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Agriscience Research: Preparing the Next Generation of Scientists

Building the Capacity of Our Students to Face the Unknown

by: Gaea Hock

There is a need to prepare the next generation of scientists to address the grand challenges facing our industry and the world. This past year has highlighted the need for scientists, an educated public, and scientific communication as we navigated through a global pandemic. Unfortunately, this will not be the last pandemic and we need to do what we can to prepare for the next. One of the best ways to prepare our current students for the unknown challenges they will face is building up their analytical skills. I recently read an article which detailed five types of analytical skills: communication, creativity, critical training, data analysis, and research. Each of these skills can be introduced, enhanced, and perfected through high-quality agricultural education practices.

I believe the National FFA Agriscience Fair is the epitome of how we can develop analytical skills in our students through purposeful utilization of the three-circle model. You are teaching scientific inquiry in your classrooms and labs. Students can extend their learning and complete a high-quality SAE focused on an agriscience research question. They can then compete in the FFA Agriscience Fair at the state and national level and apply for an Agriscience Research Proficiency Award. You can help guide students through the research process and elevate their abilities by encouraging them to continue to enhance their analytical skills.

As a high school teacher, I did not mentor students through an agriscience research project. The National FFA Agriscience Fair was in its infancy and did not take off in my state until after I left for graduate school. When I returned to Kansas, I inherited the Kansas FFA Agriscience Fair. I made the goal to reinvigorate and strengthen the event. I provided professional development, rallied teachers who were also passionate, wrote a grant to support teacher training and student research projects, developed resources, assisted in finding experts, created a committee in KAAE to get more buy-in and support for the event, and joined the National FFA Agriscience Fair Committee.

It has not been an overnight success and we continue to improve it each year. I have learned that I need to rely on others to help provide the professional development, mentor student projects, serve as judges, and provide feedback on projects. One of the grant projects was a team effort by my friends Dr. Jeremy Falk and Dr. Marshall Baker. The grant objectives included partnering agriscience researchers at the land-grant research stations with area agriculture teachers and students. We developed an Agriscience Research Workbook as part of the USDA NIFA funded project (IDA01701-CG) and included some of the pages in this issue of the magazine. My experience with the project confirms the belief that there are highly-qualified mentors willing and eager to assist agriculture teachers, if we would just ask. Consider who in your local area might have the expertise and desire to help a young person with a research project. Who in your school would have the knowledge and insight to provide support? Who at the university is doing research your students are interested in learning more about? Virtual technology provides a great tool for connecting your classroom and students with researchers all over the country.

As a college professor, I work to instill and promote analytical skills in all of my students and future teachers. The same is true of you and your desire to begin to support student agriscience research or ratchet it up to the next level. We are each doing our own part to advance science and build the capacity of our students to face the unknown.

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Back Photo Courtesy of Zachary Callaghan

The Impacts of Agriscience Research

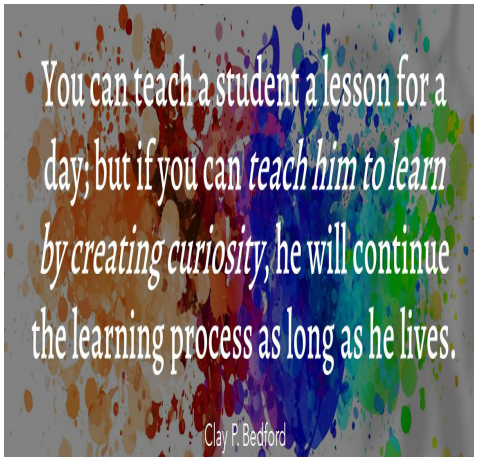
by: Jeremy Falk

Scientific research in agriculture is changing our world. Researchers are working to solve grand challenges that no longer just center around growing enough food - but around infrastructure, people, and perceptions. We need researchers to have a background in agriculture and to come from our Ag Ed classrooms. Agriscience teachers, like you,

are impacting our collective understanding of agriculture and providing us with future researchers and scientists who can continue solving problems. In fact, many of you have taught students who have gone on to develop new varieties of crops; have improved livestock production; and have increased our understanding of doing business in an evolving world. Thank you for making an impact, which may have started with a 9th grade agriscience lesson. Authors of this issue of the Ag Ed Magazine have experience with teaching Agriscience and fostering creativity in their students. Please dig in and look for strategies that will work for your classroom and your students. Some of the most effective teachers will acknowledge that they don't know all the answers and will boldly seek solutions with their students.

As we get started, let's remember that agriscience is a way of teaching the science of agriculture. It has the scientific method at its center and can be used to teach students two things: things that we know to be true, and how to find more answers. Agriscience lessons may be intentional demonstrations of known principles (think: what happens when we feed chickens a commercial grower versus corn meal). Agriscience can also be when we find a problem, seek information about it and related information, then try to find data.

If you and your students want to conduct research and gather



data, then you may want to have a list of ideas to spur thoughts for your students. Much like SAE idea cards, you can create lists of researchable ideas and use those lists to generate specific ideas for students. Speaking of SAEs, those are fantastic to come up with ideas for research! Local and specific ideas are always good to help students learn how to conduct research. I also keep a running list on my phone of some ideas that come from conversations with teachers, researchers, and students. Make time for your scientific discussions in class, and be sure to write them down.

The implications of a strong scientific background in agriculture are difficult to measure, but there are plenty of success stories. Greg Pile, now-retired Ag Teacher from Sumner, WA, is a great example of a teacher who taught students how to ask questions and

methodically collect data. He has graduates who have won awards and accolades at the National FFA Convention as well as at the International Science Fair, but he's quick to point out that the real success is that those students are answering real-world challenges in their careers. Your impact as a teacher is vast - and developing a curiosity in your students will yield positive results both locally and globally.

Jeremy Falk is an Associate Professor of Agricultural Education at University of Idaho. He is a former Ag Teacher at Federal Hocking in Ohio. Some of his research interests are in community support for Ag Programs and coaching behaviors of teachers.

THEME ARTICLE

Juggling the Three-Components of Ag Ed: Using Agriscience Research to Tackle All Three at Once

by Brooke Thiel

Ag teachers confessing they struggle to balance the three components of agricultural education (classroom, SAE, and FFA) is not a new discovery. While working as a secondary agricultural education teacher, I spent hours lamenting over my inability to consistently maintain equal performance in the classroom, FFA, and SAE. Research in the Journal of Agricultural Education has been reporting the disparity between time committed to each of the three components for years. Most teachers indicate SAE is where they spend the least amount of their time as Ag Ed instructors (Shoulders & Toland, 2017). Since the removal of mandated SAE involvement with the passage of the Vocational Education Act of 1963, engagement in SAE has steadily declined across the nation (Phipps et al., 2008). Yet, the National Council for Agricultural Education has attempted to breathe new life into SAE through the SAE for All framework. As we consider how to embrace SAE for All and achieve better balance between the three components of agricultural education,

> I believe agriscience research has the potential to help teachers maximize their time and feel a little less like they're juggling so many different tasks at once.

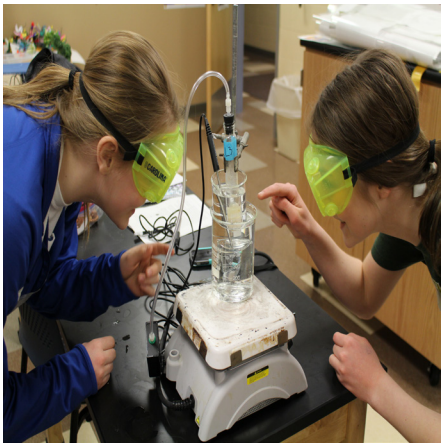
Agriscience in the Classroom

Agriscience research is the ultimate inquiry-based learning experience. Completely student-centered and student-led, engagement in agriscience research activities are an effective way to differentiate instruction because students can pursue topics they are interested in and the rigor can be adjusted to their specific abilities (Thiel & Marx, in press). If you are looking for ways to teach across content areas, agriscience research is a fantastic way to collaborate with colleagues in other disciplines and increase the rigor of the science, math, and writing content in your courses.

If your school is focused on the development of 21st century skills, students who engage in agriscience research report higher self-efficacy of the following skills (a) critical thinking, (b) communication and collaboration, (c) information literacy, (d) flexibility and adaptability, (e) initiative and self-direction, (f) productivity and accountability, and (g) leadership and responsibility (Thiel & Marx, 2019). Those skills are not only important for success in the classroom, but also in their future careers and lives.

Agriscience Research SAEs

In order to discuss how agriscience research projects fit within SAE, it's important to review the definition of SAE. According to The National Council for Agricultural Education (2017), "Supervised Agricultural



Experience (SAE) is a student-led, instructor-supervised, work-based learning experience that results in measurable outcomes within a predefined, agreed upon set of Agriculture, Food, and Natural Resources (AFNR) Technical

> Those agricultural careers in STEM account for 27% of annual job openings, and we are not producing enough graduates to fill those positions.

Standards and Career Ready Practices" (p. 2).

As we think about preparing students for careers in agriculture, we have to recognize that the agricultural industry is rapidly changing. Agribusiness and management are the most in-demand careers in agriculture, followed by

agricultural careers in science, technology, engineering and mathematics (STEM) (Goeker et al., 2015).

Preparing students for careers in research and development should be one of our top priorities. Until students have the opportunity to participate in a work-based learning experience in agricultural research, they may not realize research careers exist or that they enjoy doing research!

> The essential skills students can develop through engagement in agriscience research will prepare them for their future careers, regardless if they go into a STEM field or not.

Additionally, those same 21st century skills students develop through classroom engagement in agriscience research are the same Career Ready Practices they develop if we call the activity an SAE. In fact, employers rank communication skills, problem solving, self-management skills (including initiative and self-direction, adaptability, productivity, and responsibility) and leadership skills as being the most important skills needed by new employees in agricultural careers (Association of Public and Land-grant Universities, 2020).

Agriscience Research in FFA

FFA makes a positive difference in the lives of students by developing their potential for premier leadership, personal growth and career success through agricultural education.

Yes, FFA does make a positive difference in the lives of our students. FFA does provide our students with a multitude of opportunities. But FFA also is a great marketing tool for comprehensive Ag Ed programs. Many Ag Ed teachers have indicated they feel they get the most recognition for their chapter's FFA successes, versus classroom or SAE successes (Wilson & Moore, 2007). FFA banquets, awards, competitions, media coverage, service learning in the community, fundraisers, etc. all lead to increased visibility in the community. As a chapter advisor, encouraging students who completed agriscience research projects to participate in the Agriscience Fair competition is just another way to maximize an experience by taking it a step further through the FFA.

> Agriscience research, whether we call it a classroom activity, an SAE, or an FFA event, provides our students with academic rigor, career exposure, and essential skill development.

Competing in the Agriscience Fair will require students to take their projects to the next level, to practice scientific communication in a higher-stakes setting. It won't be for every student, but for some students, it can be a fantastic opportunity that concludes the entire research experience. Also, for some students, the awards and recognition they earn through the FFA, in the form of Agriscience Fair competitions, proficiency awards, or degrees, may be the motivation they need to expand and grow their agriscience research project(s) (Thiel & Marx, in press).

Bringing it Together

I have argued before getting caught up in the semantics of what we title an experience has the potential to limit or reduce engagement, require teachers to duplicate their work, and create unnecessary barriers. Instead, let's focus on what the students are getting out of the experience, rather than what we should call the experience. Calling something an SAE doesn't inherently mean it will lead to the development of technical AFNR skills or Career Ready Practices. Instead, what students get out of an experience, SAE or other, is driven by teachers' intent and how they guide learning experiences (in or out of the classroom).

Having studied how teachers integrate agriscience research projects into their programs in North Dakota, the majority of teachers find success by integrating the three components together (Thiel & Marx, in press). Those teachers use classroom time to supervise and guide students while they conduct their agriscience research projects. Often those projects have the opportunity to advance to the state

Agriscience Fair if the students are interested. None of the teachers identified the research projects their students were completing as SAEs because they have always been under the impression that SAEs cannot take place during class time (which is still ambiguous in my opinion). As we reconceptualize what SAE looks like moving forward, we have to recognize that Ag teachers can't do it all. Having led agriscience research projects myself, and confirming my experience with others, supervising high-quality research projects takes a lot of guidance and support from a mentor. Yes, outside mentors exist, but in rural communities they are difficult to find and the agriscience research SAE mentor often ends up being the Ag teacher/FFA advisor. Insisting agriscience research SAEs take place outside of the classroom creates an unnecessary barrier that will reduce overall student participation in agriscience research experiences (Thiel & Marx, in press). If teachers are able to use classroom individualized agriscience research experiences to achieve measurable outcomes, expose students to potential career opportunities, and help them foster important technical AFNR and Career Ready Practices, I'm not sure it's defensible to say a classroom agriscience research project can't be considered an SAE.

> Ultimately, if we want agricultural programs to have rigorous classrooms, quality SAEs, and successful FFA chapters, we have to find ways to help teachers manage them in sync and agriscience research may be a great place to start.

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Brooke Thiel is an Assistant Professor of Agricultural Education in the School of Education at North Dakota State University. Prior to returning to higher education, she taught high school Ag Ed for 7 years where she involved numerous students in agriscience research projects. Observing their growth and excitement has motivated her to promote and study the benefits of agriscience research.

Data Collection and Sample Sizes and Experimental Design, Oh My!

by Zachary Callaghan

It's no secret that incorporating Agriscience Fair projects into an agricultural education curriculum can be challenging – for veteran and new teachers alike. This stuff isn't even a part of a traditional agriculture program, right? I'd argue that we've been teaching "research" concepts for far longer than we might think, under the guise of a much more familiar part of our curriculum: the SAE. Historically, many secondary agriculture programs required students to manage an SAE, which often was conducted through the school's own farm. These compelled students to take the information they learned in class and apply it to a real life scenario. Those students surely made mistakes, corrected their actions based on the evidence provided, and became better agriculturists because of it. A similar pattern follows students conducting research projects, although a 40-acre school farm and various agronomic inputs aren't necessarily required… your classroom will suffice.

My Experiences

As a first-year teacher, I don't claim to be an expert on much. I have, however, gained valuable experience when it comes to conducting research projects, some of those good… some bad. My first encounter came with a strong learning curve to say the least. I was a senior at Kansas State University, and it was my first month of student teaching at Riverton High School in southeast, Kansas. One day, my cooperating teacher and I decided all students enrolled in Animal Science and Horticulture classes should complete a research project. There were approximately 60 students between the three included classes. The end goal was to have students compete in the Kansas FFA Agriscience Fair later that spring. Long story short, having 60 individual projects was overwhelming at times. Then add COVID-19 shutdowns and remote learning to the mix. Despite those challenges, we still ended up with a couple of good projects competing at the state level. Even though my cooperating teacher had never mentored students on agriscience research, he was extremely helpful throughout the whole process and we both learned a lot in that first go.

Now that I'm in my own classroom, I decided to take a different approach this year. Instead of trying to stay on top of 60 individual projects, I focused all of my time and effort on one class. I teach an Advanced Animal Science course, which is brand new at our school this year and includes a grand total of three students. My agriscience research experience this year is a night and day difference compared to last spring. In comparison to the students completing projects last year, my small group seems to have enjoyed the projects more. I've enjoyed teaching them more with this format. I can give them direct and instantaneous feedback. The experiments are far more detailed, reliable, and unique. In short, for those interested in implementing agriscience projects, start small and dedicate enough time to focus your efforts on planning legitimate research studies, then you can grow from there. Quality projects will far outweigh any quantity of students you have presenting a poster at an agriscience fair. I'd venture to guess that most teachers don't have classes of three, but give it a shot in a smaller, upper level class and see what happens!

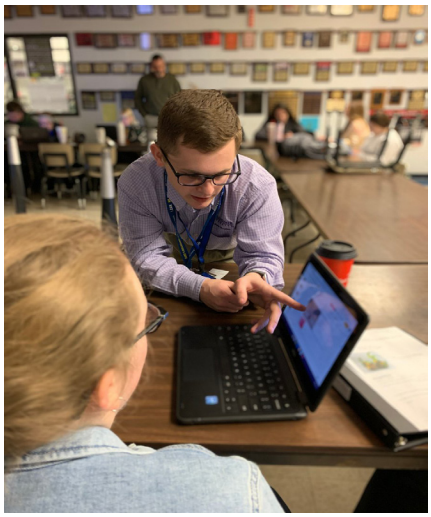
What are Students Saying

I'm constantly trying to think of ways to improve how I connect the importance of research to agriculture with my students. I use student feedback to redirect my efforts and enhance the experiments my students complete. Oftentimes, the most challenging aspect of the whole research concept is coming up with a unique and attainable research question. Once you know what you're going to research, you can use Land-Grant university experts, Extension specialists, and Google Scholar to pinpoint your research methods. But, that initial "What am I going to study?" is the first huge hurdle to overcome.

A second hurdle is to strongly encourage students to find a topic they wouldn't mind spending lots of time with. If they don't like plants or horticulture, they should

probably stay away from a Plant Systems research project. I don't require students to complete a project in the content area of their class as the main goal is to learn about the research process. One of my students had an initial research idea that he wasn't too fond of, but kept trying to make it work. We had already worked to come up with a research question, research objectives, and had just finished writing our final research methodology outlines. One day he came in and said "Mr. Callaghan. I can't do my project anymore." Those words evoke many feelings in a teacher, and not good ones at that. Just as I was searching for a response, he shouted "mushrooms!" Not sure what he was referring to, I questioned his strange exclamation. He began to tell me all about his idea for testing the effects of light intensity on oyster mushroom growth. He'd finally found something to get excited about, then he proceeded to take off and catch back up with the rest of his classmates, despite restarting from scratch.

Other aspects my students consider to be challenging is the actual data collection and analysis. This can be hard to teach because it will be different for every project. Special considerations, such as identifying who is going to come in on the weekend to collect data if you are using school facilities, must be accounted for. I've solicited the help of K-State researchers and Extension specialists to aid in this department. Students contacted the researchers with questions on experimental design



and data collection, which has been extremely helpful. I've found these experts are usually pretty eager to assist and love that young students are getting involved with research.

Opportunities and Resources

Agriscience research requires students to think beyond the means of a worksheet or a lab. It's a fantastic opportunity to challenge students who are exceptionally gifted. Additionally, this is the epitome of the various forms of problem-based/project-based/inquiry-based instruction educational institutions are pushing for right now. Students will learn that everything we have in life didn't just happen; someone had to come up with the idea, research had to occur, and improvements are discovered over time.

The amount of time to spend on these projects in class can be tricky. I've dedicated a considerable amount of time to this unit in Advanced Animal Science. It may be hard to decide what you have to cut from your current curriculum, but I can guarantee the knowledge gained from the quality projects my students have produced this school year will stick with them far longer than anything I could have sat in front of the classroom and told them. The students actively construct their own knowledge by asking a question and satisfying that curiosity through the scientific method.

In Kansas, the FFA Agriscience Fair is growing. More and more teachers are finding the value in student-led instruction. I had the privilege of networking with researchers while volunteering as a co-coordinator of Kansas' FFA Agriscience Fair in college. The research faculty that assist with this event want to see more students engaged in this type of work and are willing to help, all you have to do is reach out!

There are countless resources available online to get started with agriscience research. Reach out to your school's science teachers. Ask English teachers to review manuscripts. Use this as an opportunity to provide a non-traditional agriculture student with an outstanding research SAE. The possibilities are endless, you just have to get the ball rolling!

Zach Callaghan is a recent graduate of Kansas State University, where he majored in Agricultural Education and Global Food Systems Leadership, and is a fire-year Agricultural Educatoin Instructor and FFA Advisor at Tonganoxie High School in Tonganoxie, Kansas.

Professional-Grade Tools: Strategies for Teaching Agriscience for All Stages of Teaches

by Douglas T. Masser

Ever wish you had more tools? Here's a chance to look at a few tools and see if any fit your needs.
They can be taught in the classroom, carried into SAEs, and there are some great FFA opportunities for the content and approach for an Agriscience Fair at local, state, and the national level.

> As a project, agriscience can fit into every circle of the three-circle model of agricultural education.

The information in this article is not new, groundbreaking, or monumental. The goal of writing this is to help us evaluate how we can use our tools of technology, colleagues, and the three-circle model to enhance the agriscience experience.
So who is this article for, you ask? ANYONE! From the new teacher who just landed their first teaching gig, to the 30+ year veteran who has been doing agriscience research projects in their classes since Day 1, and anywhere in between. From middle school teachers who help develop a student's love for agriculture, to the high school educator doing the final preparation before entering the workforce or postsecondary training. Regardless of where you fit, the hope is that you learn at least one helpful hint to improve your agriscience instruction and make scientific thinking instruction easier for you and your students.

Let's get started! Each section is split into two parts to help organize the article as you read and skim.

New-to-You Stage Teacher:
These ideas are great for new teachers or those who are looking at investing more time into agriscience projects. These ideas are the best place to start if agriscience is new to you.

Rediscovery Stage Teacher:
Think of these tips as self-reflection areas to identify strengths and areas of improvement for your instruction. Each should push you to enhance your curriculum or to help you organize the process through which these experiences occur.

Purposeful Scientific Thinking Collaboration
Scientific inquiry, engineering design process, scientific method-whatever you want to call it IS incorporated into other classes in your school. The question is, how do we use this prior instruction and expertise to build our agriscience projects? Here are a few thoughts to ruminate on to increase the collaboration between science and agriculture teachers:
New-to-You Stage Teachers

- **Research any local science fair competitions** that your students can compete in with their projects.
- **Develop a common instructional technique for scientific inquiry**-Because scientific inquiry can be so broad, have the conversation around the vision of the science department and their views on scientific thinking instruction. Every kid takes science classes, so tapping into this prior knowledge from other courses allows you to minimize repetitive instruction and increase time for students to investigate their projects. Use the same graphics and handouts that students already know.
- **Align science fair and agriscience fair**-Does your school have an integrated science fair project or class that your students may be taking? If so, how can agricultural topics get infused into this project for your students? Many of the requirements between local science fairs, projects, and classes overlap, allowing your agriculture students more opportunities for collaboration, evaluation, and competition.

Rediscovery Stage Teachers

- **Add instructional strategies to your toolbox**-Check out the Next Generation Science Standards, Project-Based Learning techniques. Are you already doing these things in your classroom? Probably. But go in with the mindset of gaining one new tool for your instruction toolbox

and you might be surprised what you find to add to your classroom.

- **Try out the experts in your school and choose one new collaborator**- Collaboration on an Agriscience project can occur with more than just your science department! Consider how some overlooked areas can enhance what you are already doing in the classroom and build the curriculum for both content areas:
  - Statistics: Can your classes work together on data analysis techniques? Do they need some real, local data to look at?
  - Engineering/Technology Education: How can our top agricultural mechanics students mesh their abilities with the engineering design process? Sometimes we need to re-examine components of a construction project for effectiveness.
  - Computer Science: How can we take an innovative idea and turn it into an application, website, or 3D prototype?
  - Business/ Entrepreneurship: How do marketing techniques and entrepreneurship principles apply to the agricultural industry? Consider gathering data that you want and need for upcoming fundraisers!
  - Health and Wellness, Family and Consumer Science, Psychology, Social Studies: What is that connection between agriculture and historical events in our country? What connections do we make to apparel and textiles?
  - World Languages: How does food, fiber, and the management of natural resources connect with the culture of a location?

Integrate Agriscience Research into Classroom Instruction

New to agriscience projects? You can conduct your own, or pair up with neighboring teachers to have your own! You can have complete autonomy to modify the National FFA rules to fit your area, and you can even have your own categories or themes.

Choose a few of these tools of the Agriscience Fair to give your students a jump-start into success:

- Scientific Notebooks: Wow-these can be a game-changer! Try using a scientific notebook in your classes for students to ask questions, hypothesize, and sketch ideas. Whenever you want to stretch minds, ask students to consider the topic you just presented and develop some new ways to use what they're learning.
- Written Report: *Caution* The entire report needs to be broken into stages. Give students a week or two to work on each part and submit for feedback. These benchmarks will help students be successful, and give you time to give them some comments before data collection. Use the headings of the report, but you can always put page limits for each section.
- Research Poster/Display: Share what your students are learning in agriculture - you'll get more collaborators! The old tri-fold boards are nice, but a 3' x 4' PowerPoint has spell check. Students will look and feel professional.
- Interview: This conversation about research is a great tool to get students to think of their next study. Involve your local community to conduct the interviews. Local producers, businesses, and administration will be on board for future research ideas.

New-to-You Stage Teachers

- **Make your first attempt (or three) attainable**-Integrating agriscience fair projects into your coursework will not happen overnight. And if they do, they certainly won't be perfect, so focus on successfully rocking one or two components of the project as a starting point. Then build on those successes in future classes. But, messy is okay in a science lab.
- **Check out the National FFA Agriscience Fair resources**- There are templates, standards, and the general overview of the event that might be helpful as you get started with projects. Not sure your students are ready for the FFA agriscience fair competition? Then hold your own agriscience fair in class! Invite upperclassmen agriculture

students, administrators, community members, or science teachers in to assist in evaluating the process.

Rediscovery Stage Teachers

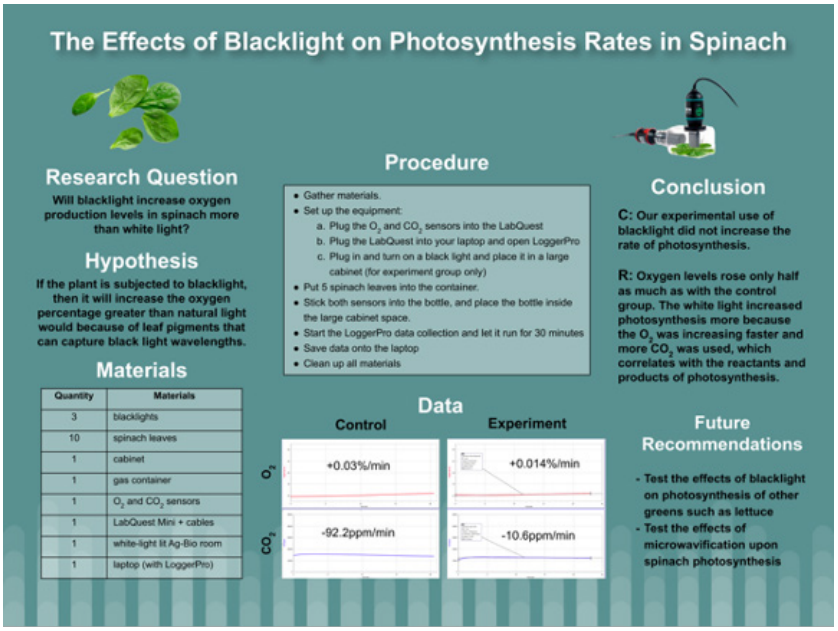
- **Connect with industry professionals**-The end goal of high school agriscience projects is that we develop their love for scientific research and inspire them to continue their research career. For those students on this path, increase the rigor of their projects by getting them to connect with researchers in their field of interest.

- **Evaluate current projects for individualization-** Once you have the process and the components down, it may be time to review how your students can start with the same topic, prompt, or problem but all develop their own projects from that launch point. Independent variables are the starting point to make small changes that have a big impact. An example is in a food science course where we can take a look at ingredients to solve issues. If we use pancakes as the same topic, we can take a week and look at the types of flour that can be used, including: gluten-free; hard red winter wheat; soft white; oat; and many more. Same can be done with types of milk. And temperatures. And humidity… and the list goes on. Evaluate your program and consider what topic will help your students understand the science in agriculture!

Staying Organized with Projects

Cool. We have new tools and big plans to dive into agriscience fair projects... but how do we manage this on top of our already busy schedule? The age of virtual learning is in full swing, so glance at these suggestions to help you stay organized with agriscience fair.

New-to-You Stage Teachers



Use collaborative technology-All things Google are great: Jamboard for brainstorming; Docs for collaborative written reports; Forms for data collection; Sheets for data analysis; and Slides for the research poster. Their collaborative nature gives you flexibility for peer review and teacher feedback. Give students a place to work.

Provide templates to scaffold the process-Chances are that both you and your students will be learning the process as you get started with

agriscience fair projects. Templates are a great way to give the support needed for everyone to learn the layout and cut down on the formatting needed for a professional report, poster, or questionnaire. The template gave them the flexibility to be creative, but structured enough to provide the backbone of a research presentation. This poster is an example of how a template was used for a class project on photosynthesis rate.

Rediscovery Stage Teachers

- Create a course/folder for **agriscience projects on your Learning Management System-** Consider creating a folder or new course in Google Classroom, Schoology, or Canvas (whatever

your school uses) to guide the progress of each project. This could be implemented into a current course, a whole "course" devoted to career and leadership development events for competing members, or an idea for an agriscience capstone course. Students then have a set location to get all rules, templates, and information for the event.

- **Create assignments/ submissions for each section of the project**- Managing emailed documents or even shared Google items can be a nightmare, so anytime we can use the LMS to help us organize the chaos of our day is a win. Create submission areas with due dates that allow students to submit their documents to you. Many LMSs allow you to assign copies of a template to your students so that you can see their progress in real-time. I use Schoology to manage all of our CDE teams, so I have instant access to any Google assignments a learner is working on for the event.

<u>Put the tools to work</u>

Now it's time to put these tools to work in your program. None of us have time to add something new - so consider this as an invitation to take something off and replace it with agriscience.

You can do this.

> Our schedules don't need more, they need better and this is your chance to evaluate what you want to swap out for an agriscience project!

Doug Masser teaches agriculture at Pequea Valley High School near Lancaster, PA.

There's No Time To Sleep In Agriscience Class

by Daniel Knapp

The puddle of drool was forming on the desk after a 40 minute lecture on meiosis, periodic table, microbiology, ecology, or [fill in your own science topics] and an assignment that entailed defining a long list of definitions. Full disclosure: this student was myself 31 years ago. So was my problem that I didn't have any interest? No it was my favorite subject. Was my problem I had no background knowledge of science? No, both of my parents had STEM careers and my extended family was involved in agriculture. So what was wrong? I was not doing science. I was not engaged in actively participating in science. So It was not a surprise that years later when I became an agriculture teacher I made sure that the part of the FFA motto, "Learning to do, Doing to learn," was at the forefront of the development of my Agriscience Program in Hagerman, Idaho.

In my early career Agriscience Fair was in its infancy and it was not a part of my program. As my program developed, I built a greenhouse and aquaculture system and I found myself developing projects that were science experiments or demonstrations. Every year there was a feed trial on chicks or rainbow trout. We did quite a few plant science experiments on fertilizers, seed treatments, beneficial insects, built some rhizotrons to watch roots grow, and other related experiments.

> I found that after the students set up, fed and watered something, swimming, chirping, hatching, growing that then their brain turned on to learning about what was going on.

Then I could sneak in an average daily gain equation, volume and flow rates, population densities, and water testing. I came to realize after the Agriscience Fair became an event in Idaho that it fit really well with my agriscience classroom. Also, it fit well with my nature by helping students compete for placing in the state. Maybe most importantly, it fit well with agricultural education's three circle model integrating SAE, FFA, and Classroom/Lab.

The first year I engaged with the Agriscience Fair, I picked the ambitious smart kid to do a project and she did well. However, I could not figure out how to spend the amount of time needed to give enough scaffolding to get a whole class of students to complete this project, nor did I have the resources to print a whole class of posters and purchase all the petri dishes, pH testers, microscopes, etc. There was no way I could sacrifice so much of my content, chapter resources, or time for this project. Our program still needed to teach natural resources, leadership, mechanics, livestock, and other agricultural subjects. In no way could I sacrifice all the other quality educational opportunities for one cause. I needed help!

At the same time, I knew the science teacher was lacking resources, materials and was needing help getting students engaged in doing hands on science. One thing I have learned in managing an Ag program and FFA chapter is that I should never limit myself to my own time, resources, or abilities.

> Young teachers should realize there are many people and organizations to partner with in your community.

Step 1: Partnerships

The obvious choice was the science teacher. I found a willing participant in the junior high science teacher Jolinda Solasobal and it fit well with the junior high curriculum, which includes the scientific method. Next, I recruited the local University of Idaho county extension agent Cindy Kinder, and pitched the idea. She was all in as 4-H is in the process of developing more STEM projects targeting non traditional 4-H students. Finally, I looked for local science research organizations and found the University of Idaho Fish Culture Experiment Station. They were willing to provide judges and provide students feed and trout if they were

conducting a related research project.

Step 2: Funding
The University of Idaho Extension and my Ag Program partnered up to write and were awarded the Bayer Fund: America Farmers Grow Rural Education Grant. We identified equipment and supplies that were needed for teaching Agriscience at our school to purchase with our grant funds. In retrospect, the most important piece of equipment was, surprisingly, the blotter printer. It was fairly expensive to purchase, and ink and paper are expensive consumables for it, but it has been vitally important to make Agriscience Fair displays with high quality and ease. No longer did we have to mess with the scissors, glue, tape, and printing blizzard that happens with a traditional display. Next, almost every science department is in dire need of supplies. We purchased microscopes, petri dishes, water testers, and other related equipment. To increase motivation and challenge students to do their best we felt cash awards were beneficial. The awarding of students with cash was a huge success. The focussed, ambitious kids were finally seeing rewards for their hard work.

Step 3: Organization and integration of FFA
Between the science program and the Ag program, not all of the students are in FFA or even in an Ag class. So we use the basic format of the FFA Agriscience Fair handbook of divisions and categories, and modify it to fit our school science fair. However, we still kept the requirements that are needed to compete in the Idaho FFA Agriscience fair. The date of the school science fair was strategically placed 2 weeks prior to the state FFA Agriscience Fair deadlines. The school science fair then turns into

a rough draft and trial run for the state FFA Agriscience Fair. The students take the comments from the judges fine tune their projects and are more prepared for submission of paperwork and interviews.

Step 4: Roles and responsibilities
The Ag program is in charge of developing ideas and helping students set up projects for our school science fair. For two months, the shop, greenhouse, aquaculture lab, and food science lab became locations for science fair projects. This is done at a time of year before the greenhouse gets super busy with the spring plant sale, but the heat is on and is fully functioning. We also housed the printer and trained the older students to print off the posters. Printing off 40-50 posters can be quite a chore, but with trained student volunteers this can be done in 3-4 class periods. The science department taught the scientific method and worked on the paper and poster in class. Our Extension educator helped write grants, set up experiments, determine awards, find judges, promote the science fair, take pictures, and helped take care of all the logistics at the school science fair. If your school is looking for collaboration it would be easy to include the English department in writing the report and the business class in designing the poster for students.

Step 5: Teacher resources
There are many different resources for teachers on the internet to help teach the scientific method. Proper citations using the APA style guide are important, and paper templates and rubrics are available on the National FFA website under Agriscience Fair. The paper was a Word document and already formatted to meet

APA criteria with headings and writing prompts for students. The display that we use starts as a PowerPoint template from postersession.com. We currently have all of our templates and rubrics as a Google Doc or Google Slide because our school has Chromebooks. This change has enabled our students to easily share the documents if they work with a partner. As students write and complete their paper, they follow the report template, and also look at the rubric. Judges of our school science fair use the same rubric as the state and National FFA level.

Step 6: Competition

Our school science fair is set up in the gym. Tables are set in rows, and posters are attached using clips to cardboard trifolds on the tables. Projects are set up in divisions and categories. In the morning students are pulled from the bleachers to be interviewed by the judges. The judges then interview students about career options in science. All of the judges are employed in science careers. Judges are invited to lunch to debrief and discuss ways to improve for next year. The fair is open to parents and community in the afternoon to walk around and see the student projects. Finally, an awards session is held and winners are announced.

Success has definitely been measured by: participation of all students in our junior high, collaboration of teachers, Extension, and research institutions, and promotion of agricultural science in the community. My students have been very well prepared and have placed very well in the state and National FFA event. Success has also been felt when I see the older students help younger students determine if their idea is applying the scientific method with confidence and accuracy. Most of all there is no more drool in science class!

Daniel Knapp is the agriculture teacher at Hagerman High School in Hagerman, Idaho. His bachelor's degree is in agricultural education ('98) from Washington State University and his master's degree is in educational leadership ('06) from University of Idaho.

7 Tips for Hosting a Virtual Agriscience Fair

by: Madeline Young

The COVID-19 pandemic may have put a damper on in-person gatherings lately, but let's face it: Even without the pandemic, virtual events are quickly becoming a reality for many of us. And why wouldn't they? With technology taking virtual events to the next level, they are a great way to potentially save time and money while increasing student participation.

According to vFair.com, the following key developments in the digital event landscape signal the surge in virtual events will only get bigger:

1. Live streaming is on the rise. According to Cisco, 82% of all internet users will be consuming videos by 2022.

2. Peer-to-peer virtual campaigns are picking up momentum. For example, people come together to run marathons or ride bikes for a charity while donning their favorite fitness tracking devices, which translates to virtual opportunities unheard of 10 years ago.

3. Marketers are getting serious about tracking event attendees—a hot topic for years. Virtual events even have a leg-up over those in-person because of the ease of tracking, which can quantitatively measure event performance in real-time and gauge event return on investment.

4. Hyper-personalization is becoming the norm. Providing a personalized experience for all event attendees is at the top of the list. With virtual events, companies can easily share personalized content with their attendees based on their interests. Event reports can show how the user engaged for quick follow up or calls to action.

True, in-person events are a great way to pass along content and network, but are they the most effective way to build and connect with an audience? Even before COVID-19, businesses and governments looked at ways to be more sustainable and reduce their carbon footprint. Hosting virtual events is just one way to tackle that issue.

At National FFA, we've seen success dipping our toes into the world of virtual hosting. Last October, we moved our biggest event of the year—the National FFA Convention & Expo—to a virtual platform. The in-person event typically attracts upward of 70,000 attendees. Going virtual, we reached more than 217,000 registered attendees with live and on-demand general sessions, workshops, connection rooms, awards and more. Regardless of the event format this year, we'll continue to

build on that virtual success so more students and teachers can participate.

In the world of agriscience fairs, where I spend most of my time, the same success we saw with a virtual convention can easily be replicated in the name of science. Success is in the details. When hosting your virtual agriscience fair, keep these tips in mind:

1. Decide what you want the students to do.

Before you begin, ask yourself a couple of questions. Do you want a presentation or interview fair? Should students create a visual aspect for their research? How long should the interview or presentation last? Are there specific questions you want the students to answer for the judges? When is the due date? Once you have the answers to these questions, you'll know what direction to go.

2. If hosting an interview fair, identify what platform to use.

Zoom works well and most people are accustomed to using it. Other platforms are available. I would encourage you to test multiple platforms to see which works best for your needs.

3. If using a pre-recorded presentation, identify which platform you want the students to use to save their "public" videos.

YouTube, Vimeo, or Google Drive work fine and are free or low cost. There are other platforms available, but a charge is likely associated with those. Do your research ahead of time and select the platform that matches your needs.

4. Identify and organize your judges.

How many judges will you need? How many divisions do you want one set of judges to evaluate? It's best to have at least two judges in each grouping. My recommendation is no more than 15 interviews/ presentations for one set of judges. You'll also need to figure out your evaluation timeframe. One week is great (including a weekend for those who can't judge because of work or personal schedules during the week). And remember to figure out how long it will take each person to score. Judging fatigue is real, so leave plenty of time for the judges to breathe.

5. Use the right rubric.

Create or find a rubric that works for your needs. Visit FFA.org/agriscience for rubrics and scoresheets associated with the National FFA Agriscience Fair. Give some thought to how you want your judges to submit their scores to you. Will you use scores or rankings? JotForm or Google Docs work great and can be adjusted to fit your needs. Make it simple to follow. You can also utilize The Ag Experience Tracker (AET) or Judging Card to facilitate the judging process.

6. Be organized.

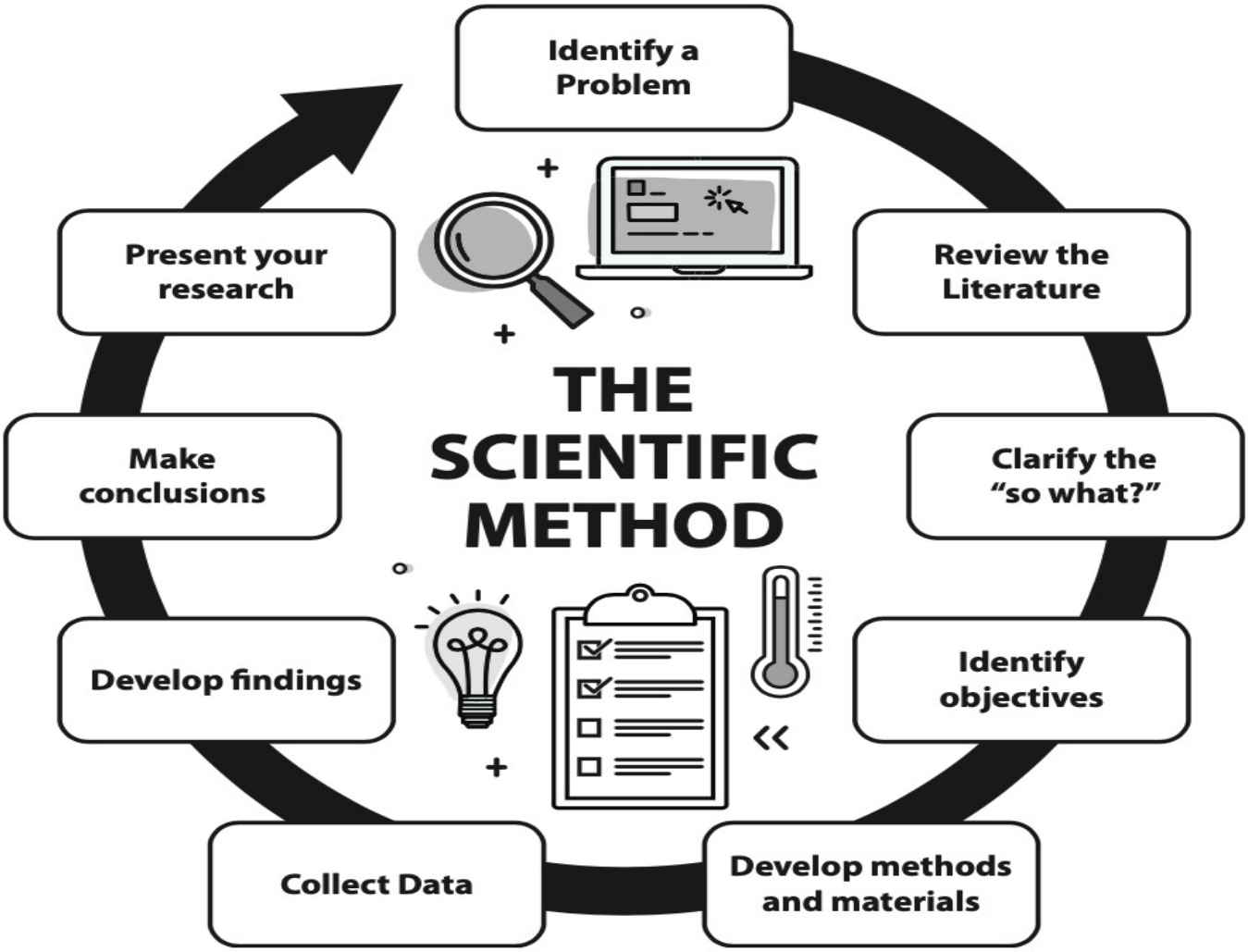
Your judges and participants will thank you. Set a timeline and stick to it. Use volunteers to help manage the load.

7. Recognize your students for their hard work. Every student deserves to be recognized for their efforts in competing in your agriscience fair. Recognition could come in many forms, such as a class grade, small trinkets, FFA swag, gift cards, certificates of completion and more.

In FFA, career and leadership development events and agriscience research are a few ways to help develop college and career readiness skills. Check out https://ffa.app.box.com/v/CDE-LDE-AgriscienceChoiceboard to challenge students to learn about and explore different events offered by National FFA. You can also review this tips and tricks document to find resources used for virtual education, as well as this document that lists the organization's educational resources.

Madeline Young has been with the National FFA Organization for almost seven years in the role of program manager and program specialist for the awards and recognition team with focuses on the Agriscience Fair, National Chapter Awards program and Honorary awards. Before FFA, Madeline was an agricultural educator in Indiana. She lives in Central Indiana with her husband and two young boys.

READY... SET... RESEARCH!



Step 1: Identify a Problem

Identify a problem that you want to know more about. This can be based on your SAE or it can be something that you've heard or read about. You can ask yourself Who? What? When? Where? Why? How? about this problem you select.

What problem are you investigating?

Step 2: Review the Literature

Look for what else has been studied and/or discovered. Look for scholarly articles, private company research, and research institutions for what has been found. Summarize your readings to help determine what needs to be studied next. Give credit, using APA style, for your sources.

Keep a record of important literature about your problem.

Author(s):	Date
Title:	
Name of Source:	
Additional Citation Information:	
What I learned from this source?	
Questions based on what I read?	
Additional resources/keywords suggested:	

Scan this for information on APA Guidelines:

https://apastyle.apa.org/apa-style-help

Author(s):	Date
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Author(s):	Date
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Step 3: Clarify the 'So What?'

After selecting a problem and conducting a review of literature related to your problem, then you can begin to clarify your purpose and what specifically you want to investigate and test in your science experiment. Clarifying the purpose will help to give you direction and focus for your research.

What is your research purpose?

Step 4: Identify Questions/Objectives

Once you have a clear purpose, what questions do you want to investigate and find answers to regarding your identified problem? This section is where you will develop your hypothesis, which is usually constructed in an If…Then… format. Your hypothesis is chosen before you conduct your experiment and the data collected and results of your experiment will either prove or disprove your hypothesis. Disproving your hypothesis does not indicate a failed experiment.

What are your research questions/objectives?

What is your research hypothesis?

Step 5: Develop Methods/Materials

As you design your experiment, make a list of the materials used and include the methods or procedures that you conducted to complete your experiment. Your materials and methods should be specific and action-oriented so that a reader of this section could duplicate your experiment.

Step 1

Step 2

Step 3

Step 4

Step 5

Step 6

Step 7

Step 8

Step 9

Step 6: Collect Data

As you conduct your experiment, your main goal is to collect accurate, consistent, timely, and relevant data that relates to the questions you asked and the problem you identified. Depending on your experiment, your data collection points will vary. **Maintain your data collection in the logbook pages beginning on page 38 of this workbook.**

Step 7: Developing Findings

After you have collected ample and adequate data, then you are charged with analyzing the data and discovering what the data answers about your experimental questions and your identified problem. This data is the meat of your experiment and validates your research, so it is important to analyze your data entirely. Utilize your agriculture teacher and research mentor to help you with data analysis.

Step 8: Make Conclusions

After analyzing your data, you will need to make conclusions based on the data and results of your experiment. This conclusion will include an explanation of proving your hypothesis to be true or false. Remember, a falsely proven hypothesis does not mean a failed experiment.

Access the Written Report Template for your Division for guidance on preparing your written report:

National FFA Agriscience Fair Resources:

Source:
https://www.ffa.org/participate/awards/agriscience-fair/

Experimental Design Overview

TITLE OF THE EXPERIMENT

- What are you trying to find out? "The Effect of (independent variable) on (dependent variable) in (organism studied)."
- A statement of what is being investigated that should include 1) the independent variable, 2) the dependent variable, and 3) the organism being studied (if applicable).

HYPOTHESIS

- What do you predict will happen during your experiment? Should be expressed in the form of an if…, then… statement. "If (you do this), then (this will happen)."
- A prediction about the relationship between the variables that can be tested.

Levels of Independent Variable [1]					
Number of Repeated Trials [2]					

DEPENDENT VARIABLE

- What results will you measure? What are your units of measurement?
- The variable that is measured as the results of the experiment and the units in which this variable is being measured.

CONTROLLED FACTORS (List at least 5)

- List at least five things that it would be important to keep the same during your experiment so that it will be a fair test of your hypothesis.
- All factors that are kept the same and have fixed values.

CONTROL OR EXPLANATION OF CONTROLLED EXPERIMENT

- What is the control in your experiment or why do you think that your experiment is a controlled experiment?
- The group that is used as a standard for comparison in the experiment is the control. Usually the group that receives no treatment.

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[1] List the levels at which the independent variable is being tested in the appropriate number of rectangles across the top.

[2] The number of experiment repetitions, objects, or organisms tested at each level of the independent variable. List the number of trials being performed at each level in the rectangles across the bottom.

Experimental Design Worksheet

TOPIC OF INTEREST:					
PROBLEM/QUESTION(S):					
HYPOTHESIS:					
If...			**Then...**		
INDEPENDENT VARIABLE					
Levels of Independent Variable					
Number of Repeated Trials					
DEPENDENT VARIABLE:					
CONTROLLED FACTORS:					
EXPLANATION OF CONTROLLED EXPERIMENT:					

This Experimental Design Worksheet may not fully relate to the experimental design needed for your research.

FINISHED RESEARCH... NOW WHAT?

Step 9: Present Your Research

Following the guidelines of your state FFA association and the National FFA Agriscience Fair Handbook, create your written report that will be submitted with your project as a part of the FFA Agriscience Fair in your specific state. This written report should follow the guidelines as outlined in the FFA Agriscience Fair Handbook.

1. Writing the Report:

Ask a teacher/adult/mentor to proof your manuscript/report.

What are the key areas you need to work to improve?

https://ffa.app.box.com/s/cf4o9ys85ieer7z5xqcjn17raji0tvgp

2. Follow APA Style Guidelines & Poster Design 101:

Scan these QR codes for information on APA format and tips of designing your research poster.

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https://owl.purdue.edu/owl/research_and_citation/apa_style/apa_formatting_and_style_guide/general_format.html
https://apastyle.apa.org/
https://ugs.utexas.edu/our/poster

ASSESS → DEVELOP → DESIGN →
→ ORGANIZE → PRINT → PRESENT

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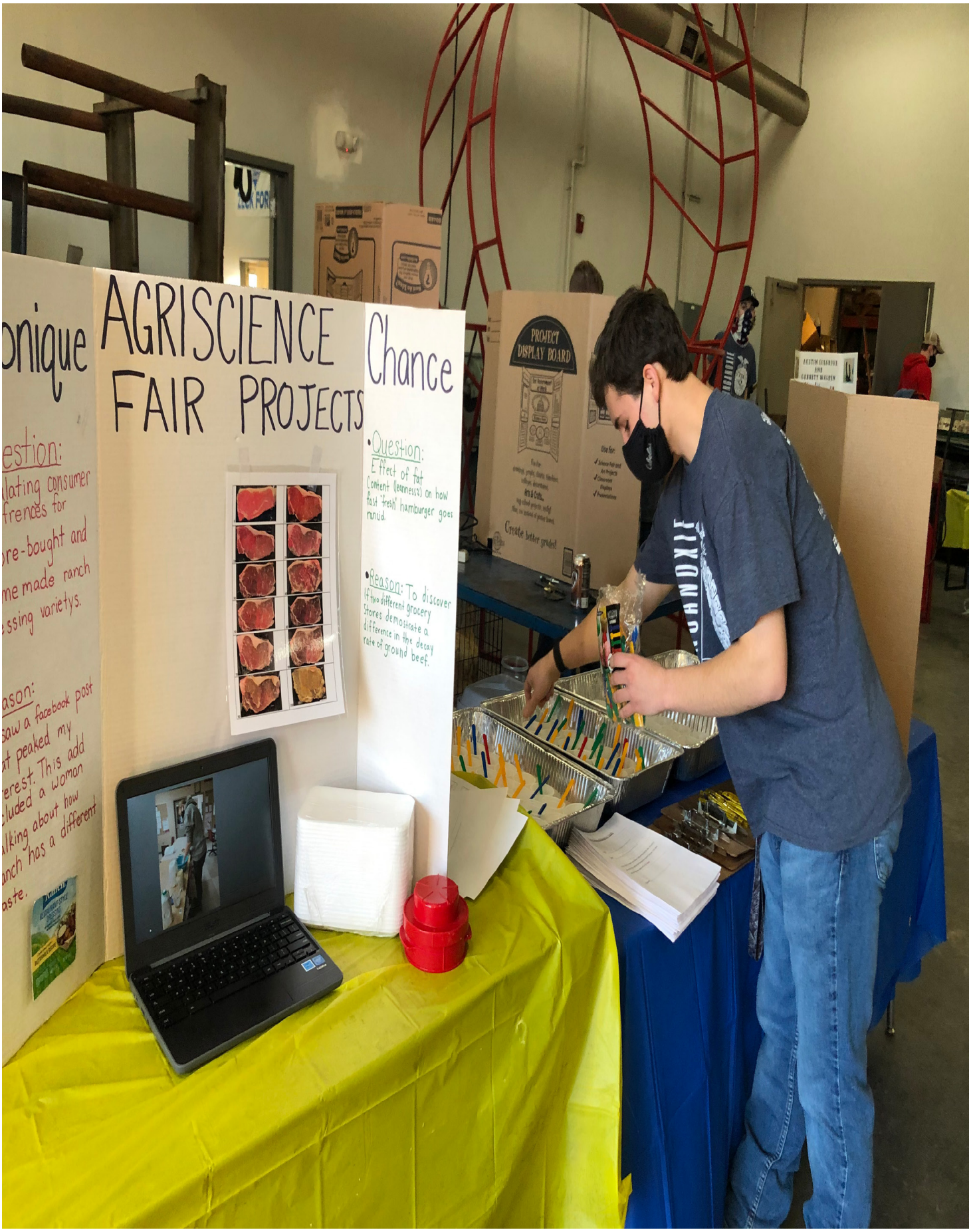
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•Reason: To discover
if two different grocery
Stores demostrate a
difference in the decay
rate of ground beef.
PROJECT
DISPLAY BOARD
Create better product