INTRODUCTION

Science Fairs have always been one of the best opportunities for students to explore and share their ideas about how the world works. Through active inquiry students ask questions, make predictions, test their ideas, and communicate their findings. This active exploration helps students come to a deeper understanding of key science concepts. By communicating their ideas, they develop presentation skills and self-confidence. The science fair is truly a great educational and motivational activity.

Science, technology, engineering, and math - STEM for short - are subjects that develop problem-solving abilities and critical thinking skills. Regardless of their future career path, students need a solid understanding of these concepts. The goal of the McMinn County School System STEM Fair is to provide an avenue for students to express their scientific creativity and problem-solving abilities while using 21st century skills. It is our vision that students who complete projects in this event will go on to become professionals in the fields of science and engineering in our community and abroad.

We encourage you to enhance your school's STEM Fair in any way that promotes science and the corresponding standards in each grade level. STEM Fair specifications are outlined in this packet with an emphasis on motivating students to continue their academic work and supporting their intellectual curiosity. We wish to thank all those individuals and groups that continue to support and nurture the scientific interests of our children.

Thanks,

STEM Fair Committee
stemfair@mcminnschools.com

TABLE OF CONTENTS

Part I: McMinn County School System STEM Fair Guidelines

Selection:
The school selection process will be at the discretion of each school. It is highly recommended that the students go through a process similar to the McMinn County School System STEM Fair. Schools should utilize the same rubric during the school selection process that will be used at the STEM Fair.

McMinn Central High School will be able to enter a total of 14 projects into the County STEM Fair (the seven highest scores from each grade cluster 9/10; 11/12). Due to student body population size, McMinn County High School and McMinn County Career and Technical Education will be able to enter a combined total of 20 projects into the County STEM Fair (the 10 highest scores from each grade cluster 9/10; 11/12).

All entries must use three of the four STEM components; Science, Technology, Engineering and Math. Classroom teachers should not advance projects to the school fair that do not meet this requirement. Students are to be selected through a school selection process.

- High School STEM projects need to be judged and selected by December 18th.

Date and Location:
The McMinn County School System STEM Fair will be held on Saturday, January 28, 2017 at McMinn County High School. Set up will be 8am to 9am

- Grades 9-12 need to check in through the McMinn County Cafeteria doors.

Eligibility:
- Grades 9-10, students will work in groups of two students
- Grades 11-12, student may select to work in pairs or individually

Wildcard:
Each high school will have one wildcard to be awarded at the discretion of the STEM Fair Committee. Any student/team that does not advance to the McMinn County Fair will need to electronically submit their research proposal. Each proposal should contain a cover letter explaining why the project is worthy of consideration for the wildcard, based on the requirements of the STEM Fair. This must be submitted no later than seven calendar days following the individual school fair. Submissions must be sent to stemfair@mcminnschools.com.

Projects for Resubmission:
Any project that has been awarded first, second or third place may not re-enter at the school level fair. Previously winning projects will be directly entered into the Past Winners category at the McMinn County STEM Fair. To be eligible, resubmitted projects must demonstrate evidence of continued data collection, extended research, and application of judges' feedback from the prior submission. In addition, all participant paperwork, including ISEF papers, must be resubmitted for the current year. Three projects from this category may be selected to advance to the Chattanooga Regional Science and Engineering Fair.

Guidelines for Required Paperwork:
1. Students must submit a STEM Fair Participant Form with a Research Plan to the classroom teacher, prior to beginning research.
2. Upon approval of the Research Plan, students must complete the required paperwork from the ISEF Wizard. Paperwork MUST be submitted prior to experimentation. Paperwork should be submitted in an envelope to the classroom teacher. Student names and project title should be written clearly on the outside of the envelope.
   ISEF Wizard- https://apps2.societyforscience.org/wizard/index.asp

Guidelines for Award:
Two independent judges will judge each project. Judges should not be employed at the school for which they are judging. Scores from the two judges will be added together to arrive at the total score. If a student is not present during the judging, he/she will receive a zero for all questions that specifically require a student response. Judging sheets and students' scores will not be released. In the event of a tie at the high school level, the project that utilizes all four STEM components will be declared the winner. In the event of a second tie, the highest content scores from the rubric will be used.

There will be a 1st, 2nd, and 3rd place winner for each grade cluster. Instructional resources will be awarded to the classroom of each 1st place county winner. Classroom teachers will not be eligible for awards on resubmitted projects.

NOTE: Deadlines will be strictly enforced. Project changes after the deadline will not be accepted.

Part II: Tentative Timeline 2014-2015

Identify STEM Fair Coordinators from each school	Late August
Introduce the STEM Fair concept in participating classes	Week of Aug 18
Release STEM Fair paperwork online	September 9
Students submit Research Proposal for approval to classroom teacher	Week of September 15
Coordinating teachers from each school report date and plan for school level fair	Week of September 22
Students submit Research Plan for approval to classroom teacher	Week of October 6
Teachers provide feedback and final approval of projects	Week of October 20
Students submit completed forms from the ISEF Wizard to classroom teachers	Week of October 27
Students engage in experimental phase of project	On receipt of approval from teacher, ending week of November 24
Students share evidence of layout for display of presentation with classroom teacher	Week of November 17
School level fairs to determine projects to compete in McMinn County STEM Fair	TBD by each school (December)
McMinn County STEM Fair	January 28
McMinn County STEM Fair winners advance to the Chattanooga Regional Fair	February (further details to follow)

It is strongly suggested that classroom teachers allow time for monitoring of the logbook every couple of weeks to ensure students are progressing appropriately. Peer review of all aspects of the project including research plan, research paper, logbook and display.

STEM Fair Participant Form
Grades 9-12
(one form per project)

The Participant Form should be submitted along with the project research plan. Each participant form must contain parent/guardian signatures. Incomplete paperwork will not be approved by the classroom teacher.

1) a. Team Member:_____ Grade:_____
Email:_____ Phone:_____

b. Team Member:_____ Grade:_____
Email:_____ Phone:_____

2) Title of Project:_____

3) Project Type: _____ Science _____Engineering

4) School:_____ Teacher:_____

5) Describe how each STEM component will be incorporated in the project.

Science_____

Technology_____

Engineering_____

Math_____

6) Proposed laboratory experiment/data collection period:

_____ _____
Start Date (mm/dd/yy) End Date (mm/dd/yy)

7) Where will you conduct your experimentation? (check all that apply)
____School ____Field ____Home ____Other:_____

8) List name, address, and contact number for all non-school work sites:_____
_____

9) Are you resubmitting a project into the Past Winner category? If so, detail how your project will meet the requirements to contain new data, extended research and application of judges' feedback from your prior submission._____
_____
_____

STEM Fair Participant Form
Grades 9-12
(one form per project)

Please circle the category that best fits your project:

Animal Sciences

Behavioral & Social Sciences

Biochemistry

Cellular and Molecular Biology

Chemistry

Computer Science

Engineering- Electrical & Mechanical

Earth & Planetary Sciences

Engineering- Materials & Bioengineering

STEM Fair Participant Form
Grades 9-12
(one form per student)

Research Plan Consent Form

- I understand the risks and possible dangers to me of the proposed research plan.
- I have read the Rules and Guidelines and will adhere to them when conducting this research.
- I have read and will abide by the following Ethics statement

Scientific fraud and misconduct are not condoned at any level of research or competition. Such practices include plagiarism, forgery, use or presentation of other researcher's work as one's own, and fabrication of data. Fraudulent projects will fail to qualify for competition.

_____

Student's Printed Name Signature Date

Parent/Guardian Approval: I have read and understand the risks and possible dangers involved. I consent to my child participating in this research.

_____

Parent/Guardian's Printed Name Signature Date

RESEARCH PLAN INSTRUCTIONS
ALL PROJECTS REQUIRE A RESEARCH PLAN TO BE SUBMITTED

Provide a typed research plan and attach to the participant form. Please include your names on each page.

The research plan for ALL projects is to include the following:

A. Question or Problem being addressed

B. Goals/Expected Outcomes/Hypotheses

C. Description in detail of method or procedures (The following are important and key items that should be included when formulating ANY AND ALL research plans.)

- Procedures: Detail all procedures and experimental design to be used for data collection
- Risk and Safety: Identify any potential risks and safety precautions to be taken.
- Data Analysis: Describe the procedures you will use to analyze the data/results that answer research questions or hypotheses

D. Bibliography: List at least five (5) major references (e.g. science journal articles, books, internet sites) you plan to use for your literature review. If you plan to use vertebrate animals, one of these references must be an animal care reference. Choose one style (APA, MLA, etc) and use it consistently to reference the literature used in the research plan

Items 1–3 below are subject-specific guidelines for additional forms to be included in your research plan as applicable:

1. Human participant research:

- Participants. Describe who will participate in your study (age range, gender, racial/ethnic composition). Identify any vulnerable populations (minors, pregnant women, prisoners, mentally disabled or economically disadvantaged).
- Recruitment. Where will you find your participants? How will they be invited to participate?
- Methods. What will participants be asked to do? Will you use any surveys, questionnaires or tests? What is the frequency and length of time involved for each subject?
- Risk Assessment
    - Risks. What are the risks or potential discomforts (physical, psychological, time involved, social, legal, etc.) to participants? How will you minimize the risks?
    - Benefits. List any benefits to society or each participant.
- Protection of Privacy. Will any identifiable information (e.g., names, telephone numbers, birth dates, email addresses) be collected? Will data be confidential or anonymous? If anonymous, describe how the data will be collected anonymously. If not anonymous, what procedures are in place for safeguarding confidentiality? Where will the data be stored? Who will have access to the data? What will you do with the data at the end of the study?
- Informed Consent Process. Describe how you will inform participants about the purpose of the study, what they will be asked to do, that their participation is voluntary and they have the right to stop at any time.

2. Vertebrate animal research:

- Briefly discuss potential ALTERNATIVES to vertebrate animal use and present a detailed justification for use of vertebrate animals
- Explain potential impact or contribution this research may have

- Detail all procedures to be used
    - Include methods used to minimize potential discomfort, distress, pain and injury to the animals during the course of experimentation
    - Detailed chemical concentrations and drug dosages
- Detail animal numbers, species, strain, sex, age, source, etc.
    - Include justification of the numbers planned for the research
- Describe housing and oversight of daily care
- Discuss disposition of the animals at the termination of the study

3. Hazardous Chemicals, Activities & Devices:
    - Describe Risk Assessment process and results
    - Detail chemical concentrations and drug dosages
    - Describe safety precautions and procedures to minimize risk
    - Discuss methods of disposal

Part V: Topic and Research Selection

Factors to consider when selecting the topic of your research project:

Choose a topic that interests you

- Check out sources of information- library, verifiable internet sources, science and math books, lab manuals, technical manuals, Consumer Reports, periodicals
- Find out if there is a sizable amount of information pertaining to your topic
- Looking through magazine and newspaper articles on science and technology may spark some ideas

Some reliable periodicals for research include:

Air and Space Magazine
American Biology Teacher
American Journal of Physics
Astronomy
Chemical and Engineering News
Discover
Environmental Science Technology
Journal of Chemical Education
Natural History
Science
Science News
Scientific American

Other Considerations

- Cost for completing the project
- Time frame to conduct research
- Effects measured without researcher bias
- Adequate resources
- Environmental concerns

Necessary Documentation

Documentation required for all projects.

- Research Proposal Form

Some projects will require additional documentation.

- Risk Assessment Form
- Human Informed Consent Form

Part VI: Science and Math Projects vs Engineering and Technology Projects

Project Goals

The Science and Math project goal is to research a problem to analyze trends in the data to explain the observations.

The Engineering and Technology project goal is to build a prototype to solve a problem. If Computer Science is used the goal is to solve a problem by writing a computer program or designing a computer system or app.

Steps for a Science and Math Project

1. Get a notebook to use as a log book and number the pages.
2. Select a topic.
3. Narrow the topic to a specific problem, stated as a research question, with a single variable.
4. Conduct a literature review of the topic and problem and write a draft of the research report.
5. Form a hypothesis or state the purpose of the research.
6. Develop a research plan/experimental design.
7. Apply for approval. Fill out appropriate forms and get signatures of approval.
8. Write the research report.
9. Collect materials and equipment. Make a lab schedule.
10. Conduct the experiment. Record the quantitative and qualitative data.
11. Analyze data, applying appropriate statistics.
12. Repeat your experiment, as necessary, to thoroughly explore the problem.
13. Form a conclusion.
14. Write the laboratory report.
15. Write the abstract.
16. Create the visual display.
17. Make an oral presentation of the project to teacher and/or classmates (optional).
18. Review and polish display for the science fair and prepare for interview.

Steps for an Engineering and Technology Project

Engineering Projects differ from most research projects. For an engineering project you still need to have a log book and do a literature search. However, the steps in the project might be as follows:

1. Define a need.
2. Develop the design criteria.
3. Do a literature search to see what has already been done.
4. Prepare preliminary designs or algorithm (flow chart).
5. Build a prototype or write program.
6. Test the prototype/program.
7. Retest and redesign, as necessary.

Part VII: Hypothesis or Statement of Purpose

Once you have researched your topic, you will need to write a hypothesis or purpose statement for your project. While scientists tend to prefer a hypothesis, some projects will work best with a statement of purpose, especially technology and engineering projects.

Hypothesis

After you have collected your research, make an educated guess based on something you think will happen. Be sure your guess is testable. You may create your hypothesis as an if/then statement, but consider rewording it to make it sound more factual. Your hypothesis will now be written as a true statement, even though it has yet to be proven. The data you collect in the experimentation phase will either support or refute your hypothesis.

> Example:
>
> If a radish seed is given acidic water, then it will not germinate as well as a seed given neutral water.
>
> Radish seeds will not germinate as well when watered with acidic water compared with neutral water.

Statement of Purpose

Projects that involve the development of new equipment, materials, procedures or models should utilize a purpose statement.

> Example:
>
> The purpose of this project is to develop a prototype vehicle that uses alternative fuel.

Part VIII: Designing the Experiment

Plan your experimental design in your log book. Use diagrams and flowcharts to express your ideas. Consider how your design will test your hypothesis. Remember in an experiment, it is important to test only one variable at a time!!!

Factors in Designing the Experiment:

Variables- Independent and Dependent
Control Set-up
Sample Size
Repeat Trials
Material Availability and Cost
Experimentation Site
Submit Project Documentation
Safety

Remember the validity of your results is directly tied to your samples size and the number of times you repeat the experiment. Sample sizes may vary, but experiments using a t-distribution should contain at least thirty samples. Ideally your experiment should be repeated multiple times.

Any experiments that require additional documentation should be performed and discussed with the supervising teacher. Be sure to adhere to all lab safety procedures when conducting experiments.

Part IX: Keeping a Log Book

The log book is a composition or spiral bound book with pages that are not removable. Documentation is an essential component of your project. The entries into your log book should provide detailed information so someone could reproduce your experiment.

Sections of the Log Book

- Write your name inside the front cover.
- Every page in the book should be numbered in the top right corner.
- Divide your log book into the following four sections. This is the minimum requirement, you may choose to have more sections as appropriate.
    - Section 1- This is where you begin the exploration into your project. List topics or problems you might investigate and thoughts about each one.
    - Section 2- This section is where you begin your literature research. Entries should be documented with the source of information.
    - Section 3- The next section contains the experimental research or design including your research plan, data collection and data analysis. Be sure to include the components of the scientific method.
    - Section 4- The last section is your daily log. It will include daily activities related to your research project. After you have conducted your research, create separate pages at the end of this section for "Discussion and Interpretation" and "Conclusions".
- Every time you make a new entry begin on a new page. Always date your work.

Log Book Entries

- Date and sign every entry. Each team member **MUST** initial every entry that is made in the log book. Therefore, everything in the log bog can be traced back to the team member responsible for the documentation.
- Write your entry immediately after your work is performed, so you can recall the detail. Entries should be written in first person plural. Record everything, all details are important.
- Mark each section clearly with a title.
- Write legibly.
- Title and label all graphs and tables.
- It is appropriate to tape, staple, or paste computer print-outs, graphs, photographs, etc. into your log book.
- Never remove an entry from your notebook. You may find that what you perceive to be mistakes in experimentation are actually valuable. If you need to strike something from your log book, mark through it with one line and date and initial.

Part X: Conducting the Experiment

Before you begin

- Be sure you have documented your plan in your logbook. Create an outline for your procedure and make a timeline.
- It is important to organize your materials before you begin.
- Plan your data collection before you begin. Create a table to record your data.
- Use a camera, video camera, or other tools for documenting your experiment.
- Make sure you have signed approval forms from your teacher before you begin your experiment.
- Observe all safety rules.

During Experimentation

- Record both quantitative and qualitative data.
- Record data in a table. Be sure to include appropriate units of measurement.
- Repeat your trials.
- If anyone other than your team makes entries into your logbook, be sure to have them sign and date their work.

Further Considerations for Engineering and Technology Projects

After you have defined the need and completed the literature search, you will need to:

- Prepare preliminary designs in your logbook
- Build a prototype
- Test the prototype
- Retest and redesign as necessary

Part XI: Data Analysis

- **Organize your data.** In order to look for trends, your results should be organized in data tables. Using computer spreadsheet programs such as Microsoft Excel™ and Vernier Graphical Analysis™ are helpful because the program can graph your data from the spreadsheet.

- **Determine the precision of your data points.** Many people use the terms *accuracy* and *precision* synonymously; however, these words do not mean the same thing in science. Take care not to confuse them in your analysis.

- **Find the central tendency in your data.** Use statistical analyses such as mean, median, mode, standard deviation, and linear regression.

- **Graph your data.** Data should be graphed either on graph paper by hand or using computer software such as Microsoft Excel. Be sure to use proper graphing techniques and label the graph appropriately. The following are examples of graphing styles that might be applicable:
    - line graph
    - bar graph
    - pie graph
    - scatter plot

- **Compare with accepted values to determine its accuracy.** Consider whether a null hypothesis is appropriate to your research. If a t-test is needed, use that for determining the strength of your data. Analyze experimental errors carefully by considering the following:
    - Are there limitations in your experiment?
    - How were variables managed?
    - Determine your percent error. Is it acceptable?
    - What went wrong? What went right?
    - What experimental design changes could be made to improve your results?

Part XII: Drawing a Conclusion

Review the results of your experiment and the analysis of the data.

- Was sufficient data collected for proper analysis?
- Were variables and controls designated clearly?
- How do your results compare with previous studies?
- Are your results reasonable?
- What trends are evident in your quantitative/qualitative data?
- What might explain these trends?
- What relevance does your project have for society or to other scientists?
- Is more experimentation needed?
- Does your data support the hypothesis?

Think carefully about the implications of your research. Ask and answer as many questions about the project as you can. This will help to direct your thoughts and help you to decide whether or not you need to modify, do retrials, or complete the project at this time.

Never change or alter your results to coincide with what you think is accurate or to fit a theory. Scientific endeavor is about the journey; many of the greatest truths have been discovered by "accident".

Part XIII: Research Paper

The purpose of a research paper is to provide readers with an in-depth look at your topic and research. Your paper should include information collected during the background research as well as a complete description of your experiment, data, and conclusion.

Science research papers can be described as one of two types, and they may be written separately or combined. **Your paper should be a combination of the two styles.**

The first type is a **literature review**. In the literature review, you compile and summarize large amounts of scientific research done by others that cover the topic chosen for investigation. You do not include your own laboratory investigations in the literature review. The review should be extensive, citing as many sources as you can locate on the topic. Choose a citation style (APA, MLA, etc.) and use it consistently throughout the paper. A thorough search of the scientific literature published on the topic covered in the project helps to make you an "expert" in your particular field of study, and prepares you to confidently discuss the area of study with others.

The second type of research paper describes the specific **experimental project** you have completed. It should contain an abbreviated (abstract) or full literature review as part of the background information as well as your hypothesis, experimental design (methods and materials), experimental results, brief data summary, discussion and analysis of the results, and bibliography.

Use scientific terminology in the paper. It will help you to feel more at ease with the topic. Your job is to convey the facts and information you have gleaned in an organized, readable, and concise manner.

A good research paper should be written in the past tense and have the following components:

<u>For Science and Math Projects</u>

- Cover Page
- Table of Contents
- Abstract
- Introduction, including Literature Review
- Hypothesis or Statement of Purpose
- Materials and Experimental Methods
- Data and/or Results
- Discussion and Analysis of Data or Results
- Conclusions
- Acknowledgements- recognition of assistance from anyone other than the research group
- Bibliography

For Engineering and Technology Projects

- Title Page
- Table of Contents
- Abstract
- Introduction - Background from reading about similar devices or systems, how they work, their history, etc.
- Statement of Purpose - What was the device, program or system designed to do?
- Materials and Experimental Methods
- Describe the structure and parts. How does the device, system or program work?
- Include a detailed schematic or algorithm.
- Give measurable characteristics of the device or system (for example: dimensions, weight, power supply, voltage generated, software and hardware requirements).
- Data or Results - How did you prove your device or system works?
- Discussion and analysis
- If the system was tested over a range of conditions, graphs can be used effectively.
- What problems prevent the device or system from being fully successful?
- Give suggested improvements.
- Conclusion – Did the device or system do what it was designed to do?
- Acknowledgements- recognition of assistance from anyone other than the research group
- Bibliography

Tips for writing a good research paper

- Produce a report outline that provides a skeletal structure for the entire paper. A good outline will give direction, cohesiveness, and orderliness to the paper and will convey the information in a concise format. Be descriptive but brief. Reduce large quantities of information into brief "bullet statements" for use throughout the paper. When you write from the outline, each paragraph should have a topic sentence and a concluding sentence to direct the reader.
- Write an introductory paragraph that acquaints the reader with the research paper. Give a preview of information that is covered in the paper. Briefly highlight the main points of the paper (50 - 75 words).
- Footnote or cite sources properly. Cite references directly within the paper with the citation set off by parentheses, and cross-referenced in the Bibliography or List of References. Use citations when you give facts such as numbers, data, and statistics, quote a source directly, cite another researcher's results, or cite information received from another expert in the field.
- Integrate support material. Be certain that pictures, diagrams, tables, and graph axes are properly labeled and include units of measure.
- Write a summary paragraph as your conclusion. Make a concluding statement and bring the paper to a close. It should state whether or not the results supported the hypothesis.

- Be careful to acknowledge all borrowed material whether paraphrased or directly quoted.

Citing Sources; Avoiding Plagiarism in Scientific Work

When using the work of other scientists you must document their contributions by citing the sources of information. Scientists generally use the American Psychological Association (A.P.A.) Guidelines, which differ from those used in writing English, or History papers. There are no footnotes at the bottom of the page. The acknowledgement of a direct quotation or your use of someone else's original idea is done within the text of the paper itself. Use citations to cite a fact, quote directly from a source, or to cite information obtained personally from an expert. The citation is set off using a "signal phrase" or with parentheses and is cross-referenced in the Bibliography.

Examples of A.P.A. formatting within the text:

- **Book or Article:** Author(s) last name(s), year of publication
    - "Light is refracted as it passes from one material to another" (Smith and Jones, 2011).
    - Smith and Jones (2011) found that light is refracted as it passes from one material to another.
    - Light is refracted as it passes from one material to another (Smith and Jones, 2011).
- **Encyclopedia or CD-ROM:** Author or if no author is listed article title, year, encyclopedia or CD-ROM
    - (Light, 2011, World Book Encyclopedia)
- **Letter or Conversation with an Expert:** Name of expert, state "personal comm." (for personal communication), date of the communication
    - Smith (pers. comm., October 19, 2011) said that light is refracted as it passes from one material to another.
    - Light refracts as it passes from one material to another. (Jones, pers. comm., October 19, 2011)
- **Internet source:** Author, date, and state "Internet"
    - (Smith and Jones, 2011, Internet)
    - (Light and Refraction, 2011, Internet)

For more details you may want to consult A Writer's Reference by Diana Hacker or Purdue University's APA Style Guide (http://owl.english.purdue.edu/).

Bibliography or References

Most scientists use the American Psychological Association (APA) system for citation and references; guidelines are as follows:

- Give the last name of the author followed by initials. Include all of the authors' names in full (not et al as is found when citing in text).
- Alphabetize your entries by last name of author or editor. If there is neither, use the first important word in the title.

- With two or more works by the same author, use the author's name for all entries and arrange the entries by date, the earliest first.
- Indent the second and additional lines of each entry five spaces.
- Place the date of publication in parenthesis immediately after the last author's name.
- Underline or italicize the titles and subtitles of books; capitalize only the first word of the title and subtitle (as well as all proper nouns).
- Before page numbers of newspaper articles and works in anthologies use "p." or the plural 'pp." before the page numbers. Do not use these before page numbers of articles appearing in magazines and scholarly journals.
- The publisher's name may be given in short form as long as it is easily identifiable.

Note the punctuation in the samples below. Each item is separated by a period "." A comma "'," precedes the pages. A colon ":" separates city of publication and publisher.

<u>Examples of A.P.A. formatting for bibliography entries:</u>

- **Books**
  - Author's last name, Initials. (Year of Publication). Title of Book. City of Publication: Publisher
  - Stewart, V. (2012). <u>A World Class Education</u>. Alexandria: ASCD
- **Journals, Serials, or Magazine Articles**
  - If Author is Named
    - Author's last name, Initials. (Year of Publication). Title of article. *Journal name (or abbreviation). Volume (number)*, page numbers.
    - Taylor, B. (July 17, 2008). How does material science affect light transmission? *Journal of Physics. Volume 82,* 48-61.
  - If No Author is Named
    - Title of Article. (Year of Publication). Journal Name. Volume (number), page numbers.
    - How does material science affect light transmission? (July 17, 2008). *Journal of Physics.* Volume 82, 48-61.
- **Newspaper**
  - Author's last name, Initials. (Year of Publication, month, day). Title of article. *Name of Newspaper*, Page number(s)
  - Heisenberg, W. (1929, June, 18). Where is the electron? The Berkley Times, B2.
- **Personal interview, letter, or telephone conversation**
  - Name. Title or position, Institution, Location. Type of communication, date(s) of interview(s)
  - Einstein, A. Patent Officer. US Patent Office, New York, NY. Pers. Comm., November 18, 1939.

- **Electronic Information**
  - Give the same publishing information that you would give for any material and in addition give the pertinent information about the electronic source (address). For material retrieved from an online source, also provide the date that you accessed information.
  - CD-ROM
    - Author, A. (Date). Title of article. In Title of the database (Type of Medium). Available: Supplier/Database Identifier or Number (Version).
    - Lawrence, J. C. (1996). Algae. In The 1996 Grolier Multimedia Encyclopedia. (CD-ROM). Available: Mindscape, Inc. (Version 8.0.3)
  - Internet sources
    - If Author is Named
      - Author, A. (Date). Title. <address>
      - Smith, M. (Dec. 25, 2000). How to Do Your Science Project. http://www.scifair.com/
    - If No Author is Named
      - Title. (Date). <Address>
      - How to Do Your Science Fair Project. (Dec.25, 2000). <http://www.scifair.com/>

Part XIV: Abstract

The abstract is the last part of the research paper to be written. It is written upon completion of the project. It is a short summary of your work that informs the reader what problem or question was studied and what the findings were.

Four Paragraph Format for an abstract:

- Brief Background and Statement of Purpose
- Experimental Methods or Design
- Summary of Results
- Conclusions and Applications, including ideas for future studies.

Sample abstracts are available on-line to help guide you in the process.

Part XV: Creating a Project Display

The purpose of your project display is to attract attention and provide information. Your display should challenge people to want to know more about your project. Photographs, graphics, and tables, along with the written text should be included. A well thought out and interesting title can also attract attention.

Take pride in the assembly of the board. It should reflect your work as you want it represented. Be neat, concise, but complete in your presentation. It should be a visual aid to show the progression of your work.

Be creative. Use color to attract attention. Before attaching all of your materials, make certain of the order in which you want them to be displayed. Keep background spaces to a minimum, but do not crowd information so that everything seems too packed. Keep it simple so judges can easily assess what you have done.

<u>The following items are part of the board</u>

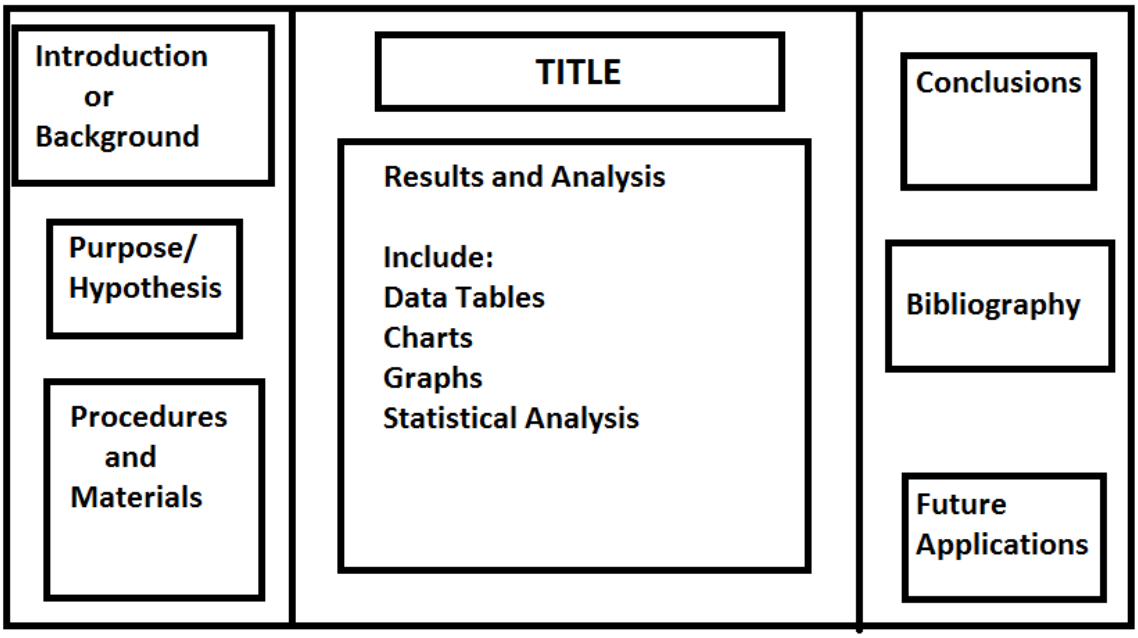
- Title - an attention grabber to make someone want to know more about the project
- Introduction or Background
- Purpose Statement or Hypothesis
- Procedure or Experimental Design
- Materials Used
- Results (Data, charts, diagrams, graphs, photographs of the results, etc.)
- Analysis
- Conclusions
- Bibliography (Optional; your bibliography may be placed in the notebook instead)
- Future Applications or Future Research

<u>Considerations for board design</u>

Your project title and section headings on your board should be large enough to be easily read from six feet away.

- The regular text displayed on your board should be readable from a distance of three feet.
- Although you may be tempted to make your board larger, remember that your board should not be mostly empty space. A smaller size board that is nicely laid out and tells the story is far more attractive than a large one that is not filled.
- Correctly and clearly label graphs, diagrams, and tables.
- Use photographs to validate and help explain parts of the project that would be difficult to explain, or that would require time to explain.
- Acknowledgments should be placed in your log, not on the board.
- Student names should be placed on the back of the board.

Sample Board



The research paper, logbook, and any prototype built for the project must be placed in front of the display board at the STEM fair.

DO NOT INCLUDE PERSONAL IDENTIFIERS ON YOUR BOARD- this includes names, school information or identifiable photographs.

Not Allowed At Booth:

1. Living organisms, including plants
2. Soil, sand, rock and/or waste samples
3. Taxidermy specimens or parts
4. Preserved vertebrate or invertebrate animals
5. Human or animal food
6. Human or animal part or body fluid
7. Plant material (living, dead, or preserved)
8. All chemicals including water
9. All hazardous substances or devices
10. Dry ice or sublimating solids
11. Sharp items
12. Flames or highly flammable material
13. Batteries with open top cells
14. Glass or glass objects
15. Any additional apparatus deemed unsafe by the STEM Committee

Part XVI: Interview

You should be prepared to explain your project to another person- either another student, a parent, a teacher, or a judge. You should be able to answer questions about your experiment including how the topic was selected, the literature review, the formation of the question or problem, the hypothesis, experimental design, results, analysis, conclusions, and future applications.

Below are some key points to a good interview

- Be prepared to effectively summarize your project in a minute or two.
- Think about possible questions that could be asked. Have someone ask you those questions so you can practice answering them efficiently.
- Be confident in your work. Show enthusiasm in what you are doing. The judges or other interested people want to know what you have done and what you have learned.
- Dress appropriately and neatly. Remember, you are representing yourself, your family, and your school at all times.
- Keep eye contact with the person asking you questions.
- Use your board/poster as a prop and tool to help you present you work.
- Have notebooks and reports in clear view and refer to them as you answer questions so that the listener or judge will be cognizant of the amount of time, work, and effort you have invested in your project.
- Learn the judge's name (ask for it if he or she does not have a nametag), and address the judge using his or her name.

STEM Fair Scoring Rubric- Science

Entry Number _____

Project Title _____

STEM Components- List and describe each used in your project

Science _____

Technology _____

Engineering _____

Mathematics _____

I. Research Question (10 pts)

___ clear and focused purpose (4)

___ identifies contribution to field of study (3)

___ testable using scientific methods (3)

II. Design and Methodology (15 pts)

___ well designed plan and data collection methods (8)

___ variables and controls defined, appropriate and complete (7)

III. Execution: Data Collection, Analysis and Interpretation(20 pts)

___ systematic data collection and analysis (5)

___ reproducibility of results (5)

___ appropriate application of mathematical and statistical methods (5)

___ sufficient data collected to support interpretation and conclusions (5)

IV. Creativity (20 pts)

___ project demonstrates significant creativity in one or more of the above criteria

V. Presentation (35 pts)

a. Poster 10 pts)

___ logical organization of material (3)

___ clarity of graphics and legends (3)

___ supporting documentation displayed (4)

b. Interview (25 pts)

___ clear, concise, thoughtful responses to questions (5)

___ understanding of basic science relevant to project (5)

___ understanding interpretation and limitations of results and conclusions (5)

___ degree of independence in conducting project (2)

___ recognition of potential impact in science, society and/or economics (3)

___ quality of ideas for further research (3)

___ for team projects, contributions to and understanding of project by all members (2)

STEM Fair Scoring Rubric- Engineering

Entry Number _____

Project Title _____

STEM Components- List and describe each used in your project

Science _____

Technology _____

Engineering _____

Mathematics _____

I. Research Problem (10 pts)

___ description of a practical need or problem to be solved (4)

___ definition of criteria for proposed solution (3)

___ explanation of constraints (3)

II. Design and Methodology (15 pts)

___ exploration of alternatives to answer need or problem (5)

___ identification of a solution (5)

___ development of a prototype/model (5)

III. Execution: Construction and Testing(20 pts)

___ prototype demonstrates intended design (7)

___ prototype has been tested in multiple conditions/trials (7)

___ prototype demonstrates engineering skill and completeness (6)

IV. Creativity (20 pts)

___ project demonstrates significant creativity in one or more of the above criteria

V. Presentation (35 pts)

a. Poster (10 pts)

___logical organization of material (4)

___clarity of graphics and legends (3)

___ supporting documentation displayed (3)

b. Interview (25 pts)

___ clear, concise, thoughtful responses to questions (5)

___ understanding of basic science relevant to project (5)

___ understanding interpretation and limitations of results and conclusions (5)

___ degree of independence in conducting project (2)

___ recognition of potential impact in science, society and/or economics (3)

___ quality of ideas for further research (3)

___ for team projects, contributions to and understanding of project by all members (2)

Name:_____

Project Title:_____

STEM Fair Research Paper Rubric
(for teacher classroom use only)

_____Cover Page (5 points) Notes:_____

_____Table of Contents (5 points) Notes:_____

_____Abstract (10 points) Notes:_____
-Includes brief introduction, problem statement, procedures, results and conclusion.

_____Introduction (15 points)
Notes:_____
-Explains why project is important, real world-applications, explanations of problem and rationale for hypothesis, includes background research

_____Materials List (5 points)
Notes:_____

_____Procedures (10 points)
Notes:_____
-Written in past tense and easy to understand.

_____Results (15 points)
Notes:_____
-Raw data, charts and tables with labels.

_____Discussion (10 points)
Notes:_____
-Analysis of results

_____Conclusion (15 points)
Notes:_____
-summarize results, prove or disprove hypothesis, evaluate the procedure and suggests future improvements

_____Acknowledgements (5 points)
Notes:_____

_____References (5 points)
Notes:_____

Total Points
Earned:_____

Additional Comments:

Name:_____

Project Title:_____

STEM Fair Display Board Rubric
(for teacher classroom use only)

Content (80 points)

_____Title (5 points)

_____Introduction and Background (5 points)

_____Hypothesis or Purpose Statement (10 points)

_____Procedure and Materials (15 points)

_____Results and Analysis (25 points)

_____Conclusion (10 points)

_____Bibliography (5 points)

_____Future Applications (5 points)

Appearance (20 points)

_____Neatness (10 points)

_____Creativity (10 points)

Total Points
Earned:_____

Additional Comments: