

ST. LUCIE COUNTY REGIONAL

STEM FAIR

(Science & Engineering)

2014-2015

Middle and High School

Handbook



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Mission Statement

The mission of St Lucie County is to provide a challenging, stimulating and engaging experience to all students who partake in the STEM Science Fair.

Vision Statement

Today's students are our future! Our educational system must provide opportunities for students to practice and hone the skills needed for their success in their lives.

A STEM (Science Fair) Project will provide St. Lucie County students with experience and exposure to meet the challenges they will face and be prepared for the opportunities they will encounter as they enter their post-secondary education and careers. All secondary students will integrate and apply Science, Technology, Engineering, and Mathematics (STEM) in an authentic project to demonstrate their ability in using the scientific habits of mind and critical thinking as they investigate, explore, and discover information about the natural world in which we live.

Ethics Statement

Scientific fraud and misconduct are not condoned at any level of research or competition. This includes plagiarism, forgery, use or presentation of other researchers' work as one's own, and fabrication of data. Fraudulent projects will fail to qualify for competition in affiliated fairs and the INTEL ISEF Society for Science and Publication reserves the right to revoke recognition for a project subsequently found to have been fraudulent.

RULES AND REGULATIONS

1. The STEM Fair Project must fit into one of the following categories: (BE) Behavioral & Social Science, (BI) Biochemistry, (BO) Botany, (CH) Chemistry, (CO) Computer Science, (EA) Earth & Planetary Science, (EN) Engineering: Materials & Bioengineering, (EV) Environmental Science, (MA) mathematical Science, (ME) Medicine & Health Science, (MI) Microbiology, (PH) Physics & Astronomy, (ZO) Zoology.
2. The use of weapons, humans, vertebrate animals, potentially hazardous microorganisms (including bacteria, viruses, fungi, or mold and parasites), recombinant DNA technologies or human or animal fresh/frozen tissues, blood, or body fluids is **NOT** permitted. Other than those food items that are available in a grocery store as a food source for human consumption.
3. **Your classroom Science teacher must approve all projects.**
4. The STEM Fair Project Schedule must be followed. Late projects will **NOT** be accepted.
5. **The project must be the student's work.** Teachers and parents may provide guidance and supervision only.
6. Projects must be on a Science Fair display board
7. Students must maintain a **dated** student handwritten log book in a permanent bound notebook (composition notebook) throughout the investigation.
8. All information may be printed, typed, or computer generated **except** in the student log book. The student **log book** must be completed in the student's own **handwriting in blue or black INK.**
9. Science displays should be neat and words spelled correctly.
10. **All material must be attached to the Science Fair board, other than the Log Book, Reprint File and Final report.** Glass or breakable items are not permitted in the display. No materials can be displayed in front of the board. You may take photographs and/or use pictures from the Internet, magazines, newspapers, etc. to include on the board.
12. **Credit must be given for all photographs and/or pictures used on your display board.** (Example: "Photograph taken by..." or "Picture taken from..."). If all photographs and/or pictures are from the same source, one credit line prominently displayed is sufficient. This includes Internet photos. **No pictures of faces** may be displayed on the science fair board.
13. **Measure and record everything in metric units.**
14. **Experiments must be repeated at least three times.**
15. St. Lucie County School District will be following the INTEL/ISEF guidelines for the STEM/Science Fair, unless those rules and regulations need to be modified or changed to assure the safety and well-being of our students and test subjects.

SCIENCE SAFETY

Read these safety rules and REMEMBER them.

The rules listed below will help keep everyone SAFE.

1. Make sure all experiments are approved as safe by your science teacher.
2. Report all accidents to your teacher or designated supervisor (if you're at school) or to your parent or guardian (if you're at home).
3. Know the location of the first aid kit, fire alarm, fire extinguisher, and nurse (if you're at school) or responsible adult (if you're at home).
4. Never taste or touch chemicals.
5. Wash your hands thoroughly before and after an experiment. Use gloves if needed.
6. Protect your clothing by wearing an old T-shirt, and protect the surface of the desk or table you are working on by covering it with newspapers.
7. Keep long hair and loose clothing out of the way while doing an investigation.
8. **Wear safety glasses and use safety equipment when doing experiments.**
9. Never drink or eat from glassware such as bottles, glasses, beakers, or cylinders
10. Never "suck up" a liquid chemical with your mouth.
11. Never sniff or breathe vapors from any gas or chemical.
12. Never point a sharp object or a test tube at anyone or look directly into a test tube when mixing or heating chemicals.
13. **Find** out any special rules about safety for fire, electricity, chemical use, or anything else, for the equipment and supplies you will be using.
14. Take an electrical cord carefully from the outlet by pulling the plug instead of the cord.
15. Keep the floor free of spilled materials.
16. Handle chemicals only under the supervision of a responsible adult.
17. Follow directions carefully. **If you don't know what to do, ask for help.**
18. Clean up carefully after every science activity. Return all materials to the places they belong.
19. Stay alert and proceed with caution when doing Science Fair experiments!

Project Categories

BE-Behavioral & Social Sciences: Human and animal behavior in context of social community relationships—psychology, sociology, anthropology, linguistics, learning, perception, urban problems, reading problems, educational testing, etc. (Not permitted at the Elementary Level)

Experiments on Humans and Vertebrate Animals are not permitted in Middle School

BI-Biochemistry: molecular biology, molecular genes, photosynthesis, protein chemistry, food chemistry, hormones, metabolism, etc.

BO-Botany: Study of plant life-agricultural, agronomy, horticultural, forestry, plant physiology, plant taxonomy, plant anatomy, plant pathology, plant genetics, hydroponics, etc.

CH-Chemistry: Study of nature and composition of matter and laws governing it-physical, organic, inorganic, materials, plastics, fuels, pesticides, metallurgy, soil, chemistry, etc.

CO-Computer Science: new developments in software or hardware, information systems, computer systems organizations, computer methodologies and data, artificial intelligence, networking and communications, computer graphics, etc.

EA-Earth & Planetary Science: Geology, geophysics, physical oceanography, meteorology, petroleum, geography, seismology, mineralogy, astronomy, climatology, weather, planetary science, etc.

EN-Engineering: Materials & Bioengineering: civil, mechanical, chemical, electrical, sound, automotive, heating and refrigeration, transportation, environmental engineering, robotics, power transmission and generation, electronics, etc.

EV-Environmental Science: Study of pollution: air, soil and water; pollution sources and control: waste disposal: recycling: reclamation; restoration; impact studies; environmental alteration (heat, light, irrigation, erosion); ecology.

MA-Mathematical Science: Development of formal logical systems or various numerical and algebraic computations, and the application of these principles—algebra, analysis, geometry, number theory, probability, statistics, logic, other topics of pure and applied mathematics, etc.

ME-Medicine and Health Science: Study of diseases and health of humans and animals-dentistry, pharmacology, ophthalmology, nutrition, sanitation, pediatrics, dermatology, allergies, speech and hearing, disease diagnosis and treatments, etc.

MI-Microbiology: Study of microscopic organisms, either unicellular, multicellular or a cellular.

No bacteria, no fungi, no parasites, no mold allowed at the Middle School Level.

PH-Physics: Theories, principles, and laws governing energy and the effect of energy on matter-solid state, optics, acoustics, particle, nuclear, atomic, plasma, superconductivity, fluid and gas dynamics, thermodynamics, semiconductors, magnetism, force and motion, etc.

ZO-Zoology: generics, animals ecology, anatomy, animals husbandry, physiology, etc.

Helpful Hints

1. Choose a real world problem of interest to you. (What is to be explored? Ask a question about it)
 - ❖ Choose something that interests you.
 - ❖ Choose something that you have to explore.
 - ❖ Choose something that can be done safely, and solved by an experiment
2. Research the problem and write a research paper citing a minimum of 5 sources using APA Format. (How can the answer to the question be found?)
 - ❖ Look in books, magazines, newspaper and the internet.
 - ❖ Get advice from a parent, scientist or teacher
 - ❖ Make observations of the natural world around you.
3. Develop a hypothesis (What do you think the answer to your question will be?)
 - ❖ Form your hypothesis: as a cause and effect statement for example: "If _____ (this is done) then _____ (this will occur) _____."
 - ❖ Your hypothesis must be clear and able to be TESTED.
 - ❖ Your hypothesis may end up being supported or not supported.
 - ❖ The hypothesis should be posed as an "if, then" statement. (see item #3 in steps to a successful science fair.
4. Design a procedure. (Tell what will be done to test your hypothesis)
 - ❖ List ALL the materials that will be needed.
 - ❖ List each step. **Number each step in order.** Write down everything that will be done. Others should be able to repeat or replicate the experiment by reading the procedures.
 - ❖ Be sure that your hypothesis is being tested, by the experiment.
 - ❖ Identify the TEST VARIABLE (independent /manipulated), OUTCOME VARIABLE (dependent/ responding) and control variables. **Remember to design your experiment so it is a controlled experiment and only ONE variable is changed at a time.** Everything should be the same for each test or trial, except the one variable being tested. The results are then compared to the standard data taken originally before the change of one variable.
5. Test the hypothesis.
 - ❖ Gather the materials
 - ❖ Follow the procedure exactly. **Repeat the experiment at least three times.**
 - ❖ Gather both qualitative (what you see) and quantitative (measured) information.
 - ❖ Collect data and record it in a dated log book, using a pen, not a pencil.
6. Organize and analyze the data
 - ❖ Make data tables, charts, or graphs. Identify patterns from the collected data.
 - ❖ Write a summary of the obtained results (data and statistics)
 - ❖ Draw pictures or take photographs to show the results and/or procedures.
7. State the conclusion. Review the data and decide if the data supports or does not support the hypothesis
 - ❖ Never change the results of your experiment to fit your hypothesis. If the results do not support the hypothesis, that's okay and in some cases good! *Try to explain why different results were obtained other than what was predicted.*
 - ❖ Think about what might be done differently for further experimentation. Explain how the experiment could be improved. What could be done differently?
 - ❖ Think about how the results could apply to a real life situation.
 - ❖ Communicate results with others.

13 Steps for a Successful STEM Fair Project

1. Choose a Topic

Once you have chosen a topic or problem, make sure you have a single idea. A topic that is too broad is difficult to handle. The following is a topic checklist:

- ✓ Can I find enough information?
- ✓ Where can I find the information?
- ✓ Will the information take a long time to get?
- ✓ Will I have to pay for it? How much?
- ✓ Will I need professional help to do the experiment?
- ✓ From whom? Are they willing to help?
- ✓ What materials will I need?
- ✓ What will the materials cost? Do I have enough money?
- ✓ Do I have enough time to complete the project?

2. Log Book: A notebook must be kept to record all data and the time you worked on your project. It is like a diary, and all entries should have a date and time. Even if you are unsuccessful in gathering and discovering information; a dated entry must be made in your LOG book. Use blue or black ink-no pencils. Keep your original LOG book, even if it a mess. DO not use "whiteout", do not erase, and do not recopy. In the event of a mistake or error, using a single line cross out the erroneous information and initial. Keep your LOG book in its original condition.

Your Research Log Book should:

- A bound composition book
- Have your name, phone #, school name, and teacher name on the front cover.
- Be written in ink, NOT pencil
- Every entry should be dated, note the place (where you did your work), time and exactly what you did.
- Include the sources of your research on the topic (Internet or library, etc)
- Provide a summary of the sources you reviewed
- Include ideas that you thought of when you read the literature
- Your problem statement (stated as a question) and your hypothesis (measurable prediction) as a cause and effect statement
- A description of any equipment and materials you used
- A detailed description of any equipment you built (include sizes, materials, etc.)
- Specific instructions for anything you may have created
- All your raw data
- Additional observations during experimentation that are not part of your raw data
- All statistical analyses (include equations, used and show calculations; including, but not limited to mean, median, mode and range, as applicable)
- A list of all contacts (scientists, engineers, etc.) with phone #,s and contact information

- Every entry should be on a new page with the date and time at the top of the page and the place where work was done
- Include any specific precautions for chemicals used that require special care (you find this out from the MSDS sheet for each chemical)
- Include disposal of materials (autoclaving) of cultures and microorganisms

As a general rule, if in doubt include it in the research log

3. Bibliography and Reprint File

Your reference list should include any documentation that is NOT your own (i.e. books, journal articles, website, etc.)

APA (American Psychological Association) Style or MLA Format (Modern Language Association)

A reprint file is a folder that contains a copy of each of your major sources. Be sure to note bibliography information on the first page of each reprint.

4. Summary of Research-Refer to the ISEF Research Plan Instructions (forms)

5. Hypothesis is a prediction, stated as a cause and effect statement, based upon your research, about the anticipated outcome for your experiment. It should be posed as an "if, then" statement. For example:

"If _____(this is done)_____, then _____(this)_____ will occur.

6. Plan Your Experiment: "Give careful thought to experimental design. Once you have a feasible project idea, write a research plan. This plan should explain how you will do your experiments and exactly what will be involved. Remember you must design your experiment so that it is a 'controlled' experiment. This is one in which only one variable is changed at a time. The results are then compared to the 'standard' data you take originally before you change that one variable. Thus, you have designed an investigation with adequate control and limited variables to investigate a question. Also, in your experimental design, make sure you include sufficient numbers in both control (if applicable) and experimental groups to be statistically valid. The experimental design should also include a list of materials. Once finished with the experimental design (called 'procedure') all students are required to fill out the appropriate forms" (Society for Science-Student Handbook)

- Materials: Make a list of all equipment and supplies you will need to do the experiment. Use specific METRIC measurements. Measurements and materials must be exact so that anyone could use the information to replicate your experiment.
- Procedure: is a step by step set of directions for performing the experiment, this should be completed in a numbered sequence, so once again, another individual will be able to replicate your experiment and get the same results.

7. Data Presentation and Analysis

- Data includes ALL information you have gathered from your experiment. You need to keep accurate records of your observations of your experiment. This could be a written description of what happened or accurate metric measurements. The data should be recorded first in your LOG book. Make neat data tables when necessary.
 - For the DISPLAY and FORMAL report, you need to copy the data information from your log book. If your data is in number form, graphs and/or charts should be made to represent the information. Pictures are a valuable tool in reading observations. Credit must be given for all photographs. Living things and models are not permitted at the science fair, so pictures and/or drawings will help to explain your experiment.
 - Analysis is your explanation of the data you have gathered. The analysis of your data should be complete and understandable to the person reading it.
8. Conclusion: Here is where you answer the question from step one. Does the information you have gathered support your hypothesis? "Did the variable(s) tested cause a change when compared to the standard you are using? What patterns do you see from your graph analysis that exist between your variables? Which variables are important? Did you collect enough data? Do you need to conduct more experimentation? Keep an open mind — never alter results to fit a theory. If your results do not support your hypothesis, that's ok and in some cases good! Try to explain why you obtained different results than your literature research predicted for you. Were there sources of error that may have caused these differences? If so, identify them. Even if the results do differ, you still have accomplished successful scientific research because you have taken a question and attempted to discover the answer through quantitative testing. This is the way knowledge is obtained in the world of science. Think of practical applications that can be made from this research. How could this project be used in the real world? Finally, explain how you would improve the experiment and what would you do differently." (Society for Science-Student Handbook)
9. Recommendations: Here is where you explain what you have learned and would have done differently. Perhaps you have ideas of how to improve this if it become a continuing project. Explain and describe how you would add to the experiment. If all did not go to plan, what changes would you recommend? Here is your opportunity to critique your project and make recommendations.
10. Acknowledgments: In a short paragraph, thank all the individuals who helped you complete the project. This information should have been written in your log book. This paragraph belongs in your final paper.

11. Abstract: Google-60th State Science & Engineering Fair of Florida
 OFFICIAL ABSTRACT AND CERTIFICATION, for proper Abstract form.
 " After finishing research and experimentation, you need to write an abstract. The abstract needs to be a maximum of 250 words on one page. An abstract should include the a) purpose of the experiment, b) procedures used, c) data, and conclusions. It also may include any possible research applications. Only minimal reference to previous work may be included. The abstract must focus on work done in the current year and should not include a) acknowledgments, or b) work or procedures done by the mentor." (Society for Science-Student Handbook)

12. Display: Maximum size of Project- Depth (front to back 30 inches or 76 centimeters, Width (side to side) 48 inches or 122 centimeters, Height (floor to top) 108 inches or 274 centimeters.

The display is a visual representation of your project. Be creative, neat and accurate. Arrange the materials on the display board before gluing or taping.

Question	Title of Project Data (graphs, charts, pictures, drawings, photo's etc.)	Analysis Conclusion
Hypothesis		
Procedure		
Abstract		

13. Final Report: is a neatly written (blue or black ink) or typed version of your entire project. It should be grammatically correct and free of spelling errors. The report includes all the steps needed to complete your project. Title each section of the report by name. Each section should start on a new page. The report should be single sided and included the following:

- Title Page
- Table of Contents
- Statement of Problem
- Summary of Research and cited references in APA Format
- Bibliography
- Hypothesis
- Experiment (includes all materials, procedure, data and analysis)
- Conclusion
- Acknowledgments
- Recommendations
- Abstract

Overview of Forms & Dates

- ✓ The Intel ISEF forms constitute written documentation of what will occur, or in some cases, has already occurred, in a research project. They are designed to provide the information that is needed to review the project to ensure compliance with the Intel ISEF rules and with laws and regulations that apply to the project. The forms should be filled out and signed before any research takes place. (Only Forms 1C, 7, and the abstract are done after the research.) The dates of the signatures reflect when the approval or consent is given. Use MM/DD/YY format for all dates. **ALL FORMS: SINGLE SIDED ONLY**
- ✓ Checklist for Adult Sponsor (1)
The checklist is provided so that the adult sponsor (teacher) can review what information (and therefore which forms) must be provided. The date signed is the date that the sponsor approves the project plan **before the experiment begins.**
- ✓ Student Checklist (1A)
On this page, the student outlines what the project is about. Items that especially need to be clear are the following:
 - ✓ #5 Any project conducted in a similar area of research as previous projects should be considered a continuation. If the project is a continuation, explain on Form 7 as completely as possible how the project will differ from previous experimentation because ONLY a new and different research project is allowed. The current year project must demonstrate significant progress.
 - ✓ #6 Explain when the actual experimental procedure (not the background literature review) will begin and end because ONLY a 12-month project that occurred within the last 18 months before this Intel ISEF is allowed.
 - ✓ #7 Explain where the experimental research will be done: research institution, school, field, home. Universities, research facilities, and industrial settings will require additional documentation on Form 1C to explain what was done at each facility. (Note: Pathogens may NOT be cultured at home.)
 - ✓ #9 Attach a research plan, as outlined in the Research Plan Instructions, which describes the project in detail and answers all applicable questions. Research plan MUST include (have a heading for each section, or do on a separate page):
 - Question or problem
 - Hypothesis: "If _____(this is done) then, (this will occur)_____cause/effect)
 - Detailed procedure to include disposal methods
 - 5 major references in APA or MLA format (part of research on topic/question)

✓ Approval Form (1B)

These statements attest that each of these people (or committees) approves or consents to this project. The dates should be signed as described below and are before experimentation unless otherwise indicated:

- | | |
|------------------------|---|
| a) Student | <u>Date they attest that they understand the possible risks</u> , that they have read and will follow the rules, and that they will abide by the ethics statement. |
| b) Parent/Guardian | <u>Date they consent to their child doing this project.</u> |
| c) SRC Approval BEFORE | <u>Date that the committee reviews this project BEFORE the experimentation.</u> Projects that must be preapproved are research in these areas: human subjects, vertebrate animals, and PHBA's (potentially hazardous pathogenic agents) including microorganisms, recombinant DNA, and human or animal tissue. |
| d) SRC Approval AFTER | This applies only to projects that needed preapproval by the SRC but were done at a research institution and were preapproved by that institution instead of the affiliated fair SRC. <u>The date signed indicates when the SRC approved this project after it was completed.</u> All documentation from the research institution showing approval of the project must be attached. |
| e) Final SRC Approval | All projects must be reviewed by the SRC after the experimentation is complete and shortly BEFORE competition in the affiliated fair. <u>The date signed shows the date that SRC gives final approval to this project.</u> |

✓ Regulated Research Institution (1C)

This form is completed by the supervising adult, explains what the student researcher actually did and is signed after the project is completed. This form is only needed if the research was done at a research institution (university lab, for example) or in an industrial setting, but is not completed for work done at a high school.

✓

✓ Qualified Scientist (2)

On this page, the scientist explains what will be done to oversee this project. The qualified scientist (QS) and, if needed, the designated supervisor (DS), will sign with the date that they approve this project (before experimentation takes place).

✓ Risk Assessment Form (3)

Required for projects using hazardous chemicals, activities or devices, and some PHBA's including protists, composting, coliform test kits, and decomposition of vertebrate organisms and must be completed and signed by the DS or QS prior to student experimentation.

✓ Human Subject and Informed Consent (4)

This page, along with the research plan, is submitted by the student researcher to explain to the IRB how the safety and well-being of the test subjects and the confidentiality of results will be ensured. The IRB reviews the project, checks the risk level and determines if written documentation of consent/permission is required. All questions must be answered and boxes checked. Each IRB member signs with the date they approve this project. This review and the date signed must be BEFORE any experimentation takes place.

When required by the IRB, a written informed consent/parental permission form is used to

explain very completely to the research subject and their parent/guardian exactly what will happen to the subject in the project. (See Sample Informed Consent Form.) Questionnaires, sample tests, etc. MUST be given to the IRB and to the parent/guardian. If the subject wishes to participate and when required, the parent/guardian also agrees, they each sign the Informed Consent Form with the date that they approve. (Before experimentation begins).

✓ Vertebrate Animal Form (5A)

This form is filled out by the student researcher when the experiment is conducted in a Non-Regulated Research Site such as home or school and describes the housing and care for the animals. The SRC reviews this document and determines the level of supervision required for the study and signs and dates BEFORE experimentation begins. The bottom of the form is filled out by the veterinarian and/or designated supervisor and is signed and dated when they approve this project with these housing conditions. (Before experimentation begins.)

- ✓ If there was any weight loss or death of an animal during the experimentation, the cause must be investigated and a letter from the Qualified Scientist, Designated Supervisor, or a veterinarian which documents the situation and the results of the investigation must be attached.

✓ Vertebrate Animal Form (5B)

This form is filled out by the Qualified Scientist when the research is conducted at a Regulated Research Institution and describes the study. A copy of the IACUC approval (not a letter from the Qualified Scientist or Principal Investigator) must be attached.

- ✓ If there was any weight loss or death of an animal during the experimentation, the cause must be investigated and a letter from the Qualified Scientist, Designated Supervisor, or a veterinarian which documents the situation and the results of the investigation must be attached.

✓ Potentially Hazardous Biological Agents (6A)

This form is filled out by the student researcher and is required for all research involving microorganisms, rDNA and fresh/frozen tissue (including primary cell lines, human and other primate established cell lines and tissue cultures), blood, blood products, and body fluids. SRC/IACUC/IBC/RAC approval required BEFORE experimentation. The qualified scientist will sign and date. The SRC will choose one or more statements that describe the approval process for the study and will add the date that approval occurred.

✓ Human & Vertebrate Animal Tissue (6B)

This form is filled out by the student researcher and explains the source of the tissue. The Qualified Scientist or Designated Supervisor signs and dates to document the source and handling of this tissue (before experimentation).

✓ Continuation Projects Form (7)

If the current project is in a similar area of research as any previous project of the student or any team member, it is considered a continuation. Explain as completely as possible how the project is different from previous experimentation because ONLY a new and different research project is allowed. The date signed is the date the student researcher is certifying that this information is correct.

✓ Abstract

The abstract is a summary of the study and is written after experimentation. {Google-59th State Science & Engineering Fair of Florida and use OFFICAL ABSTRACT & CERTIFICATION, for proper Abstract form}. ISEF finalists must use the on-line system. Regional and local fairs use the Adobe® Acrobat® file in the document library.

Full Rules, Regulations and ALL forms can be found on the Intel International Science and Engineering Fair website

<https://student.societyforscience.org/intel-isef>

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