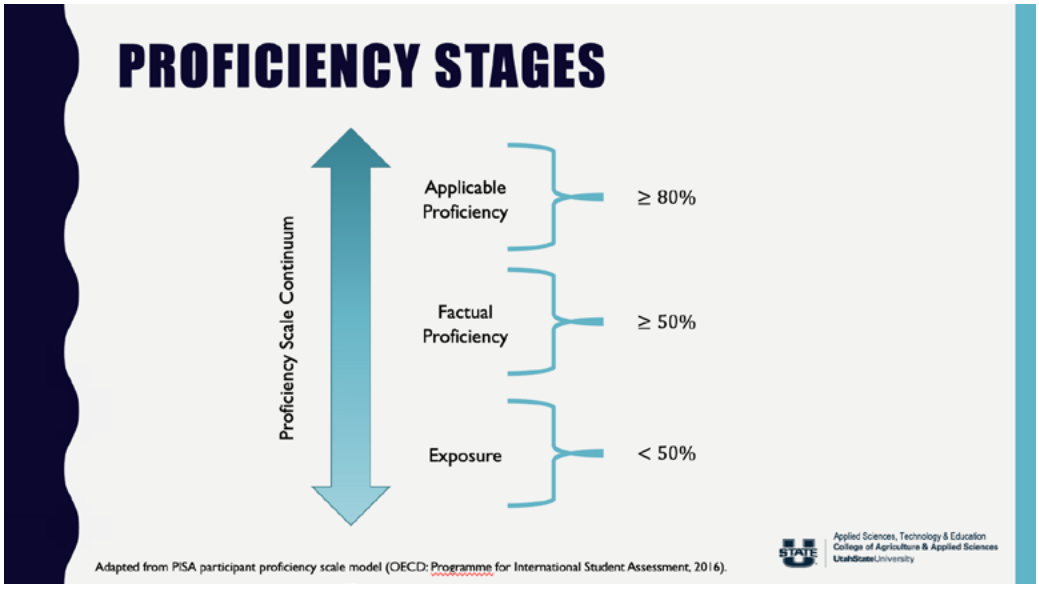
by Amelia Miller

Every morning my grandpa made a pot of Maxwell House coffee. He would add some cream and clink a spoon inside the cup until everyone in the house woke up. Grandpa never discussed the coffee's roast, country of origin, or strength. After breakfast, he routinely poured a couple of cups into a measuring cup which he heated in the microwave at lunchtime, having little regard for its freshness. In his nearly ninety years of life, he progressed from using a manually operated percolator to adapting to an electric drip brew coffee pot for his morning coffee, all the while sticking to the most basic coffee brands. Although Grandpa's coffee knowledge was rudimentary, he knew how his coffee maker worked, what brand of coffee he wanted, his preference to add cream, and even the value of repurposing the iconic blue coffee cans to hold hardware, spare parts, or bird seed.

Proficiency assessment

Using proficiency stages is one way to measure learners' understanding of and growth over time within a content area (OECD, 2016). These stages include exposure, factual literacy, and functional proficiency. Educational theorists Dewey and Kolb outlined experiential learning theory indicating that learning never stops; it is continual exposure to more complex concepts, processing, defining, testing, and repeating this cycle over and over (Kolb, 1984). Proficiency measuring assessments can illustrate this progression of experiences. Students answering the fewest questions correctly have only a small exposure to the content. Students correctly answering at a factual literacy level possess content knowledge and the ability to answer questions identified as challenge questions. Students answering the most questions are considered at the applicable proficiency stage with the highest content comprehension. To think about applying proficiency scales in a simplistic way, Grandpa was proficient in coffee at the exposure level. He had a very basic skill set to make his Maxwell House each morning; he would not be found experimenting between Columbian or Hawaiian Kona roasted beans, ordering a venti latte with steamed oat milk in a Starbucks line, or discussing international trade of coffee beans.

> Measuring agricultural literacy by proficiency levels allows educators to acknowledge that students have had some experience with agriculture by the time they reach kindergarten.



Three proficiency stages can be used to measure agricultural literacy.

Measuring agricultural literacy

To be agriculturally literate is to "understand and communicate the source and value of agriculture as it affects quality of life" (Spielmaker et al., 2014, p. 2). Measuring agricultural

literacy by proficiency levels allows educators to acknowledge that students have had some experience with agriculture by the time they reach kindergarten. These youngest students have, at the very least, consumed food, thus being exposed to the most basic component of the agricultural system (Longhurst et al., 2020). The National Agricultural Literacy Outcomes (NALOs) provide a roadmap for teaching about agriculture in kindergarten through twelfth grade. These outcomes, built on previous agricultural literacy frameworks, are cross-walked with national content standards (Spielmaker & Leising, 2013). Themes include Agriculture and the Environment; Plants and Animals for Food, Fiber & Energy; Food, Health, and Lifestyle; Science, Technology, Engineering & Math; Culture, Society, Economy & Geography.

Currently, assessments to measure agricultural literacy are available for grades K-5 and 9-12, with a 6-8 assessment coming soon (National Center for Agricultural Literacy, n.d.). These assessments are based on the NALOs, measuring students' agricultural proficiency level as appropriate for each grade band: K-2, 3-5, and 9-12. For example, the K-2 assessment is almost entirely based on pictures asking students to match animals and products, weather, young and adult animals, and stages of plant growth. Therefore, it is expected that a kindergartener would score at an exposure level, whereas a second grader would score at the applicable proficiency level on the same assessment. This progression in scoring is expected within each assessment's grade bands, from youngest to oldest.

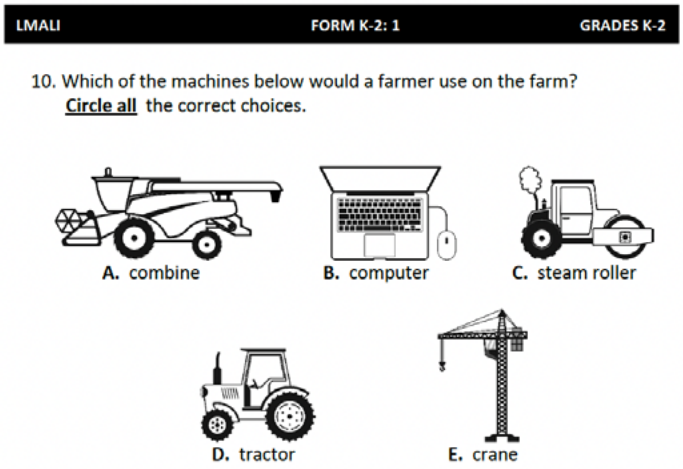
How agriculturally proficient are your students?

As secondary teachers, your students have been assessed throughout their schooling, from reading assessments to state standardized tests to the SAT and more. Why should you incorporate an agricultural literacy assessment into your practice? Career and Technical Education is rooted in preparing students to be educated, employable citizens and future leaders (ACTE, 2022). An agriculturally literate society values agriculture, desires to build the agriculture workforce, and makes educated decisions about agricultural policy to strive toward a food-secure nation (Spielmaker et al., 2014). These qualities are embedded in agricultural education curriculums (NAAE, 2022). While each state has its requirements for completing CTE courses and FFA competitions provide a measure of skills and knowledge in agricultural practices, this agricultural literacy assessment demonstrates foundational proficiency (Longhurst et al., 2020). No matter a student's intended postsecondary path, agricultural literacy will serve them and society in the future (Spielmaker et al., 2014). Not only this, but consider how this easy-to-access assessment might be used as a growth assessment over the course of a semester, year, or throughout a student's academic experience in the agricultural education program. (To access, see: agliteracy.org/research/assessment/.)

Agricultural literacy proficiency continuum

Many 21st Century agricultural education students will not come from farm backgrounds or have family ties to agriculture. With this possible limited exposure to agriculture, connections to food, farming, fuel, fiber, and forestry need to begin at a young age to achieve applicable agricultural proficiency (Roberts et al., 2016). If you find your students are not scoring at an expected agricultural literacy proficiency level for their grade, consider which NALO themes associate with these low scores.

- Are these content areas you could address within your CTE requirements?
- Are alumni or partnering organizations hosting activities that would speak to this content? Farm Bureau Discussion Meets, World Food Prize, Journey 2050, or FFA's #SpeakAg program are examples that could help increase agricultural literacy.



(LEFT) Example of a K-2 agricultural literacy assessment question.
(BELOW) Example of a 3-5 grade agricultural literacy assessment question.

14. Select the **one** choice that is **not** a reason people eat different foods around the world.

a. people have different religions
b. people celebrate different holidays
c. people live in different climates
d. people have different types of soil
e. people speak different languages

– Are there ways to partner with other required courses to infuse agricultural connections?

For example, if students do not have the expected proficiency level for Theme 5: Culture, Society, Economy & Geography, talk to your social studies or economics teachers. Could you help arrange a guest presenter to help an economics class understand global economic connections to agriculture? Could students already investigating U.S. inventors select from some who created agricultural inventions?

To further build agricultural literacy over time, engage students in your school district at a young age to jumpstart critical thinking in agriculture. Not only will this serve as recruitment for your secondary CTE program, it will also work to increase the agricultural literacy of your student population and the agricultural literacy of elementary teachers. In addition, partnerships with elementary school classrooms would serve as great projects for Supervised Agricultural Experiences (SAEs).

– Use lessons, books, and activity kits from National Agriculture in the Classroom (agclassroom.org) to guide teaching younger audiences.
– Provide student volunteers to assist with your state Agriculture in the Classroom program's efforts (agclassroom.org/affiliates/programs/).
– Celebrate National Ag Day in March by having high school students read to elementary students.
– Host an "adopt an animal" pen pal program. Pair your students and livestock with an elementary school classroom. Have the high school student write letters to the younger grade teaching about the animal.
– Build connections to help your state's Agriculture in the Classroom program provide professional development to elementary and middle school science teachers so these teachers can become your ally in using agriculture as the real-world context for curriculum content.

Now is the time to assess your students' agricultural literacy and make plans for next semester. However, do not feel like you have to go this alone; grab a cup of coffee (even from a blue Maxwell House can, like Grandpa) with your state Agriculture in the Classroom program manager to outline the continuum of agricultural literacy outreach in your school district.

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An SAE in Agricultural Literacy: Developing Individuals...Growing Stewards

by Jay Whaley

I often think we, in agricultural education, should make sure our students articulate and communicate at a level that makes them advocates for our industry. I tell my students regardless of their career objectives, it is my job to make them advocates for agriculture and to help them to educate others on the importance of agriculture. Agricultural literacy is essential for this to happen.

During this last year, we were able to promote agricultural literacy in two ways: an elementary education program and a school-based Supervised Agricultural Experience (SAE) Program. Through grant funds, Soroco High School, in Northwestern Colorado, partnered with Colorado State University Extension AmeriCorps to bring a new agricultural literacy curriculum called DIGS (Developing Individuals...Growing Stewards) to our school. All kindergarten through 5th-grade students participated in the DIGS agricultural literacy curriculum twice each month for a total of one hour. Students learned lessons across all agricultural education pathways, exploring activities related to pollination, water, natural resources, livestock, where their food comes from, and much more. Each lesson had an activity associated with the lesson, students learned about pollination and completed a pollination activity, they studied dairy products and made butter. They learned about maps and the importance of maps to farming. They learned about water pollution and studied the poultry industry. The most exciting part of the year was the day their chicken and turkey eggs hatched. They learned about incubation. There were lessons about the cyclical nature of agriculture, energy, and the value of farmers markets. The goal of providing this curriculum was to encourage students to explore agriculture through all grades, pursue agriculture as a potential career and to encourage them to consider taking agricultural education as secondary students. As the 115 elementary students progressed through different lessons and activities, they met benchmarks and upon completion were "badged" as Junior Agriculture Ambassadors, receiving an ice cream celebration, badge and certificate. One student even commented they were now a "Sheriff for agriculture!" It was a great way to teach agriculture skills, and reward the elementary students for their knowledge.

> As we look at the rural/urban divide facing our country- let us do all we can to get our educated, articulate FFA members in the schools to assist as educators and be advocates.

To make this a successful program, a local teacher leader, Tiffany Gates, was asked to teach and lead the curriculum at the elementary school. She would receive the curriculum, get trained on the different lessons, and then deliver the activities. As she needed assistance, our local agricultural education program would step in and help purchase supplies and equipment and even provided a student to help deliver and teach the cur-

Marissa Martindale, Soroco FFA Member teaching DIGS Curriculum at Soroco Elementary.

(LEFT) After completing the lesson, students recorded their learning in the "Field Notes" booklets, that were then utilized for assessment, benchmark achievement and badging.
(RIGHT) Marissa Martindale: State Winning Agriculture Education proficiency- pictured with her aunt , grandparents, and Soroco Agriculture Education Instructor Reece Melton.

riculum. We found that having a local person in the school responsible for the project was critical to the overall success. Gates stated "The end goal was to have every student realize that agriculture surrounds them every day - from the food we eat to the clothes we wear. By immersing them in these hands-on activities, they enjoyed it and became literate in the pathways at an elementary level".

The second benefit of the agricultural literacy program was having a local student assist with the program. FFA member Marissa Martindale was placed with Tiffany Gates as a formalized work-based learning program. Marissa, a senior, received high school graduation credit for her work-based learning during school hours, and we used it as an SAE in agricultural education where she logged hours creating lesson plans, and assisting the teacher with content. Marissa showed tremendous growth throughout the year, and even went on to be a state winner in her proficiency area. This was a perfect example of our students learning to do and doing to learn outside of the formal walls of a traditional agriculture class.

As explained by Tiffany Gates, "It was awesome to see how literate my High School student became in all the pathways by teaching the material. Not only did she have a hand in preparation and modification of lessons or materials, she [the high-school student] ended up teaching a few classes every week, with my guidance, and became proficient as she built upon her knowledge from her own curriculum at the HS level." This program allowed Marissa to serve the elementary studentsl while practicing a future career. Teaching other students empowers our high school students. As educators we all know how rewarding it is to see our students mastering the teaching of content. Agricultural education can and should use SAE and work-based learning to help teach concepts in agricultural literacy to elementary students.

As we progress into SAE for All, and develop SAE's with our students, we should look at serving our industry through SAE's in agricultural literacy. Opportunities abound in our schools, farmers markets, and fairs and even in other venues such as athletics, through social media, and more. As we look at the rural/urban divide facing our country- let us do all we can to get our educated, articulate FFA members in the schools to assist as educators and be advocates.

Jay Whaley is the Agricultural Education Instructor at Soroco High School, South Routt School District in rural northwestern Colorado. Jay is a passionate educator and facilitator of student success.

My Ag Literacy Journey

by Sarah West

Agricultural literacy was a term I heard a few times before starting my time in the graduate program studying agricultural education. Over the last two years, from being a brand-new graduate student to walking across the stage at graduation, my journey in agricultural literacy taught me countless lessons.

When one begins a journey, they often have a plan and potential ideas of the outcomes, but like most journeys – there are changes and detours along the way. My work in agricultural literacy began in delivering a year-long agricultural curriculum designed to encourage a positive experience with agriculture for third through fifth graders. Over the course of a year, I helped implement and evaluate the efficacy of the curriculum in two elementary schools. Students were evaluated based on growth in agricultural knowledge using knowledge assessments and also evaluated their positivity, or attraction to agriculture, known as affinity, utilizing workbooks the students filled out following their monthly lessons. We anticipated this would be fun and exciting for students – and it was but we also encountered a few roadblocks. Understanding these may make for an easier agricultural literacy program in your own programs or states!

There were four main takeaways for me over the process: the power of motivational badging, the importance of long-term agricultural literacy programming, exploring affinity for agriculture, and importance of program support in local schools.

The power of motivational badging

One activity we utilized was badging – an end goal for students after they completed the entire curriculum. We utilized badging to not only capture what students had learned, but also to provide the students with a celebration and recognition of their accomplishments. While the idea of agricultural literacy programming or curriculum is not new; students do not often engage adequately with the material presented. Badging, or rewarding students with badges at the end of an activity, rests on three theories: expectancy-value theory, cognitive evaluation theory (CET) and self-determination theory. These theories demonstrate an individual's likelihood to participate based on the "positive relationship between individuals' expectancies" with the activity they are performing (Abramovich et al., 2014, p. 4). They also emphasize learner autonomy, competence, and relatedness to others (Abramovich et al., 2014; Anderman & Midgley, 1998). I utilized this understanding to provide the 'end-goal' in the programming – earning the "Junior Ag Ambassador" badge!

Each time I visited the schools, we discussed the opportunity to become "Junior Ag Ambassadors" when the students completed the curriculum or activities. Their excitement was apparent and demonstrated that an end "prize" can be influential in students' participation and involvement with a lesson. We badged over one-hundred students in this project – students liked receiving recognition of their accomplishments!

Long-term programs make an impact

The second lesson learned in this project was the importance of a long-term curriculum on both a professional and personal level. On the professional side, the students who participated in lessons each month were able to recall what they learned the previous month when I visited with them. We were able to build off what they learned with each lesson, culminating in a well-rounded understanding of agriculture, especially when considering their age. These lessons were not a "one and done" type of educational experience. It was nine months of consistent, positive experiences that students remembered each month. And it worked! Utilizing validated agricultural literacy knowledge assessments, students showed a growth in knowledge.

On a personal side, I was able to develop a relationship with the students where they looked forward to having me visit their classrooms and were quick to share what they had learned with me. On each visit, they would excitedly tell me all they had learned the previous month and all they could remember from months before. During our lessons, they would relate our current lessons to the past ones, bringing up topics I had focused on or stories we had talked about. If I had only visited the classroom one time, the students would not have shared in the excitement with me as much.

From both points of view, professional and personal, having a curriculum that lasted more than one day highly influenced the students' learning and connection to agriculture and the ability to build on-going relationships.

The difference between affinity and knowledge

The third influential lesson I learned in my agricultural literacy journey was investigating the differences between knowledge and affinity for agriculture and the role each has in agricultural literacy. Very briefly, knowledge of agriculture is, in my opinion, most referred to when discussing agricultural literacy. It is the ability to repeat facts and "know things" about agriculture. This is an important aspect of agricultural literacy, but I argue that there is another level of each person that is vital to agricultural literacy, and that is affinity for agriculture.

Affinity has been explored in other disciplines outside of agriculture, including natural resources and music which can serve as a benchmark for us as we explore affinity in agriculture (Appel et al., 2022). An individual with affinity feels an "emotional attraction" to the topic and "internalizes" it to the point that the topic is a part of who the individual is (Eastep et al., 2011; St. George et al., 2014). It causes an emotional response leading to action (Kals et al., 1999). Affinity leads to a personal, significant, and meaningful link between a person and the topic. Most often, affinity develops based on positive experiences with the topic. Higher levels of affinity can influence an individual's behaviors, aspirations, choices, and more (Cheng & Monroe, 2012; Hinds & Sparks, 2008; St. George et al., 2014;). It may lead to decisions that support the topic (Cheng & Monroe, 2012). In the context of agriculture, an increase in affinity may encourage students to pursue agricultural careers or make decisions that support the agricultural industry.

Exploring affinity was inspired by my own experience growing up on a farm alongside my family. I care about agriculture and hold positive feelings toward the industry. When I began this research project, I wanted to see if affinity could be utilized in outcome evaluations of an agricultural literacy curriculum. We defined affinity for agriculture as positive emotions toward the industry which included emotions such as interest, importance, general liking, and desire to be involved. To evaluate this, we designed a curriculum activity booklet that went with the lessons and asked students to answer questions regarding the lesson and agriculture. At the end of the curriculum, we performed a content analysis to see how the students responded. There were many comments indicating students viewed agriculture positively and had an interest in the industry. We also had students complete a survey that asked them to rate how they felt regarding their interest in agriculture, how much they liked agriculture, and how they felt during the curriculum. Overall, the responses were positive and revealed students had positive emotions toward agriculture and the curriculum.

> An increase in affinity may encourage students to pursue agricultural careers or make decisions that support the agricultural industry.

I hope this research project is just the tip of the iceberg in affinity research. This project demonstrated there is a place in agricultural literacy for affinity because it was impacted by the curriculum and, in my opinion, influenced the students' learning. In my mind, if you can help a student develop a connection to a topic, such as agriculture, it will encourage them to learn more about it, beyond memorizing facts.

The need for program support

Program support was necessary for the success of this curriculum. The two schools that participated in this research project had different strategies for implementing the curriculum. At one elementary school, one teacher was responsible for delivering all the lessons and related activities each month and the students' schedule was modified to allow for this enrichment. This meant that each class would see this teacher twice a month, and only saw this teacher for their "ag class." There was support from all levels of this school, including the principal, superintendent, and the agriculture program at the high school. They helped the individual teacher feel supported and encouraged through the processes. All the students at this elementary school, in grades K-5, completed the agricultural literacy curriculum.

The second school each teacher was responsible for delivering each lesson integrated into their own curriculum every month. There was less support for the curriculum school-wide and teachers were not necessarily encouraged by anyone other than the high school agriculture teacher and me. Out of 11 classes, two of them completed the curriculum, with three others participating in some of the lessons.

This was the "less than glamorous" side of this research project. It was difficult to motivate teachers to deliver the curriculum when they didn't feel supported and felt as though they didn't have the time or resources to teach the lessons. As challenging as this was, it clearly

demonstrated the importance of support for implementing in-school curriculums.

Why agricultural literacy?

As someone new to the concept of agricultural literacy at the start of my graduate school journey, this project highlighted the importance of the concept and its role in the future of agriculture. I had the privilege of seeing students discover parts of agriculture they had not thought of before. I saw them get their hands dirty, create barns out of crackers, learn how to read a map for GPS-guided tractors, explore animal traits by building pigs from marshmallows, and so much more. Watching them develop this interest in agriculture demonstrated the importance of a long-term agricultural literacy curriculum, engagement, and agricultural literacy efforts as a whole.

After graduation, I started working for Rocky Mountain Farmers Union as their Director of Strategic Communication. There is not a day that goes by that I don't think about agricultural literacy and the role it has in our industry and beyond. As the individual responsible for communicating on behalf of our farmers and ranchers, I am grateful for the time I spent learning about agricultural literacy. For all those in the agricultural industry and outside of it, being able to discuss the food system and explain it to others is a vital skill if we want to continue to support the future of agriculture.

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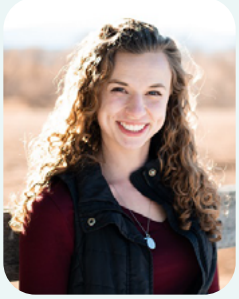

Sarah West is originally from Washington State and came to Colorado State University for a graduate degree in Agriculture, focused on Agricultural Education. She now works for Rocky Mountain Farmers Union as the Director of Communication Strategy.

The Power of Partnerships in Agricultural Literacy Outreach

by Jenny Bennett

Over the past 30 years, agricultural literacy organizations and programs have boomed in popularity due to a renewed public interest in agricultural production and processes (W3006, 2019). Agricultural literacy programs often aim to reach individuals, especially school-aged children, to promote accurate agricultural knowledge, an understanding of agricultural relationships within the industry, and the ability to communicate agricultural concepts to others (National Center for Agricultural Literacy, n.d). While there has been significant development of innovative agricultural literacy interventions, especially within the last decade, there remains questions regarding the relative impact and success of these programs as it pertains to the development of agricultural literacy of school-aged children (Cosby et al., 2022). One of the potential causes of this concern may be related to the significant input required in the development, promotion, implementation, and evaluative stages of ag literacy program initiatives (Bennett et al., 2022). Implementing agricultural literacy efforts can be challenging, and the challenges associated with these efforts may ultimately impact the program's short and long-term success.

This article explores one component that can mitigate some of the challenges associated with implementing agricultural literacy initiatives. Partnerships can increase your program's impact, decrease strain of execution and improve program sustainability. To be true to the spirit of this article, stakeholders from the state of Colorado (where the author resides and works) who are actively involved in agricultural literacy initiatives were asked to contribute to the article's content. Even before writing this narrative, our partners beat us to the punch and consistently emphasized the importance of partnership in impactful and sustainable agricultural literacy programming. "Agricultural literacy is not something any organization, government entity, or institution can tackle alone" (J. Gillmore, personal communication, October 2022).

Point taken, so who makes great partners? In this article, we will explore six partnerships you should consider investing in when looking to develop agricultural literacy initiatives to maximize impact and minimize strain to create more sustainable programming.

1. Post-Secondary Agricultural Education programs

Thousands of students enroll each year in post-secondary agricultural education programs. Their years in these preparatory programs are filled with agriculture content courses and education, communication or leadership courses, all to prepare them for their internship experiences and subsequent career in agricultural education. While student teaching is often the penultimate experience in which preservice school-based agricultural education (SBAE) students can truly practice their agriculture teacher skills and knowledge, this does not have to be the only experience. Holly Heckendorf and Malei Tipton, students in agricultural education at CSU, explained that "the [agricultural literacy experience] helped prepare me for my career. I feel more confident in my teaching and see the importance of peer collaboration." Agricultural literacy programs are the perfect space to provide diverse teaching experiences for these students.

Jennifer Scharpe from Colorado Ag in the Classroom appreciates this partnership because students often serve as "'boots on the ground' to teach agriculture and expand the reach of Colorado Agriculture in the Classroom (CoAITC) programs. In return, these students can gain real-world, hands-on experiences teaching agriculture to different audiences using CoAITC's classroom-ready resources and programs." After completing a summer of agricultural literacy experiences as a CSU student, Kevin Snyder remarked, "I feel as though I played a part in educating our community members on the Colorado agriculture industry and our responsibility to protect and conserve our state's natural resources." Finally, Toni Gross, a graduate student and current agriculture teacher, explained, "[it]was one the best things I could do to enhance my education and learning experience." As teachers with unique literacy programs, consider partnering with your university students seeking to gain skills and develop internships collaboratively to build skills in the next generation of agricultural educators.

2. Agriculture in the Classroom®

The National Agriculture in the Classroom Organization has the most extensive reach across the United States regarding agricultural literacy programming (W3006, 2019). The national organization comprises 52 state and territory programs (Annual

(TOP) Kevin Snyder, a senior at CSU is teaching about soil horizons across ages at the Mordgridge Learning Laboratory at the SPUR Center, Denver. June, 2022. (MIDDLE) CSU students debriefing with one another after a day of teaching. Students give one another feedback on their methods, talk through each lesson, and discuss observed outcomes. (BOTTOM) CSU students having fun teaching a Colorado Ag in the Classroom sponsored lesson, Seed Survivor, on "Ag in the Classroom Day, at CAM's Classroom" at the Colorado State Fair. August 2022.

Report, 2020). Each program approaches agricultural literacy programming to meet the needs of its state (National Center for Agricultural Literacy, 2022). These individual programs are usually a staple in most community events promoting projects often unique to each state program from the Agricultural Literacy Curriculum Matrix. Needless to say, Agriculture in the Classroom® is not only helpful agricultural literacy programming, but it also carries immense power to connect other organizations that may be great partners. For instance, Jennifer Scharpe, executive director of the Colorado Agriculture in the Classroom (CoAITC), states, "The concept of agricultural literacy is too big for any individual or one organization to undertake. One of the core principles of CoAITC is to partner with like-minded organizations to create awareness about the significance of agriculture in our everyday lives. CoAITC does not want to be on an island. We can maximize resources and educational efforts to have a greater impact through collaboration."

3. Local agriculture events, fairs, shows and festivals

Agricultural fairs and shows are a staple in most rural, urban, and suburban communities. Each carries its own traditions, making them unique and a significant attraction within its community. For several reasons, these spaces are ideal partners for agricultural

(TOP & MIDDLE) Busy days at the Larimer County Fair conducting agricultural literacy programming for fairgoers. August 2021 and 2022.
(BOTTOM) Denver County 4-H collaborating with CSU SBAE students to host a lesson at the National Western Stock Show about making bread. January 2020.

literacy programs. One of the most noteworthy reasons for this might be the potential for a high programmatic impact. Events such as the National Western "can draw both urban and rural students – and I think something should be said about that. We often talk about the urban/rural divide. Our event is an opportunity to bring those different communities together." JT Gillmore adds, "these agricultural events draw individuals from all walks of life... This might be the only place they can interact with livestock or crops that produce their fiber, food, and fuel."

For Teah Romano, an Event Coordinator for the Larimer County Fair in Colorado, in addition to finding experiences that will excite fairgoers, she also understands that the fair is a space to connect people to agriculture. "My major focus has been on the community. Who around us, in our own backyard, can we invite to be a part of the Fair that would contribute to this mission? ... the fair represents agriculture, especially animal and crop production, with 4-H and Open Class. Ag literacy is important for everyone- not just those involved in agriculture."

4. 4-H and Extension

Extension is a critical part of the Land-Grant system where the central tenants are teaching, research and service. Specifically for extension, a central part of their service mission is to make their University programs, resources, and services accessible to all (Colorado State University, 2021). Extension is an ideal partner in agricultural literacy initiatives because of its longstanding dedication to

service and experience in agricultural outreach. Jenia Hooper, a 4-H Youth Development Extension Educator in Denver County, Colorado, relies on partnerships in agricultural literacy initiatives, "As an urban extension office, we rely on and value collaboration to implement our afterschool, summer, and community programs and are ultimately able to better serve the needs of our communities because of those partnerships...For example, through these relationships, we have brought agriculture literacy to our local recreation centers and libraries, spaces where agriculture topics are not usually commonly found."

The Denver extension office can provide agricultural literacy opportunities in diverse, often urban, spaces. The Denver team also serves as excellent partners and is working on expanding the impact of agricultural literacy experiences at the National Western Stock Show. They offer classroom visits to allow students the opportunity to learn about a variety of agriculture concepts before experiencing them at the Denver Stock Show. Providing a "pre-experience" to an agricultural field trip, the Extension team creates a sense of relevance and extended connections to agriculture.

5. Secondary Agricultural Education programs and FFA Chapters

The National FFA Organization aims to grow "the next generation of leaders who will change the world...through agricultural education" (National FFA Website, n.d.). With over 850,000 current members nationwide, each FFA member has their own story and reason for deciding to be a part of their school's agricultural education program. Hadassa Graham, FFA advisor and agricultural education instructor at Florence High School in Florence, Colorado, states, "Even in a rural program, my students come from varied backgrounds. Some students live a life directly related to agriculture, specifically production agriculture, which others only see in western movies or from the interstate...Engaging in agricultural literacy outreach opportunities is an excellent example of the three-circle model in action. Students can take what they learn in the classroom and from their personal experiences in agriculture; Come together as an FFA chapter in a service-learning experience, and act as leaders for the agricultural industry to translate their agricultural knowledge in a way that others can learn from them."

FFA's value as a partner in agricultural literacy outreach is special. Members are the next generation of agriculturalists and while they are high school students, they can also be educators. This has a double benefit of increasing their own literacy, as teaching often leads to deeper comprehension. Consider working with other chapters in your areas to extend the impact even more. You could be planting the seed for the next generation of individuals in the industry who appreciate and understand agricultural literacy and may even encourage agricultural education as a career of choice.

6. Commodity organizations, agriculturally focused interest groups, educational outreach organizations

Commodity organizations represent the farmers or ranchers of a particular agricultural product. While each state may have its own

(LEFT) Colorado FFA State Officers and members of the Florence FFA Chapter take a break from teaching to show off their CAM's Ag Academy temporary tattoos. September 2022.
(RIGHT) Educational material created by The Colorado Beef Council is used to teach elementary school-aged students about beef production in Colorado at the National Western Stock Show by CSU College of Ag Students and Colorado FFA Members.

characteristics, these organizations' general mission is similar and often aligned with the goals of agricultural literacy. Julie Moore from the Colorado Beef Council explains that the Colorado Beef Council "represents Colorado's largest commodity and is funded by the Beef Checkoff program. The Beef Checkoff program is governed by the Cattlemen's Beef Board with oversight by USDA and has a mission to increase beef demand through promotion, information, education, and research."

Commodity organizations are fantastic partners as they are experts in agriculture products commodities and often have well established personal relationships with producers. "The value [that] commodity organizations can provide as partners in agricultural literacy efforts is their commodity-specific knowledge. This knowledge can elevate any programming effort and ensure that accurate and relevant information is delivered through your educational program. Additionally, if the project could be enhanced with the input of a farmer/rancher, they have people they can call to bring to the table. Together, with the commodity organization's product expertise, and the educational expertise of the agricultural literacy program, we can develop educational experiences about our commodities that the average consumer will understand" (J.Moore, personal communication, October, 2022).

This list could have been much longer. Partnerships should form with any volunteer organization that hopes to pursue ideals that match your agricultural literacy objectives. This article aimed to give a perspective on successful partnerships within agricultural literacy programming that have increased impact, decreased stress of planning and delivering programming, and improved sustainability for several agricultural literacy programs in Colorado. So, the next time you daydream about developing an agricultural literacy program, know that you do not have to do it alone. In fact, if this article has taught you anything... you shouldn't do it alone. We are stronger together in developing impactful and sustainable agricultural literacy programs. "It's going to take these kinds of partnerships to help counter the growing concerns regarding ag literacy" - JT Gillmore.

A special thank you to the following individuals for their contribution to the content of this article. Agricultural Literacy in Colorado and CAM's Ag Academy Agricultural Literacy Outreach would not be what it is without each of you! Your partnership and dedication to agricultural literacy is both inspiring and so meaningful. I feel fortunate to be a part of this giant endeavor alongside each of you

JT Gillmore, Colorado State Fair

Shelby Rich, National Western Stock Show

Julie Moore, Colorado Beef Council

Jenia Hooper, Denver County Extension

Hadassa Graham, Florence High School

Malei Tipton, Colorado State University

Kevin Snyder, Colorado State University

Toni Gross, Severance High School

Holly Heckendorf, Colorado State University

Teah Romano, The Ranch Events Complex

Jennifer Scharpe, Colorado Agriculture in the Classroom

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Bringing Literacy to the County Fair

by Katharine Eshelman & Ruth Shepardson

Ten years ago, a student asked a question that illustrates why we should remain diligent about ag literacy in public spaces. A young preschool boy on a barnyard tour at the Mesa County Fair asked, "Can you show me how they get the bacon out of that pig?" The question was surprising because it seemed advanced in many ways. He already knew that bacon comes from pigs. He already knew that meat is protein and protein is good for human nutrition. He was ready to know the details of how the animal systems in agriculture work. The barnyard tour was geared toward very basic knowledge, however this young boy was able to develop a deeper understanding of the agriculture industry because individuals were available to answer his question.

Two FFA chapters in Mesa County, Colorado (Plateau Valley and Fruita) paired with Colorado State University (CSU) to bring CAM's Ag Academy to the 2022 Mesa County Fair. CAM's Ag Academy is the agricultural literacy outreach program coordinated through Colorado State University Agricultural Education program with the goal of creating a positive experience related to agriculture. The unique and innovative beauty of CAM's Ag Academy was the way stakeholders created a beneficial experience for all involved. To start, CSU had the opportunity to continue its land grant mission by reaching out to promote community-based education; pre-service agricultural education teachers got experience developing and executing lessons in a meaningful, hands-on format and the Mesa County Fairboard had an opportunity to provide a rich experience to the community it serves. However, the most innovative piece of this project was the way it empowered high school students to advocate and educate consumers within their community.

Over the course of three days, high school agriculture students partnered with CSU pre-service ag teachers to share lessons with school age children, adults with special needs, and other adults and families who were accompanying them. This partnership gave high school students the confidence to provide agriculture literacy to the public because of the high-quality curriculum and authentic support.

While agricultural literacy programming can take on many forms, the structure of CAM's Ag Academy at Mesa County Fair included both 20-minute mini-lessons in the classroom area of the fairgrounds as well as a scavenger hunt encompassing the entire fairgrounds that could be experienced any time. In the classroom area, CSU students and high school students co-taught hands-on activities about a variety of agriculture topics. Daily, the scavenger hunt was changed to encourage people to visit all parts of the fairgrounds.

Fruita and Plateau Valley FFA members learn to teach an Ag Literacy Activity from CSU students at the Mesa County Fair.

> By bringing in a partner for the ag literacy programming, FFA members from the local chapters could come and go from the ag classroom without significant advisor supervision because of the consistent attention, mentorship and expectations of the CSU students.

When participants came back and shared their adventures, they processed their experience and were congratulated with an official badge which designated them as a Junior Ag Ambassador. The Junior Ag Ambassadors left CAM's Ag Academy with the charge of teaching those they came in contact with about agriculture.

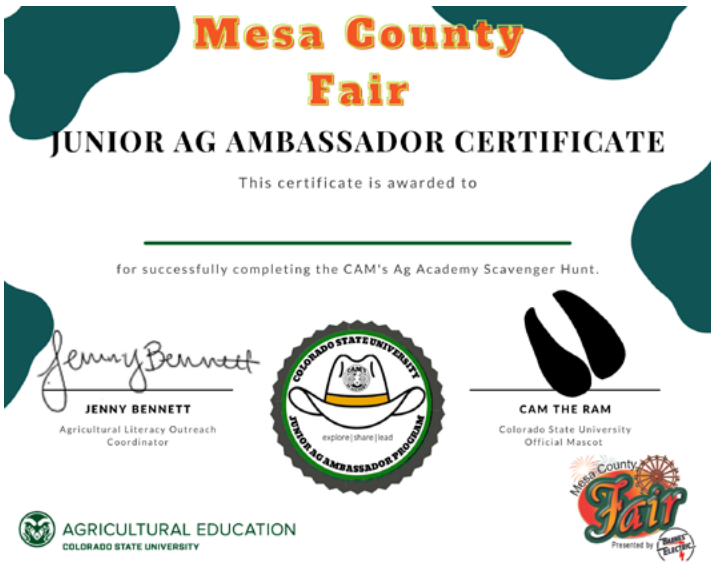
An estimated 400 hours of preparation for the Mesa County Fair's 2022 CAM's Ag Academy event led to 90 hours of work with the public during the length of the fair. The obvious benefit is young people who have had a positive interaction with ag literacy. However, other benefits emerged as a result of CAM's Ag Academy presence on the fairgrounds. Oftentimes, ag advisors are busy helping their chapter members prepare for livestock shows during a fair or assisting with activities that are important for community engagement. Additionally, many times their own children participate in the fairs and deserve parental support. Both limit the time an advisor can spend educating the public or coordinating intensive literacy programs. By bringing in a partner for the ag literacy programming, FFA members from the local chapters could come and go from the ag classroom without significant advisor supervision because of the consistent attention, mentorship and expectations of the CSU students. Another benefit was an improved relationship with the county fairboard. The education provided in CAM's Ag Academy helped fairgoers understand the importance of agriculture and the Mesa County Fairboard was able to recognize both CSU and the local FFA Chapters as not only participants, but contributors to the fair.

CAM's Ag Academy introduces two important groups of people; those eager to share their knowledge of the agriculture industry and those curious about the production of their food. These two groups exist in all communities and providing a place for them to meet at the local county fair benefits us all. The success of this agricultural literacy programming can be attributed to 3 main characteristics: simplicity, empowerment and partnerships. These characteristics are fundamental to any group replicating this experience.

The curriculum was high quality, simple and organized ahead of time. Existing resources from Ag in the Classroom and other commodity organizations were used when possible. The materials that were created for the fair were professional in nature, accurate, and reusable for future programming.

The CSU students were trained to empower and guide high school students in teaching at CAM's Ag Academy. The two groups of students formed positive relationships with them while teaching and modeling best practices. The structure of CAM's Ag Academy and the Jr. Ag Ambassador badges sent the message that when we learn something new, we can share that knowledge with others and advocate for the agriculture industry. The CSU students taught the high school students, who

Having completed their classroom activity and scavenger hunt, youth at Mesa County Fair say their Junior Ag Ambassador Oath and receive their badge and certificate.



taught youth who came into the booth. And the youth were then challenged to teach others. High school students reported that their time was well spent, they had fun and they felt they made a difference. Students were able to use this experience as part of their Supervised Agricultural Experience (SAE) while others are thinking about starting one after they enjoyed their time teaching people at the county fair.

The formation of partnerships was vital to the success and one of the biggest benefits of the project. High school students see CSU as an organization that can help and mentor them and CSU students gain practical and important skills they will use in upcoming student teaching experiences. It was, literally, a win-win experience.

While we don't always have the opportunity to answer questions for a little boy who wants to know how to "get the bacon out of a pig," ag literacy projects in public spaces such as county fairs provide a unique opportunity for partnerships to grow, information to be shared, and experiences to be had. Perhaps more inquisitive questions can be answered which will help to build positive relationships with others, and with agriculture as a whole.

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Ruth Shepardson has spent 22 years teaching agriculture and advising FFA events in Western Colorado. She loves learning, meeting people as geeky as she is and being outside in the agricultural industry.

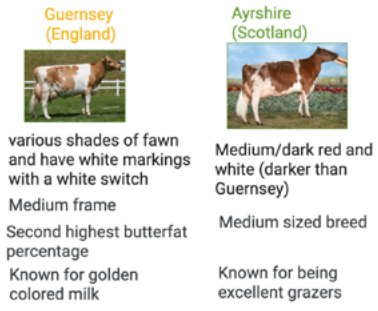
5 Visual Strategies to Support Multilingual Learners in Agriculture Classes

by Dr. Alma L. Contreras-Vanegas & Dr. Lisa Ogle Brown

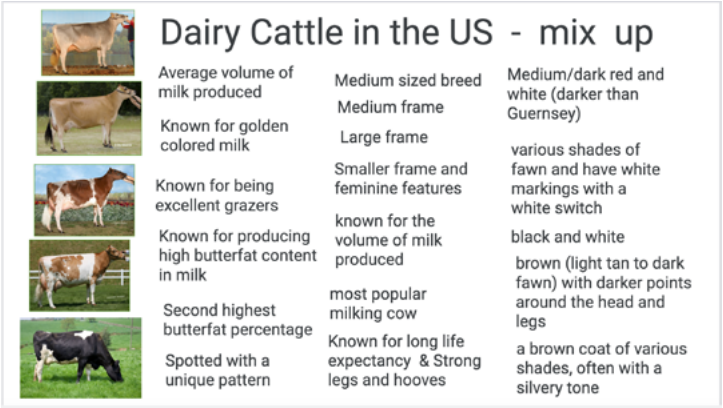
Introduction

Teachers at all grade levels and subject areas have expressed the need for additional support when teaching multilingual learners (MLs). Teachers of agriculture are no exception. When teachers have MLs in their classrooms, it is necessary to know the level of English proficiency they are at before planning a proper lesson. For example, MLs may be at the beginner, intermediate, advanced or nearly fluent in English proficiency (Fleenor & Beene, 2019). Although there are many different strategies to implement when teaching MLs, this article focuses on five visual strategies. These visual strategies can be implemented when teaching any topic in agriculture at all levels of English proficiency. The five visual strategies include the following: realia, videos, digital technology, demonstrations, and graphic organizations.

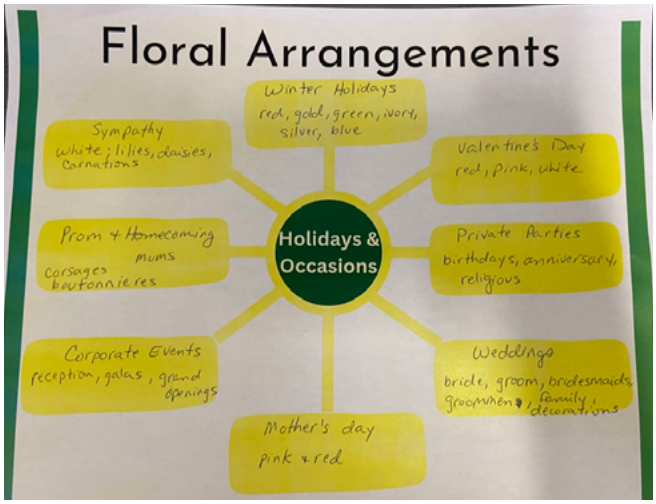
1. **Realia** is a strategy in which you bring real objects into the classroom. For example, if the teacher is teaching parts of a flower, the teacher brings real flowers to class and has the students locate the different parts of the flower (stem, leaf, flower, roots) while looking at different flowers. Once students find the parts of a flower, the teacher has them complete a foldable or create a flower with appropriate parts out of materials (eg. pipe cleaners, construction paper, etc.) while using the real flowers as a model. By having realia in the classroom, students are able to connect the learning in the classroom with real life.
2. **Videos** are commonly used in classrooms to introduce new topics. It is important to choose the right videos for the proficiency level of your MLs. Choosing the right video means teachers are aware of the proficiency level of their MLs. If teachers have MLs at the elementary and intermediate level, captions in the L1 will be greatly beneficial for them to read along and clarify any misunderstanding in the video. Teachers should also keep in mind the length and the type of vocabulary covered in the video. If the video is very long, consider watching it in parts for MLs not to feel overwhelmed having to read the captions or trying to translate too much at once. If the video covers unfamiliar vocabulary, teachers should review these terms before watching



(BOTTOM LEFT) Image 1. Google Jamboard drag and drop – Characteristics of Dairy Cattle.
(RIGHT TOP & BOTTOM) Image 2. Google Jamboard drag and drop – Characteristics of Dairy Cattle student answers.

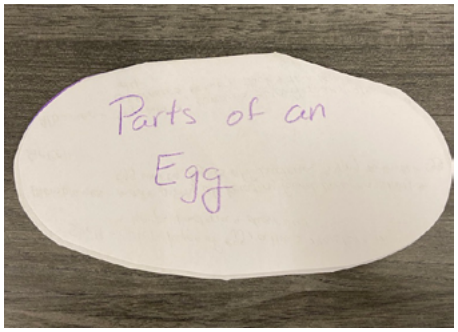


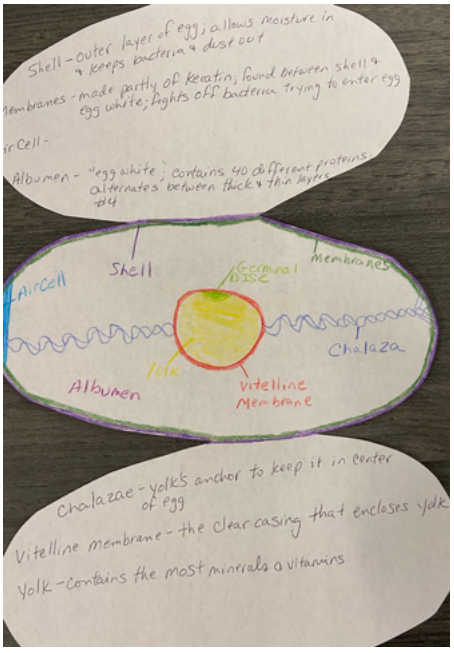
(TOP LEFT) Image 3. Spider map of holidays and occasions for floral arrangements (student product).
(BOTTOM LEFT) Image 4. 3D graphic organizer of parts of an egg (student product).
(BOTTOM RIGHT) Image 5. 3D graphic organizer of horse facial markings (student product).

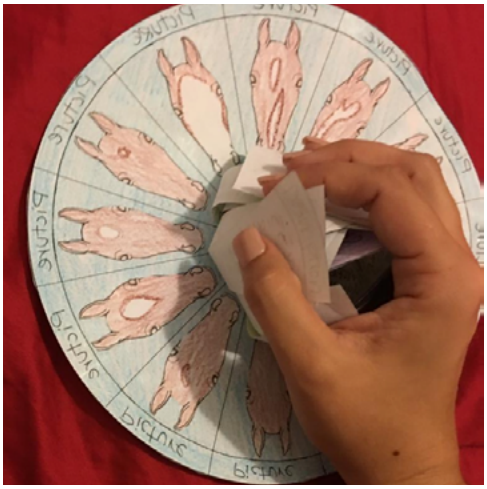


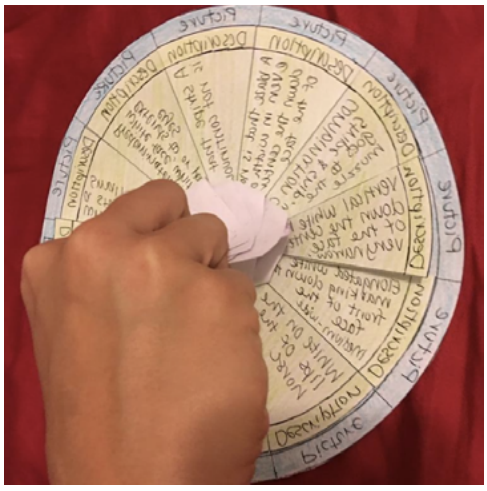
the video to help students gain the information rather than having them get stuck on terms they don't know.

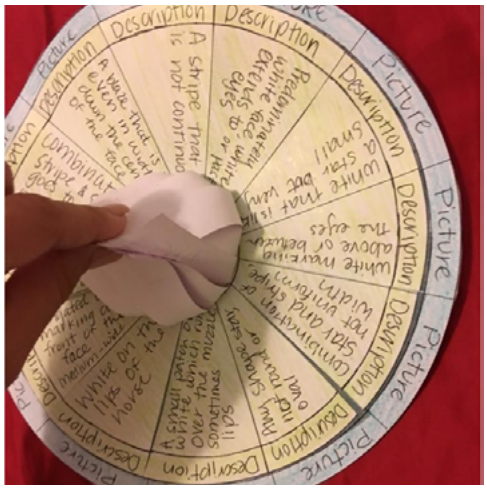
3. **Digital technology** is readily accessible in classrooms nowadays. There are many options on how to use digital technology, such as mobile apps, online games, and more. One great interactive digital technology example is Google's Jamboard. Here are some ways teachers can use Google's Jamboard: create a card sort (Image 1), have students drag labels and drop on the appropriate part of an animal, use it to sort various cattle into categories (ie. Continental, Dairy, American) (Image 2); or create a Venn Diagram to compare and contrast ruminant vs. non-ruminant digestive systems.
4. **Demonstrations** are important as the teacher is modeling how to correctly accomplish a task. When demonstrating a technique, such as ear notching for litter identification, teachers need to be explicit and write the steps down on the board and then model each step one at a time. Teachers can also provide pictures (when appropriate) as they go over each step to teach students the identification system in swine production. Once students have listened to and seen pictures of the different steps, the teacher may move on to the demonstration of how to use the











ear-notching tool. The next step is to allow students to practice using the tool with lunchmeat using the different steps that are written on the board. After independent practice, teachers can have the students demonstrate their newly learned technique to another classmate for further learning.

5. **Graphic organizers** are a great tool to use when teaching any topic. Graphic organizers group information in manageable chunks for students to analyze and process. Some example graphic organizers include circle maps, spider maps (Image 3), Venn diagrams, TWL charts, and Frayer models. An example of using a spider map can be when teaching about floral arrangements. Begin by creating a list of functions and holidays that incorporate floral arrangements or flowers then group them by event (eg. birthdays, homecomings, weddings, etc.). Then have students brainstorm what kind of flowers they may see in those types of arrangements. Remember to include visuals with graphic organizers as well. 3D graphic organizers are kinesthetic tools which also help organizing and synthesizing information necessary for student success in the agricultural classroom. Students have found them very helpful to use as study guides (Image 4 and 5).

Conclusion

There are many great strategies to help make content comprehensible for MLs. It is the responsibility of teachers not to leave any child behind. By using visuals in everyday teaching, teachers are supporting MLs at all English proficiency levels and helping them be successful in the classroom.

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Creating a Pathway Program through CommUniversity Partnerships

by Wendell Scales, Dr. Jacquelyn D. Wiersma-Mosley, Katherine Dilley, Terrius Bruce, Ayanna Bledsoe, Samantha Best, & Chelta Wray

There is a strong need to develop a community-integrated secondary education Agri-STEM pathway program that impacts underserved and marginalized communities. Agriculture and race are inextricably linked within the context of the United States (Smedley, 2011). This fraught relationship has evolved over the centuries from chattel slavery, to sharecropping, to lynching, and stolen lands. Increased attention and resources are required to appropriately address racial and inequity issues among agriculture fields. Unfortunately, educational institutions and the field of agriculture may be essentially forgetting certain groups of students and professionals. Studies have shown that racial groups have been severely underrepresented in agriculture and agricultural education (Hartmann & Martin, 2021). Thus, there is a strong need for agriculture pathway programs that can be produced through CommUniversity partnerships, which can impact the campus, community (both regionally and statewide), and its agricultural-based industry. To build its economic vitality, the field of agriculture needs to produce more leaders who mimic diverse demographic composition. Unfortunately, agriculture disciplines do not produce enough diverse graduates to enter back into the community who could help states thrive economically. In addition to helping to fill the demand for underrepresented individuals entering agricultural positions within the state, CommUniversity partnerships help bring diversity to regional companies, helping these companies become more receptive and responsive to an ever-diversifying client base.

To address this major gap and to increase agricultural ready students, CommUniversity partnerships in Arkansas created AGRI-STEM curriculum and outreach programs that holistically equip underrepresented students with exposure to agricultural sciences in K-12 in order to increase the number of highly qualified underrepresented individuals pursuing undergraduate degrees in agriculture. First, **Arkansas Lighthouse Charter Schools** go above and beyond to pave the way to college for K-12 students who would otherwise face limited opportunities. **Lighthouse** exists because there is a staggering opportunity gap in the American educational system, resulting from lifetime income inequalities that have significantly affected the quality of life for a disproportionate number of historically underrepresented students. Second, the **University of Arkansas Dale Bumpers College of Agriculture, Food, and Life Sciences** is actively working to develop an increasingly diverse and inclusive community for all students seeking agriculture careers, with action steps of recruiting and retaining underrepresented students in Arkansas. In addition, we partnered with **MANRRS** *(Minorities in Agriculture, Natural Resources, and Related Sciences)* and created the first **Arkansas Junior MANRRS** chapter in the state. **MANRRS** is a national society that welcomes membership of people of all racial and ethnic group participation in agricultural and related science careers. It is a springboard for underrepresented students' entry into and advancement in careers. **MANRRS** provides role models and networking opportunities, and offers students opportunities to enhance leadership and organizational and public speaking skills. **MANRRS** members are often the only, or one of few, underrepresented students in their

college classes, disciplinary societies or at their career locations. **MANRRS** provides historically underrepresented students a network of counterparts from similar backgrounds with related interests and goals. Finally, **MANRRS** serves employers in the broader agricultural sector (e.g., John Deere, Land O' Lakes, U.S. Fish and Wildlife Service, Syngenta, and more) by providing a platform to identify prospective well-qualified employees who are members of underrepresented groups, who are projected to be the majority in the workforce in 2032 (Wilson, 2016).

Junior MANRRS provides an opportunity to increase historically underrepresented K-12 students' direct exposure to a land-grant university and mentorship via **MANRRS** collegiate members; (2) improve diversity in underrepresented areas of agriculture and related sciences by dispelling agriculture "myths"; and (3) expose underrepresented K-12 students to important "soft skills", applied research, and opportunities to present at regional and national conferences.

AR CommUniversity created immersive experiential curriculum for underrepresented students through the *Arkansas Lighthouse Summer Enrichment Academy (ALSEA)*, which took place at the **UA Bumpers College** campus in Fayetteville, AR (2021, 2022) and over 220 K-12 students had the opportunity to learn about AGRI-STEM in exploring farms, laboratories and other agriculture spaces affiliated with Bumpers College. In June 2022, 17 scholars (ages 13-15; 5 females, 12 males; 10 identified as Black or African American, 5 identified as White/Caucasian, 1 identified as Hispanic/Latino, and 1 identified as Asian) attended the 3-day ALSEA summer camp. The 3-day (2-night) *ALSEA* included

- Ice cream social event to welcome students to campus, on-campus residential housing for all students, touring campus and agricultural facilities and spaces, such as spending dedicated time in hands-on workshops emphasizing various agricultural skills; visiting rice laboratories on natural genetic variation in diverse rice populations where students were introduced to experimental materials and methods to give them an experience of the fun and excitement of experimental science; visiting with faculty and **UA MANRRS** students who served as mentors for hands-on experiments in on-campus labs; touring **Crystal Bridges**, located in Northwest Arkansas, a public non-profit charitable organization that includes a museum, art collection, five miles of sculpture and walking trails (within a 120-acre park), and includes year-round programming for all ages, including lectures, performances, classes, and continuing education for K-12 students. Students had the opportunity to learn and engage in the arts, and nature/conservation which are central to the mission of Crystal Bridges; and presenting and awarding *ALSEA* 7th and 8th grade students with a *science white lab coat*, as well as official membership in **AR Junior MANRRS**, to launch them on their journey towards agricultural-STEM careers.

Student feedback indicated:

- 90% of students had never attended an AGRI-STEM program, nor had anyone participated in a regional agriculture fair, and none had family working in an agricultural field.
- 70% indicated they were very likely to attend college someday, and 2 students identified as first-generation.
- 80% were excited to visit the UA, with a third interested in majoring in Bumpers College, and only 3 students indicating interest in pursuing a career in AGRI-STEM.

After attending the 3-day ALSEA program,

- 94% left knowing a great deal or a lot about Bumpers College, 65% were excited about Bumpers College;
- over half of students indicated they were interested in a career in AGRI-STEM;
- 70% indicated ALSEA was "excellent"; 71% rated the lab sessions as excellent, and 71% indicated they would apply for the 2023 ALSEA program and all would attend if accepted.

In conclusion, AR CommUniversity aims to empower underrepresented students to interact with AGRI-STEM labs and discov-

eries, modeling what they CAN BE as Scholars and Scientists. AR CommUniversity has the capability and capacity to lift underrepresented students out of poverty in a single generation by providing access to higher education and agricultural careers (Leonhardt, 2017). In partnering together, we created a direct pathway program of students from all over Arkansas. The ultimate goal of a CommUniversity pathway program is to open doors for underrepresented students by providing more equitable and high impact AGRI-STEM immersive experiences, which will help to increase the number of underrepresented students graduating high school, pursuing agricultural degrees in higher education, and ultimately entering the agriculture workforce.

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Review of the Integration of Aquaculture (Agriscience) with other Academic Content Areas through Hands-On Learning Activities: Teacher Perceptions, Barriers, and Impacts on Student Success

by Dr. Kenneth R. Thompson, Dr. Carl D. Webster, Dr. Kirk W. Pomper, & Dr. Jennifer A. Wilhelm

The aim of this article is to explore the integration of aquaculture (i.e., agriscience) with other academic content areas and evaluate how these "real-life" learning environments may enhance learners' ability to deepen their understanding. This paper will examine published reports on how these "goal-based" integrated student-centered learning environments (SCLEs) promote intrinsic motivation for learning, how integration of aquaculture is perceived by teachers, identify the barriers, and the impact on student success when they are engaged in these active learning environments. The specific questions after reviewing various published articles include the following: 1) do teachers value these integrated hands-on agriscience activities; 2) why are these authentic hands-on activities not integrated more frequently in academic subject areas (e.g., the barriers); 3) do these interactive SCLEs foster deeper understanding and produce good learning outcomes for students when infused with other academic content areas?

Notably, the foundation of these active learning environments is rooted in situated learning theory as students are asked to carry out certain tasks and do their best to solve problems in a SCLE that reflects the nature of such tasks in the real world. Hence, a major focus of this review will identify the benefits of teachers-designers to create opportunities for students to "learn by doing" using aquaculture as a teaching tool, and thereby, prepare students to actively participate in discovery learning practices. Students engaged in self-directed inquiry in the field of aquaculture provides opportunities to individually or collectively conduct authentic hands-on experiments, determine solutions based upon their own ideas, compare results amongst their peers or experts upon completion of their investigation, and reflect on the differences (if any).

Authentic hands-on student-centered learning environments (SCLEs) and experimentation

Authentic, hands-on activities allow learners to make connections to everyday experiences, provide opportunities to collect real-world data which might be new to them, requires learners to make their own choices and build upon what they know, and most notably take responsibility and ownership for their own learning. Students engaged in authentic "agriscience" projects either in a laboratory or outdoor field setting, exposes them to real-world phenomena they may not have ever encountered before while engaged in hands-on activities. Hmelo-Silver (2004) emphasized that hands-on project-based science (PBS) activities are well suited to helping students become "active" learners because it situates learning in real-world problems students can understand, see, and relate to within their everyday life. Hmelo-Silver (2004) reported that PBS approaches to learning have a long history and one of many instructional approaches that situate learning in a meaningful task. However, researchers have demonstrated these active student engagement-learning environments often rely on a skilled facilitator to scaffold the science inquiry, and students often work in small collaborative groups to solve a problem.

One example of a project-based situated learning environment that can be implemented by an educator is to provide students opportunities to create a "constructionist learning environment." It is thought to be more meaningful and motivational when students design and construct their own projects and take charge of the task. It has been reported by researchers that these hands-on practical learning

(LEFT) Students apply concepts they learned in the classroom while caring for fish in the aquaculture lab. (RIGHT) Monitoring water quality and temperature are essential for the successful production of fish in the aquaculture unit.

activities encourage knowledge-in-use and will ultimately foster deeper understanding for learners. Likewise, technology tools that enable scientific measurement and collection of real-time data can be incorporated in these creative constructionist SCLEs for educators, which will motivate learners and thereby increase their understanding.

Integration of authentic "real-life" aquaculture hands-on learning activities with academic subjects

Conroy and Walker (2000) stated that many educators view aquaculture education as an ideal vehicle to facilitate the integration of academic and vocational subject matter when it is infused into secondary or other agriculture curriculum. Research suggests that aquaculture is an effective "teaching tool" because it easily integrates many disciplines including biology, chemistry, economics, math, physics, and can provide hands-on experiences that complement academic theory. Aquaculture provides experiential science and mathematics education to help meet demands for cross-curricular integration (Conroy & Walker, 2000). Rosati and Henry (1991) found that when infused into high school agriculture curriculum, aquaculture meets the needs for instruction in basic biology, chemistry, and mathematics concepts required for workers in technical jobs. Researchers have found that using aquaculture to teach principles of math and science through hands-on activities improves student interest and motivation (Conroy, 1999; Conroy & Walker, 2000; Mengel, 1999). Notably, Conroy & Walker (2000) interviewed students who participated in an aquaculture hands-on learning activity and found that they believed aquaculture had enhanced their academic performance in mathematics and science, and made those areas more relevant for them. Teachers, students, and administrators agree aquaculture has potential to address workplace skills and promote youth development (Conroy & Walker, 2000; Mengel, 1999).

Barriers for integration of aquaculture with academic subjects and recommendations

Research demonstrates that teachers believe time mostly impacts success of the integration of other disciplines (Myers & Washburn, 2008). Teachers believed there were not enough hours in the day to work, take care of tanks, and discuss lesson plans with others (Conroy & Walker, 2000). Teachers also reported insufficient funding; concerns about large class size, support to plan for implementation, and personal lack of experience in science integration were barriers to integrating science concepts into an agricultural education curriculum (Myers & Washburn, 2008). Integrated lessons tend to be longer than traditional lessons, require labs or working space, and often involve more than one group of students and facilitating integrated learning opportunities across classes can be an enormous challenge (Frykholm & Meyer, 2002). Some teachers struggled with integration and indicated teachers were inadequately trained to teach scientific aquaculture, and they often sought assistance from other science teachers (Conroy & Walker, 2000).

Another barrier to integration is the physical isolation that exists between the agriculture teacher and their peers. Other researchers suggested that agri-

(LEFT) Students enjoy learning by doing in a multitude of educational settings.
(RIGHT) Learning to properly formulate and prepare fish food is critical for correct rate of gain.

cultural education is considered inferior and nonacademic and territorial issues exist which ultimately hinders collaboration between the various departments. However, when teachers work together, cooperation and resource sharing increases and thus, the potential for collaboration between agriculture and science teachers is tremendous. Frykholm & Meyer (2002) found that a team model approach in which more teachers bring various perspectives and increased content expertise, in particular, to the collaborative effort is very advantageous as teachers are not required to possess deep content knowledge in both mathematics and science. It is well supported in the literature that professional collaboration is an essential component of successful schools and it has been shown that administrators play a crucial role in effective collaboration as adequate administrative support is directly correlated to successful integration.

Collaboration among teachers for resources, instructional ideas, and exploring external funding opportunities that involve science integration is very important (Myers & Washburn, 2008). Schools where teachers felt they had administrative support, or where aquaculture was a theme for integrated instruction, time and other issues mentioned previously related to integration and planning were at least partially resolved; however, in schools lacking support, teachers were found to be only as successful as their individual efforts (Conroy & Walker, 2000).

Recent publications related to hands-on aquaculture/ aquaponics as a STEM teaching tool

If you are interested in learning more about teaching aquaculture or aquaponics please read the following publications.

- Thompson, K. R., Webster, C. D., Pomper, K. W., Tidwell, J. H., and Krall, R. M. (2022a). Use of aquaculture and aquaponics in high schools to teach environmental and ecological concepts. World Aquaculture Magazine, September 2022 issue.
- Thompson, K. R., Tidwell, J. H., Webster, C. D., Pomper, K. W., and Jones, K. R. (2022b). Students applying knowledge in the real world: A case for scholarship of engagement. Community Works Journal. Digital magazine for educators. July 2022 issue. communityworksinstitute.org
- Thompson, K. R., Walling, C. T., Hager, J. V., Pomper, K. W., and Tidwell, J. H. (2022c). Hands-on project-based learning in aquaponics builds students' confidence in STEM. The Agricultural Education Magazine, 95(2), 31-33; September/ October issue; Agricultural Education and Students with Exceptionalities.
- Thompson, K. R. (2022). Engaging secondary students in experiential learning opportunities using hands-on aquaculture instruction. The Agricultural Education Magazine, 95(1), 36-38; July/August issue; Nonformal Agricultural Education.

Personal reflections from the senior researcher (Dr. Thompson)

Recent work at Kentucky State University, funded by the USDA-National Institute of Food & Agriculture (NIFA) Capacity Building Grants program, demonstrated that hands-on, project-based STEM learning activities in aquaculture/aquaponics can produce many positive learning outcomes and is a

valuable teaching tool. Students shared in focus group interviews that the real-life, applied aquaculture activities increased their aspirations, motivation, and interest to learn more about STEM and related career paths. The focus groups also indicated students obtained problem solving and decision-making skills that extended beyond the classroom. Students gained teamwork skills, took ownership of the project, and boosted their self-confidence.

Conclusions

Aquaculture is believed by educators to be a useful teaching tool for cross-curricular integration and to study multiple levels of complexity, especially mathematics and science content areas, through active hands-on experiential science-based activities that relate to real world contexts. Students engaged in these interactive SCLEs are offered opportunities to collect real data, make connections to everyday experiences, and take ownership of their own learning which they may not encounter in more traditional instructional learning environments. Researchers from this review show that using "real-life" aquaculture to teach principles of math and science through hands-on activities improves student interest and thereby promotes intrinsic motivation.

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Myers, B. E. & Washburn, S. G. (2008). Integrating science in the agriculture curriculum: agriculture teachers perceptions of the opportunities, barriers, and impact of student enrollment. Journal of Agricultural Education, 49(2), 27-37.

Rosati, R., & Henry, R. (1991). Aquaculture: A new component of the agriculture curriculum. NACTA Journal, 35(4), 16-20.

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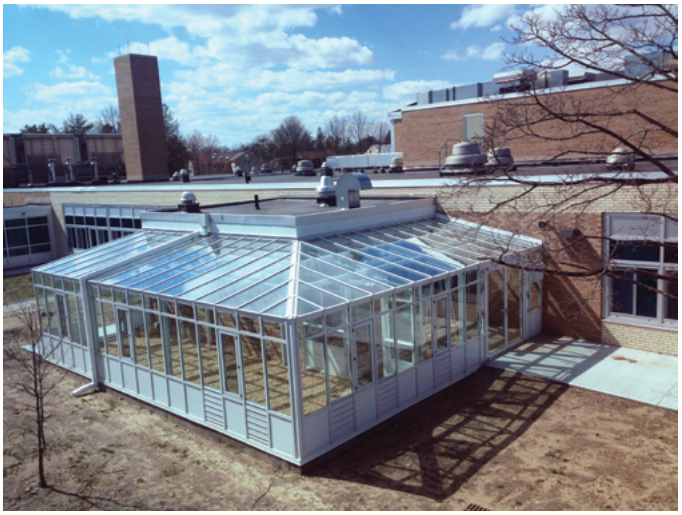

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