National FFA Agriscience Research Resource

Table of Contents

Awards Programs

The National FFA Agriscience Fair, Agriscience Research Proficiency and Agriscience Research Career Development Event are exciting opportunities for those interested in the scientific principles and emerging technologies of the agricultural industry. Availability of each program is subject to adequate sponsor funding.

The **National FFA Agriscience Fair** provides middle and high school students the opportunity to achieve local, state and national recognition for their accomplishments in agriscience research. This program also gives students a chance to demonstrate and display agriscience projects that are extensions of their agriscience courses.

The **Agriscience Research Proficiencies** are awards to recognize students who have excelled in their supervised agricultural experience (SAE) of agriscience research and experimentation. It is for SAE programs that involve planning and conducting scientific investigations based on hypotheses and the use of the scientific method of investigation. This may include qualitative research or quantitative research.

The **Agriscience Research Career Development Event** allows students to use the knowledge and skills learned in the classroom in a challenging setting. Qualified teams will conduct a complete research investigation based on local needs, present the results of their local research project, critique a completed research project report and demonstrate their research skills and knowledge by completing an individual exam. This program encourages students to apply the research skills from their classrooms in a critical thinking and teamwork atmosphere.

The **Star in Agriscience** represents the best of the best among thousands of American FFA Degree recipients whose SAE is based around agriscience research and experimentation.

Selecting a Topic

Approximately 61 million Americans work in agriculture today, with only two percent of those working in traditional, production agriculture. Agriscience is an exciting and continuously growing field. You too can be on the cutting edge of science and technology. Have you considered a career as a botanist, food scientist, geneticist, microbiologist, quality assurance specialist, research technician, soil scientist, water quality specialist or a veterinarian? These and many other agriscience careers await your exploration.

When selecting a topic for an agriscience competition, there are some items to keep in mind. If possible, select a topic that matches closely with your on-going supervised agricultural experience (SAE). By integrating your agriscience fair project and your SAE, both programs will provide great benefit. Doing this allows you to participate in all aspects of research and experimentation with your area with a goal of enhancing your experience. A quality experimental SAE can be developed by all FFA members and is especially well suited for those in agricultural classes where there is a strong emphasis on biotechnology or agriscience. Experimental SAE activities can provide valuable learning experiences for all students.

Be sure that the topic you select is of interest to you. Choose a topic that is realistic in relationship to your abilities, knowledge and the resources available. The best idea in the world will remain just an idea without the ability, desire and tools needed to complete the task. Long-term projects (two-and-three year studies) allow you to more deeply investigate your topic and tend to do better in agriscience events than those completed in only one year. These projects collect more data during multiple phases and involve more replications of the experiment than projects of shorter duration. Try to select a topic that lends itself to expansion from year to year in order to discover as much as possible about your subject and collect complete and useful data. The earlier you begin competing in the agriscience program and the longer you remain committed to a project, the better your chances are of reaping some excellent benefits from your efforts. For additional information and ideas on agriscience projects, check the following references. Included are a few website addresses, but many more are found from doing a search for "science fair projects" on the Internet or other reference sources.

Science Fair Handbook for High School Teachers: order from Instructional Materials Service, Texas A&M University, 2588 TAMUS, College Station, Texas 77843-2588, 979-845-6601 (phone), 979-845-6608 (fax), ims@tamu.edu, http://im.tamu.edu Catalog No. 9022.
Access Excellence at the National Health Museum: A website for teachers and students studying biology in the modern world. Developed by Genentech, a San Francisco biotechnology company, www.accessexcellence.com.

A Science Fair Project Resource Guide: A resource for finding science fair topics. Supported by the Internet Public Library. Also contains many links. www.ipl.org/div/kidspace
Collaborative Institute Training Initiative: The CITI Program is a subscription service providing research ethics education to all members of the research community. A site for self-guided study of ethics questions. Provides an excellent resource for ethical questions that would show up on the exam in the future CDE. www.citiprogram.org
Cool Science Fair Project Ideas and Science Fair Projects: Links to resources relating to school and science fairs and science fair projects. www.sciencepage.org/scifair.htm.
Hundreds of Science Fair Projects For Students: Free science fair project ideas, with full instructions and explanations. www.all-science-fair-projects.com
Science Fair Project Help-10 Easy Steps to Success: Dr. Shawn's tail-kicking science projects, complete science fair project guide, essential secrets of science fair success and science project resource links. www.scienceclub.org/scifair.html
STEM Student Research Handbook: Dr. Darci J. Harland provides a comprehensive resource for STEM teachers and students and outlines the various stages of large-scale research projects, enabling teachers to coach their students through the research process. This handbook provides enough detail to embolden all teachers—even those who have never designed an experiment on their own—to support student-researchers through the entire process of conducting experiments. Early chapters—research design, background research, hypothesis writing, and proposal writing—help students design and implement their research projects. Later chapters on descriptive and inferential statistics, as well as graphical representations, help them correctly interpret their data. Finally, the last chapters enable students to effectively communicate their results by writing and documenting a STEM research paper, as well as by preparing for oral and poster presentations. Included are student handouts, checklists, presentation observation sheets, and sample assessment rubrics. Order from the National Science Teachers Association, www.nsta.org

If you simply have no idea what type of project you are interested in, then you need to do some research. A visit to the state or national agriscience competition can be an excellent means for getting ideas.

Once the topic has been identified, it is time to construct the theoretical base upon which your experiment will be built. It is up to you to find as much written material about your topic as you can using a variety of sources; i.e., the Internet, books, magazines, film, local experts, university professors, county extension agents, etc.

Do not limit your search to only one type of media. If your topic is unique, then you will find very little material available that directly relates to your experiment. In this case, locate any material that relates (even vaguely) to your subject. There may be information about a similar process that you plan to use, or the economic impact exhibited by another crop, animal or process that might be mirrored in your experiment. Remember you are searching for items that will enable you to build an argument that your proposed research project is necessary and can make a positive contribution to the body of knowledge that already exists.

As a rule of thumb, include a minimum of 15 references in the project report. While this is not a mandatory number for references, it shows you made an effort to locate pertinent information supporting your proposed research topic and methods.

Completing a Research Topic

Before the actual experiment begins, it is important that you prepare a plan for the research that is to take place. A formal research proposal should resemble what you would be required to file if pursuing an advanced degree in college. This sounds like a tough task, but the process is achievable and provides tremendous experience for future education.

Although the national FFA does not require a research proposal to be submitted, you will find that completing a quality research proposal means your research project will be planned in greater detail. If the proposal is well written, 75-80 percent of the final project report, which will accompany the award applications and agriscience fair display, will already be completed before the project is finished. The following is a review of the areas that are to be included in the project report.

Note to Instructor:

While you are not required to have an in-school research committee to approve student projects, it is highly recommended, especially when dealing with live animal research or human subject. Once the committee has received the proposal, they should meet with each student for a formal discussion about their proposed project before issuing approval. This allows each student to learn to defend their research project verbally, something you must be able to do if you are to advance in competition. It also gives written approval of the research that is to be completed. This is important should the project ever be questioned at any level in the future. Research projects may have aspects that are controversial in nature. Having the project approved by a group of credible individuals, not just the teacher and student, lends argumentative support if the merit or methods employed in the project are questioned. A suggested research committee would consist of an agriculture instructor, a science instructor, a school administrator, and a local agribusiness person or FFA alumni member.

Project Components

Logbook

Your logbook is one of the most important pieces of your project. It will contain accurate and detailed notes of a well-planned, implemented project. Your notes should be a consistent and thorough record of your project. These notes will be your greatest aid when writing your paper.

Written Report

Title Page

Your title should be a precise description of the work performed. The title page should include the title of your project, your name, grade, school and school address. This should be all that appears on this page. The title itself should be no more than three lines with a 15 word maximum. Any numbers, chemical elements and compounds should be spelled out. All words should be capitalized except for articles such as "a" or "the" and prepositions such as "of," "in," "on," "during" and "between;" and conjunctions such as "and" and "but" unless they are the first word of the title.

Abstract

An abstract is a brief summary of your paper, which concisely describes your purpose, methods, results and conclusion. Do not include the title in the abstract. Your abstract may include potential research applications or future research. The abstract should not contain cited references. It should be no longer than one page and in paragraph form. Because this is the first page of your project report, it will be where the reader forms an opinion on your work. In your abstract, arrange your points as 1) Purpose 2) Procedure 3) Conclusion. These sections would include materials used, effects of major treatments and main conclusions. Do not include discussion, citations and footnotes, or references to tables and figures or methods.

Introduction

The introduction answers the question "Why was the work done?" In several paragraphs, provide background on your subject. The introduction should clearly state the problem that justifies conducting the research, the purpose of the research, the findings of earlier work and the general approach and objectives. You must cite sources for statements that are not common knowledge. The last paragraph of the introduction includes the objectives of the study.

Review of Literature

The literature review should detail to the reader what information currently exists concerning your research project. Information listed in your review should be materials that you have used for your research. Material cited could include articles about similar studies, similar research methods, history of the research area and any other items that support the current knowledge base for the research topic and where your project might complement existing information.

Materials and Methods
A well-written materials and methods section will enable others to reproduce your results by duplicating your study. Write in third person, in past tense, encompass all of the materials required and explain the technical and experimental procedures employed. With fieldwork, describe the study site. Include any statistical procedures employed.

Results
This section should be a summary of the results your project has produced, even if they were not what you expected. Do not include discussion or conclusions about the data. Tell the reader exactly what you discovered and what patterns, trends or relationships were observed. Decide on the most meaningful way to present your data (tables, figures) and refer to them in your text.

Discussion and Conclusion
In this section, draw conclusions from the results of your study and relate them to the original hypothesis. It is helpful to briefly recap the results and use them as a foundation for your conclusions. If your results were not what you expected, take this opportunity to explain why. Give details about your results and observations by elaborating on the mechanisms behind what happened. Tie your study in with the literature, but do not hesitate to offer sound reasoning of your own.

References
Only significant, published and relevant sources accessible through a library or an information system should be included. All citations in the text must be included in the Reference section. When you use information or facts that are not common knowledge, you must give credit to the source of that information by citing a reference. You should use the APA style recognized citation system throughout your report.

Acknowledgements
Acknowledge anyone who helped in any aspect of your project in this section.

Format of Report
The report should be printed on white paper, 8 ½" by 11" white bond paper. The report will have 1" margins. Font size must be 12 using Arial, Courier or Times New Roman. The report should be formatted with APA citations.

Understanding the Scientific Method

In order to be successful in the agriscience competitions, you must fully understand the scientific method of research and how it is used to solve problems. This section will examine the scientific method in a step-by-step manner, and show how it is incorporated into the complete agriscience research project and competition.

State the Problem

In order to begin a research project, you must first define, in specific terms, the problem that exists. Avoid projects too general or broad in scope. Focus the project to solve a specific problem.

Example: Are there economic advantages to growing vegetables hydroponically compared to using traditional gardening methods?

Form a Hypothesis

Once the problem is stated, you must then form the hypothesis concerning the outcome of the experiment before the experiment actually begins. A hypothesis is a statement of what you believe may happen based on the information you have gathered in your review of literature.

Many researchers (especially those just beginning to do scientific research) choose what is known as a **"null-hypothesis,"** which states that there will be no differences measured when comparing the groups used in the experiment. A null hypothesis is selected because it is easier to explain why differences occurred than to explain why there were no differences (should this occur) between groups in an experiment.

Example Hypothesis:	Example null-Hypothesis:
Hydroponically grown vegetables will be produced in a more economical manner than those grown using traditional methods.	There will be no economic advantages when comparing hydroponically grown vegetables to those grown using traditional gardening methods.

Testing the Hypothesis

An experimental design is used to support or reject any hypothesis (or null-hypothesis) stated. The project is divided into groups, usually referred to as either control or experimental groups. A control group is defined as being the group in the experiment that most closely mirrors what has been done traditionally.

In the example discussed here, vegetables produced using common gardening procedures would be the “control group.” An experimental (or treatment) group is one that differs from the norm. In this example, the vegetables grown hydroponically are considered our “experimental (treatment) group,” to be compared against the control.

Once the groups that will be used in the experiment have been identified, you must establish a time period needed to determine if differences exist. The time period needs to be realistic. For example, in the hypothetical research project comparing hydroponically grown vegetables to those produced using traditional methods; the length of the project would have to include at least one growing season in order to measure the rate of plant growth, flowering and total production. Some projects may be much shorter or longer in duration depending on the variables surrounding the problem and its solution.

When designing an experiment, it is important to try to limit the number of variables, other than the ones you are measuring. For example, you may normally fertilize your garden prior to planting and then not add any additional fertilizer during the growing season. During the experiment comparing traditional gardening to hydroponics you realize that those plants using hydroponics will be receiving nutrients in their water throughout the experiment and decide to fertilize the garden periodically. You have now changed the control group into an experimental group because you are treating it differently than you normally would and could possibly cause an inaccurate result to occur. One of the hardest parts of research is to see a trend occurring early in the experiment and yet continue on to the conclusion, possibly sacrificing some of your research specimens along the way. As your research progresses, modify the project, make notes in your logbook as to why and how the project was changed and proceed on to the pre-set deadline. Perhaps some new information related to your problem is discovered, or the experiment is experiencing problems related to the current design.

Develop the experiment keeping what data is to be collected firmly in mind. Select experimental groups that will enable you to measure important aspects related to the project; germination rate, pounds of vegetables produced, etc., in comparable terms. For example, in our hydroponics versus traditional garden experiment, you would not plant tomatoes in the hydroponics unit and try to compare them to peppers grown in the traditional garden. Differences that occur during the course of an experiment must be measurable, or the results are useless in trying to make recommendations, observations or conclusions about your research.

! ***Special Tip:*** *Try to keep any and all biases concerning the research out of the experiment. Perhaps you are a firm believer that vegetables should only be grown in a traditional garden, and you begin to notice that those being grown hydroponically are out-producing the traditional groups. You must resist the urge to “help along” the traditional groups by adding fertilizer, increasing water supply or changing other variables. Many researchers have lost credibility when it was discovered that they manipulated their experiment in such a way that helped their hypothesis to be proven correct. It may be hard not to give your research a “helping hand,” but your data will be honest and the conclusions you have will be accurate.*

Prior to beginning the research, decide how to record data. This includes what specific data will be needed and in what form it will be recorded. While a common notebook will suffice for a logbook, there are many styles of journals commercially available. If possible, all data should be collected at specific intervals (Tuesday and Thursday of every week for example) from each experimental group throughout the research period. Make data recording a habit and not something that gets done "every now and then." Remember that the credibility of your research depends on accurate data. Do not rely on your memory. Write down everything concerning your research in detail, even if it seems insignificant. Unnecessary data can be discarded when the project is analyzed; missing data cannot be retrieved once you have failed to record it on time. Good record keeping will make data analysis much easier once the research is concluded.

Analyzing Data

Once the project is completed, the data generated must be analyzed in order to compare groups. If your agriculture instructor is not comfortable deciding on the proper statistical tests to include in the research report, enlist the aid of a math instructor or a professor at a local college or university. If you wish to run your own statistics, there are several statistical software packages available that can help you. One program is Microsoft Excel. Once the statistics are completed, select those that best describe the major aspects of your research. You may find that some data can be left out of your final report. Remember, it is better to have too much information when completing the research report than to have too little.

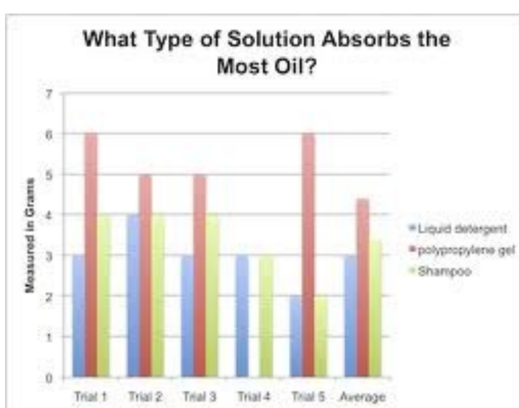
Reporting Data

Once you analyze the data for statistical differences, decide how to include it as part of the research report. Report the data in the simplest terms possible so that someone unfamiliar with your area of research can understand the results. There are no guarantees that the agriscience judges will have scientific backgrounds and understand your work if it is not presented in a straightforward format. Charts and graphs are the best format to use to accomplish this objective. Make sure your graphs are easy to read and not overcrowded with data. Use color whenever possible to show differences and catch the readers' attention.

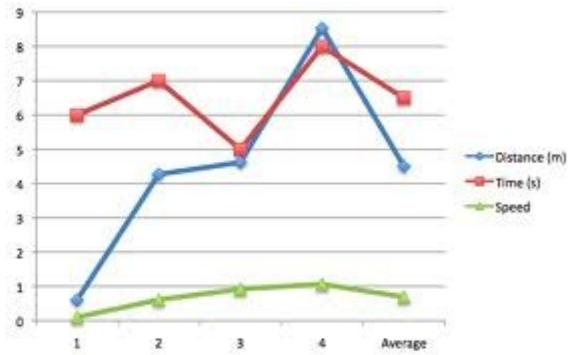
Graphs are an excellent way to explain what happened during an experiment. Utilizing a spreadsheet found in programs such as Microsoft Excel makes it relatively simple to create a graph that enhances the visual display of the project. Graphs may have excellent results both in the scientific paper and on the display booth.

Below are three different types of graphs you may want to use:

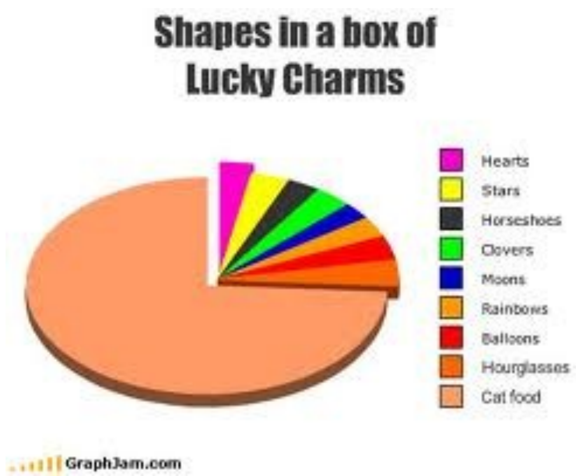
Bar Graph



Line Graph



Pie Graph



Display

Agriscience Fair displays must follow these guidelines:

- Height: no taller than 108 inches from the floor to the top of the display (this includes the table and display)
- Width: maximum of 48 inches
- Depth: maximum of 30 inches
- Exhibit must be stable and freestanding

The following image will give you a general idea of the types of things that should be included on your display; these ideas are exclusive or all-encompassing.