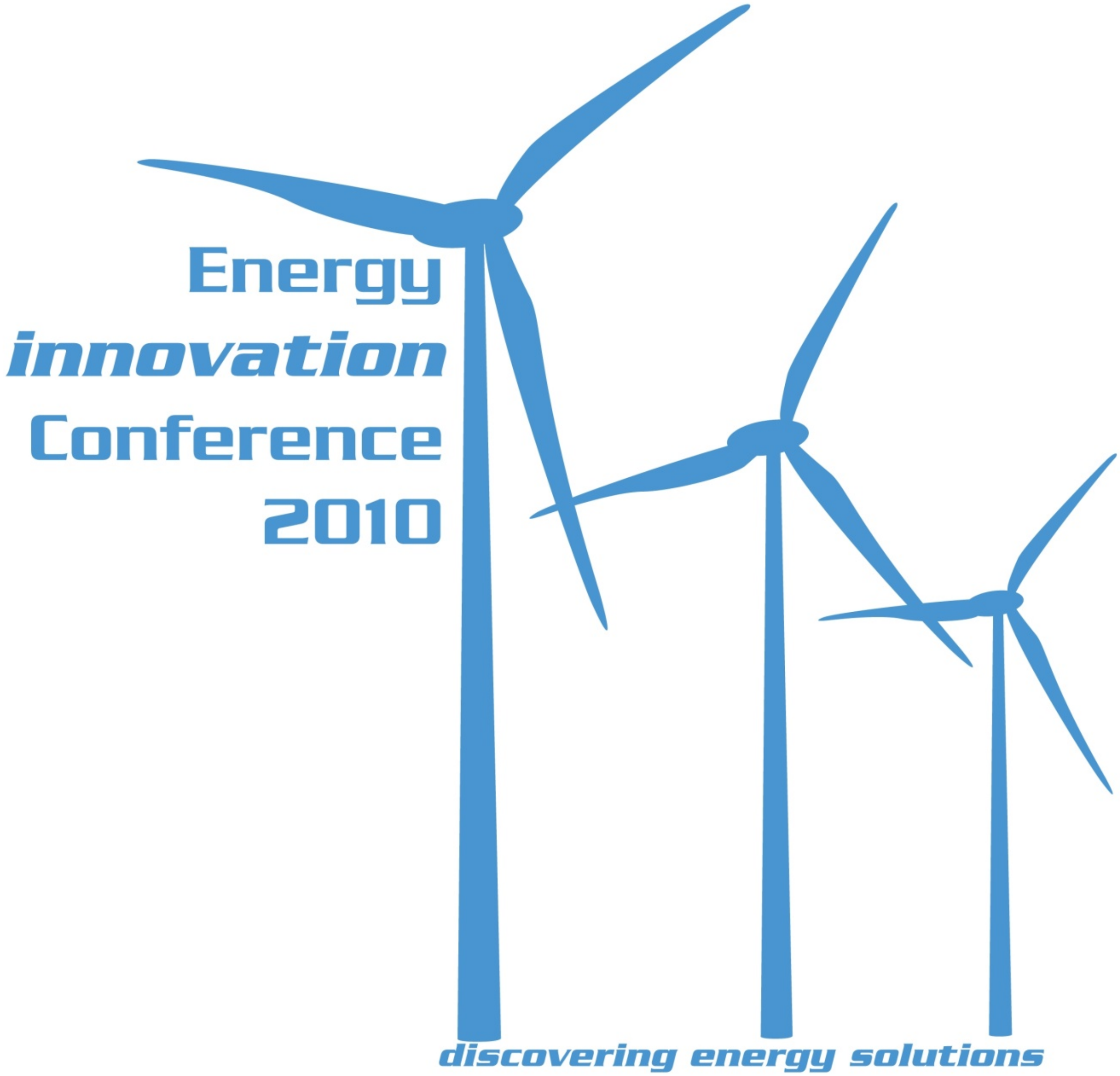
Lake Land College



Energy Fair Guidebook

Adapted with permission from the Guidebook of the Illinois Junior Academy of Science

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Energy Innovation Conference Energy Fair Award List:

	Junior Division	Senior Division
First Place Prize awarded to student	$200.00	$200.00
Second Place Prize awarded to student	$150.00	$150.00
Third Place Prize awarded to student	$100.00	$100.00
Program of First Place Awardee	$500.00	$500.00

Trophies will be awarded for all individual winners in and the schools of first place winners in each division.

Certificates for all entrants and ribbons for 1st, 2nd, and 3rd place winners will be provided for school competitions as needed.

Each winner for 1st, 2nd, and 3rd places in each division may bring two additional persons to the award dinner. Reservations are required. Details will be mailed in early February.

THE ENERGY FAIR PROJECT

Students must design an experiment to investigate a question or problem. A project based solely on library research is not an acceptable project. Demonstrations and models are not acceptable projects.

CATEGORIES

Acceptable categories for Energy Fair project topics are those investigating alternative or renewable energy resources and energy conservation.

CHOOSING A TOPIC

a. **Be creative!** Plan a project that is original in plan or execution. The project should express scientific ideas in new or better ways.

b. **Be scientific**: investigate and explore an interest - a fascination - something that gives you a question you would like to be able to answer. The library is an excellent place to start.

c. The student should consider the research problem in relation to his or her scientific background, financial situation, desire to contribute to science, the time required for the study, and the availability of resources and materials.

d. It is important that each project have a central theme or purpose, that is, to answer a definite scientific question or to solve a problem.

e. The experimentation behind a science project is what is significant. It is not the choice of the topic that is most important, but the way the project is handled. Sometimes the simplest topic offers the greatest challenge to the imaginative and intelligent student.

f. Start planning early in the year.

g. Be realistic about the amount of time needed and available.

USING THE SCIENTIFIC METHOD

1. **FORMULATE YOUR RESEARCH OBJECTIVES**
   Decide what question you want to answer or what problem you want to solve. Be sure to have adequate technical and financial resources available to conduct your research. State your objective clearly in writing.

2. **PERFORM BACKGROUND RESEARCH**
   Before you begin your project, you must become as knowledgeable as you can about your topic and about other research that has been done on that topic. You may use books, scientific literature, the Internet, or interviews with scientists or other knowledgeable people. This research not only helps you get ready to conduct your experiment, but will form the background for the Review of Literature required in your report.

3. **FORMULATE A HYPOTHESIS**
   Based on the background research, write a statement that predicts the outcome of the experiment. Many hypotheses are stated in an “if . . . then” statement where the “if” statement pertains to the independent variable, and the “then” statement pertains to the dependent variable. For example, if plants are grown under various colors of light, then the plants grown under blue and red lights will show the greatest increase in biomass.

4. **DESIGN THE EXPERIMENT**

Decide what data you need to meet your research objective and how you will collect it. Be sure to consider possible hazards in your experimental approach and decide how you can conduct your research safely. Be sure to consult the rules in this manual before finalizing your experimental design.

In order to obtain valid experimental results, consider the following items when designing the experiment:

- Make sure the quantity and quality of data you collect provides a reasonable assurance that your research objectives will be met.
- Identify all <u>significant</u> variables that could affect your results.
- Control any significant variables not manipulated in your experiment to the extent possible.
- Include a control or comparison group in your experimental design.

Be sure to establish deadlines for completing the different phases of your research. These phases might include building equipment, collecting data, analyzing the results, writing the report, constructing your display board. Also, remember to use metric measurements whenever possible.

5. **CONDUCT THE EXPERIMENT**

Follow your experimental design to collect data and make observations. Be sure to keep a journal as you conduct the experiment to record your data, any problems you encounter, how you addressed them, and how these problems might have affected your data. It is imperative that your journal be complete and that you express all activities pertaining to your work. This journal will be used when you write your report.

Keep these points in mind when conducting your experiment:

- If you get results that seem wrong or inconsistent, do not just throw them out. Try to figure out what happened. Maybe the data is correct and your hypothesis is flawed. Explain this in your report.
- Don't get discouraged when you encounter problems. Scientists often have to repeat experiments to get good, reproducible results. Sometimes you can learn more from a failure than you can from a success.

6. **REPORT THE RESULTS**

Your report should provide all the information necessary for someone who is unfamiliar with your project to understand what you were trying to accomplish, how you did it, and whether you succeeded. It should be detailed enough to allow someone else to duplicate your experiment exactly. Be sure to include charts and graphs to summarize your data. The report should not only talk about your successful experimental attempts, but also the problems you encountered and how you solved them. For judging at the Energy Fair, you must also prepare a display board to accompany the written report and be ready to orally discuss your project with judges.

Be sure to consult this policy manual for report guidelines. These guidelines must be followed exactly.

<u>ESTIMATING EXPERIMENTAL ERROR</u>

Science is all about measurement. Understanding data variability and potential error sources is essential to a full understanding of experimental science. It is a scientific truth that no measurement is ever 100 percent accurate. There is always some error.

Experimental error can occur in many ways, with random, systematic and measurement errors being most identifiable. The level of understanding experimental error is proportional to the student's grade and age level. Measurement error is usually easiest for them to understand.

Measurement errors most commonly come from the person(s) doing the measuring, the instrument used, and the environmental conditions at the time of measurement. Students should be aware of why experiments do not or might not have the same results when repeated. A scientist should also understand how measurement error affects conclusions drawn from the data.

See the Appendix for information regarding experimental error.

The **main purpose of experimental error in science fair projects** is that students are not just to draw conclusions on mean and median results. Variability measures should be considered in their conclusions.

Students are encouraged to ask their math or science teacher for the best way to calculate and deal with measurement error for your experiment.

When students discuss the results of their project, they should be able to think of reasons why experiments did not or might not have had the same results when repeated. They should be able to name at least one possible source of error, and be able to describe with some degree of confidence how certain they are about their results.

Students should begin to think of ways to improve the precision and accuracy of their data, identify reasons for too much variability in their data, and note how experimental error can be reduced by collecting more data, taking a better control of the measurement process and better control of the experimental variables.

Here are some questions that you may wish to consider when designing your science fair experiment:

- Will my experimental design generate data that is accurate and precise enough to answer my research question?
- How can I improve the accuracy of my data?
- Is there too much variability in my data?
- Can I reduce my measurement error by:
  a. Collecting more data?
  b. Better control of the measurement process?
  c. Better control of the experimental variables?

SAFETY RULES FOR EXPERIMENTATION

RULES AND REGULATIONS

The student and the sponsor have ultimate responsibility for the safety of the student while doing experiments or otherwise developing a project for the Energy Fair. Because many dangers may not be readily apparent, some guidelines are presented here to aid in developing a safer project.

All project development and experimentation must be conducted only with proper supervision. This is particularly true for chemicals, electricity, radiation sources, and biological cultures many of which are governed by rules and regulations, both State and Federal, that affect both handling and disposal. For the Energy Fair, these instances should be rare.

PROJECT AND EXPOSITION

All exhibits must conform to the following regulations. These same rules should be used, where applicable, at local and district Energy Fairs.

1. Your school must exist within Lake Land College's geographic district.

2. To participate at the Energy Innovation Conference Energy Fair you must be selected for participation.

3. Grades 6, 7 and 8 make up the Junior Division, while grades 9, 10, 11, 12 are in the Senior Division.

4. A typed research paper plus a typed one-page Abstract of the paper must be displayed with your project. The Abstract is the first page of the research paper and serves as the cover sheet. At the Energy Fair, you must have three (3) copies of your complete research paper. Copies of your research paper may be used for special judging and may **NOT** be returned. It is recommended that you retain the original copy of your research paper.

5. A typed Safety Sheet signed by the student and his/her sponsor must be located behind the Abstract in the research paper. Lack of a signed Safety Sheet will result in the project being disqualified. This sheet must specify all hazards and potential hazards in addition to the precautions taken by the experimenter. If no safety hazards exist, a statement to that effect must be made.

6. Projects MAY NOT involve human or non-human vertebrates, or vertebrate tissues.

7. **A copy of the Abstract, Safety Sheet, and Endorsement sheet(s) (if applicable) must be displayed on the front of the exhibitor's display board.**

8. Students are to remain with their projects during the official period of judging.

9. Projects may involve no more than two students.

10. A student may enter only one project.

11. Normal wear and tear on the exhibit is to be expected during the time that the exhibit is open to the public. If valuable equipment is on display, it is your responsibility for its supervision.

12. All equipment, material, and research papers exhibited during the science exposition are entered at the risk of the exhibitor. Neither Lake Land College nor the sponsors assume any responsibility for loss or damage to such equipment, materials, or research papers.

USE AND CARE OF MICROORGANISMS

1. This area of science, may involve many dangers and hazards while experimenting. It is the sole responsibility of all teacher(s)/sponsor(s) to teach students proper safety methods and sterile techniques.

2. The Energy Innovation Conference Energy Fair prohibits the use of primary or secondary cultures taken from humans or other warm-blooded animals in any project because of the danger from unknown viruses or other disease-causing agents that may be present. Pure cultures of microorganisms known to inhabit warm-blooded animals may be obtained from reputable suppliers and used in proper settings.

3. Microorganism experimentation should be conducted in a laboratory setting.
    - A **primary culture** is one taken from a vertebrate animal, living or dead. For example, a culture may NOT be taken from a mouth, throat, skin, hamburger, meat, chicken, or fish.

    - A **secondary culture** is a culture taken from an object that has come in contact with a vertebrate animal. For example, a culture may NOT be taken from eating utensils, door knobs, toilets, countertops, milk, eggs, etc.

5. All cultures should be destroyed by methods such as, autoclaving or with a suitable NaOCl (bleach) solution before disposal.

SAFETY GUIDELINES FOR EXPERIMENTATION

CHEMICAL

1. Students should always wear eye protection and appropriate protective clothing when working with any chemical.

2. The student and the sponsor should seek data from a textbook, *Merck Index*, Material Safety Data Sheet (MSDS) or other responsible source regarding the health hazards, combustibility, and compatibility of the chemical with other chemicals. Before beginning a project review the recommended procedures for safe use and handling of the chemical.

3. All chemicals must be disposed of in accordance with State and Federal Environmental Rules and Regulations.

4. If possible, the student should work under the supervision of a responsible chemist.

5. The Safety Sheet must include a statement as to the proper handling of any chemicals.

6. Students who produce alcohol in connection with and energy fair project must obtain permission from the Bureau of Alcohol, Tobacco, and Firearms. Refer to: natirevctr@cinc.atf.treas.gov or phone 1-800-398-2282.

ELECTRICAL AND MECHANICAL

1. All electrical apparatus that operates with 115-volt current should be constructed in accordance with the National Electrical Code (NEC). If in doubt, contact a competent electrician.

2. Many experiments can be done using a low amperage, 6 or 12-volt electrical source. As these are much safer electrical sources, their use should be considered when doing a project.

3. The Safety Sheet must include a statement as to proper electrical construction.

FIRE AND RADIATION

1. Students should always wear eye protection when working with any open flame.

2. Students using radiation sources (laser, U-V light, X-ray, microwaves, or high intensity radio waves [RF]) should be adequately shielded from such sources. Many experiments using these sources should not be undertaken unless under the direct supervision of an adult familiar with the equipment and hazards involved.

3. No student may work with any radioactive materials unless the work is conducted in a licensed laboratory under the direct supervision of a licensed individual.

4. **The Safety Sheet must include an explanation of protective measures.**

WRITING A SCIENTIFIC RESEARCH PAPER FOR AN ENERGY FAIR PROJECT

Scientists, regardless of their level of achievement, are only as effective as their ability to communicate to others, in spoken or written word, the results of their endeavors. A scientific paper is, very simply, a clearly written, concise report of an experimental research project. **THREE (3) COPIES OF THE PAPER ARE REQUIRED BECAUSE NOT ALL PAPERS COLLECTED CAN BE RETURNED.**

THE PHYSICAL ARRANGEMENT OF THE WRITTEN REPORT

The following section establishes the basic written report requirements. Familiarity with the basic techniques and requirements will help you to read and understand scientific publications, give you an inside view of how scientists think, and help you to write your own scientific paper describing the results of your research experimentation. The main point to keep in mind is to think before you write, then rethink, revise, rewrite, and reread again and again. Make it clear and concise.

The paper must include (in this order):

1. **ABSTRACT -** In preparing your abstract, you must keep in mind that:

   (1) The abstract is a concise summary of your work.

   (2) As the first sheet of your research paper, it will help the reader form an opinion of your work.

   (3) You will find writing and rewriting will help you produce a good short summary of your project in the required form.

   (4) The physical form of the abstract is as follows:
   - Typed single-spaced
   - Limit the abstract to about 200 words or less.
   - Limit the abstract to three (3) paragraphs:
     1. Purpose
     2. Procedure
     3. Conclusion

   (5) Use the Abstract Form in the **Appendix** (only the front side of the form should be used).

2. **SAFETY SHEET -** all safety hazards and precautions must be identified. If no safety hazards exist, a statement to that effect must be made. Use the form found in the **Appendix.**

3. **TITLE PAGE -** your title should be concise and clear.

4. **TABLE OF CONTENTS -** include page numbers.

5. **ACKNOWLEDGMENTS -** should give credit to those who have helped you in your investigations for guidance, materials, and/or use of facilities.

6. **PURPOSE AND HYPOTHESIS -** should state precisely the question you are attempting to investigate. Include your hypothesis or the expected outcome of your test.

7. **REVIEW OF LITERATURE -** is to report to the reader background information and/or work done in the past that pertains to your project. These references should be properly documented and listed in the section "Reference List". Traditional footnotes are not to be used for citing references. The correct citation style to use is discussed in detail in the *Publication Manual of the American Psychological Association*, *Fifth Edition, 2001*, or later.

8. **MATERIALS AND METHODS OF PROCEDURE -** should be a simple chronological account of what was done. The explanation of what was done must be clear and detailed enough so that the reader can duplicate the work. The apparatus and materials used should be listed - explain the workings of any apparatus you constructed or used. Drawings, diagrams that are clearly labeled, and photographs are appropriate if they enhance and clarify your explanation - do not use them as filler.

9. **RESULTS -** should be organized in tables and/or charts with graphic presentations, when applicable. Choosing the appropriate graph is important. The graphs should be presented so that they are easily read by someone not familiar with the work. If quantitative data are not involved, a day-by-day log may be used in place of the tables and charts. In either case, care should be taken to insure accuracy and clarity.

    - A discussion section should follow the data section to include your evaluation and interpretation of the data and/or results of your investigation.

10. **CONCLUSION -** should be a concise evaluation and interpretation of the data and/or results. The conclusion should be limited to the results of the investigation and should refer to the stated purpose and hypothesis**.** Experimental error should be estimated and considered when drawing the conclusion.

11. **REFERENCE LIST -** is a list of published articles, books, and other communications actually cited in the paper. Sources should be current. The Reference List section is arranged alphabetically according to the author/editor's last name when it is known or the first significant word in the title if the author/editor is not known. The correct style to use for citing references in the Reference List section is discussed in detail in the *Publication Manual of the American Psychological Association*, *Fifth Edition 2001*, or later.

TECHNICAL POINTS OF A SCIENTIFIC PAPER

In preparing the paper, the author should be concerned with the following mechanics:

1. The paper must be **typed, doubled spaced** and have at least one-inch margins.

2. Use only one side of the page.

3. The font style and size (for example 10 or 12 pt Times New Roman) must be appropriate for a scientific paper.

4. The paper must be neat and legible.

5. There is no limit on the number of pages permitted in the project session portion of the exposition.

6. Type the last name of the student listed on the first line of the abstract at the top of each page.

7. Tabular information should be kept to a minimum. Each table, chart, or drawing should not be more than one page in length and tabular data should not be duplicated in the text. Headings for tables and columns should be brief. Tables, charts, and drawings should be done on standard 8 1/2 x 11" paper.

8. Graphs should be suitably titled and have both axes correctly labeled. Do not forget to include the correct units of measurement for any numbers.

9. Photographs should be of good quality and contrast, and should have captions typed under them.

DESIRED QUALITIES OF SCIENTIFIC WRITING

The following points should help you to write your paper in an acceptable scientific style:

1. When writing the first draft, do not start until you have clearly thought out your paper; the desired final result should be a clear and understandable paper.

2. The tone of the paper should be established as one of objectivity.

3. Learn to use the technical words that save space or that convey meaning better than common words; by all means avoid the use of vague terms.

4. Sentences should be short and simple.

5. The use of the 1st person "I" or "We" should be avoided whenever possible. Terms such as "The research experiment" or "The exhibitor" are examples of 3rd person usage. Third person is the preferred method for scientific writing.

6. After you have written your first draft, reread, revise, and rewrite it. Put yourself in someone else's mental shoes and read it slowly and thoughtfully. Have you omitted any steps? Are the steps in the proper order? Do your sentences say what you want them to say? If possible, have someone else read it; if not, put it away for a few days, and then reread it yourself. Your paper must be an accurate report of what you have done - check and recheck your calculations, references, spelling, and grammar.

UNDESIRED QUALITIES OF SCIENTIFIC WRITING

Many of the faults in scientific papers can be traced to editing failures - objective reading of the many drafts of your paper will reveal fallacies and other faults that can and should be eliminated from your final draft. Errors to avoid may include:

1. An illogical or unrelated grouping of facts.

2. An unjustified switch in point of view as indicated by a change of subject or voice.

3. The omission of vital facts or steps in procedures, interpretations, or conclusions.

4. The needless repetition of facts.

5. The imprecise use of words, the use of words in a manner peculiar only to the author or a small group, or the use of words only for the sake of the use of words.

6. The inclusion of inaccurate or improper use of paraphrases or references.

7. The exclusion of valuable data that were unfavorable to the conclusion.

8. The drawing of conclusions not supported by the facts and data presented in the paper.

9. Inaccuracy in calculations, spelling, grammar, and quotations.

10. The lack of objectivity.

11. Omitting literature citations in the text of the Review of Literature.

ORAL PRESENTATION—IF REQUESTED BY JUDGES

In presenting your project to the judges at a science exposition, consider the following:

a. **INTRODUCTION**
- State your name(s), age, school.

b. **ACKNOWLEDGMENTS**
- Give credit to those whom you have contacted and to those who have helped you.
- Discuss any work done in the past pertaining to your project.

c. **PURPOSE AND HYPOTHESIS**
- State exactly what the investigation is attempting to discover.
- Make a prediction about the outcome.
- How did you get interested in this project? Give the reason for choosing it.

d. **BACKGROUND INFORMATION**
- Background explanation for your project (to familiarize the judges), scope of your study, etc.

e. **PROCEDURE**
- Proceed in a logical manner, telling what you did step by step.
- Be complete. Do not leave out necessary details.
- Use visual aids: charts, pictures, graphs, etc. Point to your display, but stand aside when you do this.
- Explain how your apparatus was used. If you constructed it yourself, tell the judges you did, if not, give credit to those who helped you. Judges are more interested in your results and conclusions than in the apparatus.
- Discuss ways you avoided experimental error such as use of appropriate instrumentation and measurements, large enough sample size, and/or having controls when possible.
- Discuss statistical aspects of experimental errors such as averages, ranges, and/or other statistical analogies.

f. **RESULTS (DATA AND DISCUSSION)**
- Explain both your controls and your experimental variables.
- Remember to use proper units of measure with your data.
- Point to graphs, charts, etc., when you refer to them.

g. **CONCLUSION**
- State in a concise and logical order the conclusions you can validly draw from the experimentation you have done and the data and/or observation obtained.
- Discuss how you plan to continue your project, if applicable.

h. **ANY QUESTIONS**

- When you have finished, ask the judges if there are any questions they would like to ask.
- When they ask you questions, think before you answer them. Answer slowly! If you don't know the answer say, "I'm not sure but I think..."
- If they ask you a question that is not related to your project and you do not know the answer, then say, "I really haven't been concerned with this in my project, but it might be interesting to look into it."
- Thank the judges for any suggestions they may have for bettering your research.

i. **OTHER SUGGESTIONS**

- Speak slowly!
- Be forward but polite, dynamic, and above all interested in what you are doing.
- Remember that you are a salesperson and therefore your job is to sell your product to the judges. The judges are interested in your work - which is why they are judging you.

DISPLAY RULES

a. **A copy of the Abstract, Safety Sheet(s), and Endorsement sheet (if applicable) must be displayed on the front of the exhibitor's display board.**

b. **Your display must not exceed the dimensions of 76 cm front to back, 122 cm from side to side, and 152 cm from table to top.** This applies to **ALL** parts of your project. **No apparatus may exceed this space. No apparatus may be under, behind, in front of, alongside, or hanging off of the display table. No apparatus that posses a safety risk to viewers may be displayed and may be removed at the discretion of the Energy Fair Committee.**

c. Your display must be designed to sit on a table and be self-supporting.

d. Material used for packing displays may not be kept within the display area, including under the table. It must be taken from the building upon completion of the Energy Innovation Conference.

e. Table drapes or covers are not allowed.

f. Spotlights, floodlights, or decorative lighting must not be used to illuminate your display.

g. Any violation of these regulations will result in a letter to the sponsor with the reason for disqualification or potential disqualification. No project will be disqualified if the safety violation can be corrected on the spot with a minimum of effort.

PLANNING AN ATTRACTIVE DISPLAY

a. The student should construct the display, with the parent, teacher, or sponsor providing guidance, encouragement, and constructive criticism.

b. The title should be brief, captivating, and sufficiently descriptive to identify the project.

c. Lettering should be neat, easily visible, and uncluttered. Check correctness of spelling.

d. Displays should be as neat and presentable as possible.

e. Wall space for posters, tape, tacks, etc., is not available. Construct displays so that wall space is not required.

f. Exhibitors should bring their own tape, thumbtacks, and other supplies.

g. The Abstract, Safety Sheet, and any endorsements must be placed on the front of the display board. They may be reduced to a minimum of a half sheet of standard paper and stacked.

SAFETY RULES FOR DISPLAY

The Energy Fair is the time for communication. You are being judged on your ability to present your research to a scientist. You have completed your experiments. You have collected, analyzed, and interpreted your data. **This is not the time to be doing your experiment.** **This is not the place for a demonstration.** You should leave all lab equipment at home or at school. Pictures, drawings, and diagrams should replace equipment.

BIOLOGICAL DISPLAY HAZARDS

a. **Animals**. No vertebrate or invertebrate animals or animal tissues may be displayed in any exhibit at the Regional or State Expositions.

b. **Hypodermic Needles**. Hypodermic needles and syringes or other sharp objects may not be displayed.

c. **Cultures**. No cultures of any kind may be displayed. Students should rely upon color photos in their displays whenever possible.

CHEMICAL AND GLASSWARE DISPLAY HAZARDS

a. **No** glass object may be displayed unless it is a component of some unique apparatus. The apparatus must be secured, without sharp edges, and away from the table's edge.

b. **Chemicals may not be displayed. Substitute photographs or drawings.**

ELECTRICAL AND MECHANICAL DISPLAY HAZARDS

All projects involving electrical or mechanical apparatus are to be operated only upon judges' request. No lighting may be used to enhance the project display.

a. **Protective Coverings**. All moving parts of machines must have protective coverings. If insulation material is displayed, it must be sealed and securely attached to the student's display board.

b. **Durability**. Material and construction must be durable. All movable parts must be firmly attached.

c. **Electrical**. All electrical apparatus must be constructed according to standard electrical safety laws. If you are in doubt, consult a competent electrician.

d. **Electrical Supply**. All displays that require house current must be designed for operation on Alternating Current at 110-115 volts. If you are in doubt, consult a competent electrician.

e. **Switches**. Doorbell push buttons must not be used to control 110-115 volt apparatus. Use toggle or push button switches designed for the proper load. Switches must be securely mounted to the exhibit. Non-insulated switches, such as knife switches, will not be permitted.

f. **Electric Wiring**. All wiring, switches, and metal parts carrying current must be completely enclosed by barriers that will positively prevent observers from reaching into the exhibit and receiving an electrical shock. Both front and back of display must be enclosed.

g. **Electrical Joints.** All electrical joints must be properly secured and insulated.

h. **Insulators.** Use porcelain and other suitable types of insulators.

i. **Insulated Wire**. Select the proper wire for the voltage to be used. There must not be any exposed or frayed wires. Nails, tacks, and non-insulated staples must not be used for fastening wires.

j. **Sound-making Devices**. When numerous exhibits are on display, the sound reaches annoying levels that are most distracting to the judges and exhibitors. Hence, equipment that emits sound may be operated only when judges request that you do so. Sound equipment that is not essential to the exhibit will not be permitted.

k. **Spark Discharge**. Federal Communications Commission regulations are specific with regards to spark discharge equipment. If equipment containing such devices is used, the machine shall operate so that it does not cause harmful interference to normal channels of communication. Do not operate any equipment until authorized by the judges to do so.

l. **Electric Plugs**. An exhibit requiring electricity must have the three-prong electric plug attached to the end of a three-wire cord on all electrical exhibits except those consisting of lamps or apparatus that was obtained with a UL approved two-prong plug. All student-constructed apparatus must be provided with a three-prong electric plug.

No projects will be allowed unless these electrical requirements are met. These electrical safety rules are absolutely necessary for the prevention of electrical fires and injury from electrical shock. Students will be given the opportunity to request electricity at the state exposition.

FIRE AND RADIATION DISPLAY HAZARDS

a. **Hazardous Materials**. Materials that are explosive, highly flammable, corrosive, or highly poisonous are not to be brought to the exhibit. Displays or demonstrations using rocket fuels, armed rockets, and explosives of any kind are prohibited. Compressed gas cylinders of any type are not permitted. Aerosol cans may not be displayed.

b. **Fire Hazards**. Open flames, torches, burners, electrical heating units or hot plates are not to be displayed or used for demonstration.

c. **Radiation**. Projects dealing with lasers, UV light, X-rays, radioactive materials, or microwaves must present no hazard to the public. UV lights, in particular, must not be displayed towards anyone's eyes and may be used only during judging upon the judges' request.

QUESTIONS AND/OR CLARIFICATIONS

All questions or clarifications regarding these safety regulations will be made to Jeff White (jwhite@lakeland.cc.il.us) in writing a minimum of 2 weeks prior to the Energy Fair. There will be no deviation from those regulations designed for the safety of the fair participants, judges, and visitors. **The decision of the Energy Fair Committee will be final on all requests.**

JUDGING CRITERIA FOR PROJECTS

The following are guidelines for the Energy Innovation Conference Energy Fair judging procedure. **THE DECISION OF THE JUDGES IS FINAL.** There are three levels of each factor being examined during the judging procedure. **Student experimenters should strive to achieve the top line for each criterion.**

SCIENTIFIC METHOD: Overall impression of the project

Knowledge Gained

- The student exhibits a thorough understanding of the topic as demonstrated through presentation and/or correct responses to questions. The student has acquired scientific skills.
- The student is somewhat familiar with topic area but cannot answer all questions effectively. Demonstrates minimal acquired scientific skills.
- The student demonstrates little to no knowledge gained nor scientific skills.

Scientific Approach

- The student has a well defined problem and uses a logical, orderly method for solving the problem. The problem was solved using scientific principles.
- The student has an adequately defined problem OR attempts to follow scientific method, but not both.
- The student has little to no evidence of scientific method used.

Experimental Approach: Independent Variables

- The independent (experimental) variable(s) have been thoroughly defined
- The independent (experimental) variable(s) have not been thoroughly defined.
- The independent (experimental) variable(s) have not been defined.

Experimental Approach: Controlled Variables

- Those significant variables not manipulated have been controlled.
- Not all significant variables have been controlled.
- Few or no significant variables have been controlled.

Experimental Approach: Control/Comparison Group

- The method was appropriate and effective. A control or comparison group was in evidence.
- Method was inappropriate, but an attempt for control or comparison was made.
- Experimentation was not performed, i.e. project was a demonstration or exhibit. No control group present.

Reliability of Data

- The data collected is numerical and metric, if applicable. **Repeated trials provide for adequate data**. The data is reliable.
- Data collected is not numerical and metric when applicable, AND/OR data collected is marginal.
- Little or no data collected.

Estimating Experimental Error

- Measurement error affecting the conclusion has been considered.

- Some measurement error affecting the conclusion has been considered.
- Experimental error has not been considered.

Validity Of Conclusion

- The conclusion is consistent with the data and/or observations. The conclusion is based on the data collected.
- Conclusion is present, but inconsistent with data.
- No conclusion or no valid conclusion present

Originality

- Demonstrates a novel approach and/or idea. It is highly creative.
- Some creativity and/or originality is demonstrated.
- No originality or creativity is demonstrated.

WRITTEN REPORT

ABSTRACT

- The abstract contains a concise summary of the purpose, procedure, and conclusion in 200 words or less.
- One or two parts of the abstract is/are missing or inadequate.
- Abstract is missing or is entirely inadequate.

SAFETY SHEET

- The safety sheet identifies all of the major safety hazards, precautions taken, and any endorsement sheets (if necessary) Safety sheet is present, but not all major hazards have been identified, precautions taken are missing, and any endorsement sheets (if necessary) do not completely describe the safe use of such organisms.
- Safety sheet is not present and or any endorsement sheets (if necessary) are missing.

TITLE PAGE AND TABLE OF CONTENTS

- The title page is clear and concise. The table of contents is complete and includes pagination.
- One or two elements is (are) missing.
- Title page and table of contents are missing.

ACKNOWLEDGEMENTS

- Credit has been given to those who have helped with the project.
- Acknowledgements are missing.

PURPOSE AND HYPOTHESIS

- The problem has been defined and a prediction has been made.
- The problem has been defined OR a prediction has been made, but not both.
- Neither the problem nor a prediction is present.

REVIEW OF LITERATURE

- The Review of Literature is thorough, adequately cited within the review of literature, and pertinent to topic using APA format **(please refer to the guidelines in the appendix).**

- The Review of Literature is inadequate OR citations are inadequate (not sufficient in number or did not follow APA format, fifth edition or later.)
- Little or no use of citations and/or review of literature is irrelevant to topic.

MATERIALS

- All materials are listed and measurements are in metric, if applicable.
- Not all materials are listed or measurements are not in metric, when applicable.
- No materials are listed.

PROCEDURE

- The procedure is complete and easy to follow; all steps have been included. Measurements are in metric, if applicable.
- Procedure is present, but not complete or confusing OR measurements were not in metric if applicable.
- Procedure is missing.

RESULTS

- The results are organized in tables and/or graphs and can be easily read by someone not familiar with the work. Data is quantitative and explanations are given when needed.
- Results are less organized, not quantitative, and difficult to understand.
- Results are not present.

CONCLUSION

- The conclusion reflects a concise evaluation and interpretation of the data and/or results. The conclusion referred to the purpose and hypothesis.
- The conclusion is present, but is inconsistent with data collected and/or does not refer to the purpose and hypothesis.
- No conclusion is present.

REFERENCE LIST

- The quality and quantity of sources is adequate for the topic. The sources listed are cited within the Review of Literature using APA format in the appendix. Sources are current.
- Quality and quantity of sources is less than adequate, or sources not all cited within Review of Literature, or APA format, was not followed.
- No reference list present.

ORAL PRESENTATION

***Judges may ask questions of students during the judging*.**
Presentation Quality

- Clear presentation; concisely summarizes the project. Information is relevant and pertinent.
- Information given is adequate, but presentation is difficult to follow.
- Information jumbles, irrelevant; presentation is unclear.

Dynamics

- The student speaks fluently with good eye contact; is polite, dynamic, and interested in their project.
- The student was polite and interested in their project. Moderate eye contact. Relied heavily on note cards.
- No eye contact. Read from notes. Did not seem interested.

DISPLAY

Information: Experimental

- Gives complete explanation of the project. Display includes graphics, charts, or pictures.
- Adequate information is present, but not thorough.
- Missing pertinent information.

Information: Technical Requirements

- A copy of the Abstract and Safety Sheet are displayed. Endorsement Sheets are displayed, if applicable.
- One of the required forms is missing.
- The required forms have not been displayed.

Artistic Qualities

- Display board is neat, organized, and appealing. No spelling errors are present.
- Display board is neat, but not well organized. Spelling errors are present.
- Display board was carelessly prepared; sloppy.

RATING CRITERIA

When rating the project and paper, the judges should consider the following:

GOLD AWARD

The following criteria may identify an outstanding project.

a. A scientific approach to a specific problem is supported with relevant experimentation.
    1. Approach indicates creativity.
    2. Conclusions logically deduced from experimental data.
    3. Clear concise research paper containing Abstract in required form, Safety Sheet, and Endorsement Sheet, when appropriate.

b. Students can speak knowledgeably on contents of paper and area of investigation.

c. Good quality and quantity of background information is reflected in the Review of the Literature and Reference List.

SILVER or BRONZE AWARD

A lesser degree of the above, e.g., insufficient Reference List, lack of thoroughness in experimental technique or observation, or lack of knowledge of subject area.

PARTICIPATION CERTIFICATE

A serious omission or mistake is present - e.g., no proof of experimentation or no scientific approach is evident. Any model or demonstration will be issued a Participation Certificate. The Judging Chair will supply specific tips and pointers for a given category.

JUDGING INFORMATION FOR THE PROJECT

AN OVERVIEW

Judging is, without a doubt, one of the most important phases of any science exposition. Because of its extreme importance, all judges should carefully review the following:

1. **Expositions are not intended to be contests between students or schools. Each exhibitor is to be judged based on the rating criteria and not in comparison to another exhibitor**.

2. Even though many exhibits show a remarkable degree of scientific knowledge, all judges are asked to keep in mind that all of the exhibitors are middle school or high school students, many of whom are experiencing their first taste of scientific evaluation by a distinguished critic.

3. As a judge, use your own good judgment at all times. Be honest with yourself and the student. Keep in mind that only a small percentage of the students will ever actually go into scientific research; however, many of them will have a great deal to say about the future of science. Certainly, a valuable experience with science at this level might potentially reap valuable rewards later.

4. The opportunity to discuss their project with interested adults acting as judges is a high point for most students. Be aware that most students have spent many months preparing for a judging period, which normally lasts fifteen minutes. Feel free to discuss any aspect of the student's work; they deeply appreciate all questions and comments.

5. In order to participate as a judge, you must be beyond high school age.

JUDGING MECHANICS

1. Be sure to report for final instructions promptly on the day of the judging. Allow yourself enough time to park your car, and to allow for traffic interference so that you will report on time. The Chair will inform you about when and where to report.

2. You will be informed of any last minute changes and/or special requests concerning judging assignments.

3. Each team is to be assigned about six projects or papers to judge. Again, **each exhibitor is to be judged based on the rating criteria and not in comparison to other exhibitors or based on your personal preferences.**

4. The judging sessions are planned that each judging team is allowed fifteen to thirty minutes for each project or paper. This does not mean that you must spend this much time on each project. Times may vary, more or less, depending upon the quality and interest of the project.

5. You may be asked to judge projects in both divisions, Middle School – grades 6, 7 & 8, and High School - grades 9, 10, 11, and 12. If so, remember to judge them based on individual merit, and please keep the maturity of the exhibitor in mind.

6. It is imperative that each judging team finish its judging responsibilities and have its judging results turned into the Chair on time.

7. Students must be with their project at the time of judging. If the student cannot be located within a reasonable period of time, then the project is considered a No Show, and no rating is to be given.

8. Many intangible factors are involved in judging. These can be evaluated only by talking with the student and cannot be estimated merely by looking at the physical aspects of the exhibit. Judges should keep in mind that a spectacular exhibit or one composed of costly equipment is not necessarily the best science project.

9. Be pleasant and interested.

10. Please remember that you are working with tomorrow's scientists; their "decision for science" may rest on the impression you leave on them.

11. **Fill out and return the judge's comment sheet to the student**. Please indicate comments that would help the student improve. Comments might be positive or negative, but should not be sarcastic. Please make sure that your comments are clear and to the point. **Do not indicate the award on this sheet.**

12. Each project judged must have a final score so that the certificate of award can be made. **Be certain that you are using the correct rubric when scoring the project.** Do <u>not</u> show the student the score. Information on specific guidelines and procedures concerning ratings will be supplied and discussed by the Chair.

13. Be sure every project for which you are responsible has been judged. <u>Return the scoring rubric immediately following the judging of each project. DO NOT hold all scoring rubrics until you are finished judging all projects.</u>

14. **Judges must return all materials.**

INFORMATION FOR PARENTS, SPONSORS AND TEACHERS

PARENTS (Sponsors and Teachers)

We know that you are proud of the accomplishments of your son or daughter and that you are anxious to see them succeed in this introductory phase of a possible career or a lifelong interest in science. The parent's role is to support their son or daughter's independent efforts, not to take over the project. Your challenge is to provide just enough assistance to allow your son or daughter's own efforts to take center stage, while offering ideas and resources that might help your child raise their efforts to a higher level.

Keep in mind the following suggestions:

a. Review this guidebook in its entirety and any other materials your son or daughter's science teacher (sponsor) sends home about the requirements of the project. All information is sent to only one sponsor per school.

b. Encourage your child as he or she brainstorms ideas for the project. Do not be too quick to shoot ideas down as impractical or expensive – let them explore ideas first. If you have concerns, form them into questions for your son or daughter to consider. If possible, allow him or her to rule out impractical ideas before you do.

c. Make sure you understand what is required before approving a science project topic. Will it be able to be accomplished with all the other activities that your child is involved in, along with other academic requirements?

d. Support your child in researching their topic and conducting the experiment; assist by supplying transportation (if needed), and access to information and materials. Often excellent learning opportunities will present themselves. You could teach your child to use a piece of equipment or machinery rather than doing it yourself just because it might be easier.

e. Make sure you are familiar with the safety guidelines and see that they are followed.

f. Assist your child in thinking through experimental procedures and how to record and organize their data.

g. Your child might need assistance in preparing their display board and presentation. Your role should be secondary to their efforts – things like reading through and suggesting editorial changes, helping with advanced computer applications, assisting with display board layout, and listening to their presentation.

h. The Energy Innovation Conference attempts to award and recognize as many students as possible. Proper handling of the successes and disappointments of a competition can lead to the continued efforts towards a higher goal.

i. Celebrate the successes and spend a moment looking at what went wrong. Encourage a discussion as to how things might have been done differently. This process is an important part of both learning and science.

j. **IN ALL STAGES OF COMPETITION, THE JUDGE'S DECISION IS FINAL.**

k. A student may be denied participation at the next level of exhibition if the project or paper is found to violate the established rules and regulations published in the most recent copy of the *Energy Fair Guidebook* of the Energy Innovation Conference.

l. Special award judges, who are not agents of the Energy Innovation Conference, may use other criteria for selecting their special awards.

m. In general, show an interest in your son or daughter's progress, offer support and encouragement, help them overcome problems, and praise their good efforts.

n. If in doubt, contact your child's science teacher or sponsor for assistance or encourage your child to do so.

SPONSORS AND TEACHERS

Behind the student is the sponsor, often a teacher of a science subject, but occasionally a dedicated citizen. These volunteers are the unsung heroes of the local, regional, and state expositions. The ways in which they can assist the students are:

a. Instill interest within the students.

b. Register in the fall with the Energy Innovation Conference Energy Fair. Registration deadline is **December 17!**

c. Provide materials that will help the student select the project*:* the Energy Innovation Conference Energy Fair Guidebook, regional mailings, access to the Energy Innovation website (www.energyconf.org).

d. Discuss how to develop a project, and show results of past projects.

e. Participate in a local Science Exposition. This local exposition will give the students experience in the displaying and explaining of their projects and may determine which projects are worthy of Regional competition.

f. Consult The Energy Innovation Conference website (www. energyconf.org) for deadline dates.

g. Arrange periodic small group discussions of progress on projects and provide an opportunity to analyze and solve problems related to individual projects.

h. Offer encouragement and guidance.

i. Solicit the cooperation of other adults for their facilities and services to be used in construction as well as guidance in the research paper writing.

j. Help students with the technicalities involved in preparing the project and paper**. Make sure they are aware of the safety regulations and formats to be followed.**

k. Check the project and paper carefully to be sure the student has complied with all safety regulations and with the regulations for writing the paper and abstract before signing your name to the safety and/or endorsement sheets. **AS A SPONSOR, YOU ARE RESPONSIBLE FOR ALL ASPECTS OF THE STUDENT'S PROJECT.**

l. Consult the website (www.energyconf.org) for entry materials.

THE APPENDIX

OFFICIAL FORMS AND ENDORSEMENTS

STUDENT PROJECT AND SAFETY CHECKLIST

Energy Innovation Conference Energy Fair

Project Checklist

Abstract
________First page of paper.
________3 paragraphs with proper headings: Purpose, Procedure, and Conclusion.
________Typed single-spaced.
________200 words or less.

Safety Sheet
________Second page of paper.
________Hazards listed, precautions described.
________Signed by sponsor.

Endorsement(s), if applicable
________Third page of paper; subsequent pages, as needed.
________Signed by student and sponsor; proper documentation is attached, if necessary.

Title Page
________Clear and concise.

Table of Contents
________Pagination is accurate.

Acknowledgments
________Credit is given to those who have helped.

Purpose and Hypothesis
________States precisely what the investigation was attempting to discover.
________States a definite question or problem.
________Hypothesis is present.

Review of the Literature
________Use of 3rd person is evident.
________Logical and/or related grouping of information.
________Accuracy in calculations, spelling, grammar, and quotations.
________Typed double-spaced, one inch margins, single-sided.
________Parenthetically cited.

Materials and Methods of Procedure
________Apparatus and materials are listed.
________Drawings and photographs are present if they enhance and clarify the apparatus.
________Step-by-step, chronological procedures are present.
________Number of test groups is adequate and the number of trials within each test group is adequate.
________The control of variables is evident.

Results
________Data is organized into tables or charts with accompanying graphs, if appropriate.
________Data is quantitative and correct units of measurement (metric) are used.
________Data is clear and accurate.
________The effect of experimental error was estimated and considered.

Conclusions
________Evaluation and interpretation of data is present.
________Refers back to purpose and hypothesis; answers the original question.
________Is valid and limited to the results of the experiment.

Reference List
________References come from a variety of sources.
________References are current.
________Reference list is alphabetical.
________Proper format is used for all references.

Exhibition Safety
________Project fits on tabletop within 76 X 122 cm limitations allowed; is no taller than 152 cm (5 ft).
________No glass object may be displayed unless it is a component of some unique apparatus. The apparatus must be secured, without sharp edges, and away from the table's edge.
________Chemicals are not displayed. Photographs should be substituted.
________Hazardous materials: explosive, flammable, corrosive, or poisonous materials, rockets, compressed or aerosol cans are not displayed.
________Fire hazards: no open flames, torches, burners, or electric hotplates are displayed.
________ Radiation: no laser, UV-light, X-rays, or other radioactive materials are displayed.
________Packing materials are not on or under the table.
________No table drapes or other coverings are present.
________No hypodermic needles or syringes are displayed.
________No cultures of any kind are displayed.
________Electrical and/or mechanical equipment is (are) shielded, durable, enclosed, insulated, and quiet.

Miscellaneous
________Three copies of the complete research paper for Project Session participants.
________Display board - Reminder: no chairs or table covers are allowed.
________Entry Tag Ribbon
________A copy of the Abstract, Safety Sheet, and Endorsements (if applicable) are displayed on the front of the display board.
________Electrical extension cord, if needed for your project. The project has already been designated as needing electricity.
________Friday night banquet tickets - see sponsor for information.

Format for Reference List

The correct style to use for citing references in the Reference List section is discussed in the appendix, based on the Publication ***Manual of the American Psychological Association, Fifth Edition, 2001,*** **or later** (APA style). Be careful to follow the punctuation, indentation, and format shown below.

- **The Reference List must be double-spaced.**
- **Note: If using the actual *APA Publication Manual,* all <u>example references</u> are single-spaced to save space in the *Publication Manual*.**
- **The Reference List should be alphabetized according to the first letter of each entry.**
- **Entries should be formatted using a hanging indent. Entries should begin flush left and the second and all subsequent lines should be indented.**
- **Italics are preferred over the use of underlining.**
- **The abbreviation for Page(s), p. or pp., is not used except in references to newspapers.**
- **Electronic source references must provide the date the information was retrieved, and also the name and/or address of the source.**

<u>BOOKS</u>

Format: The author's last name is listed first. The author's name is followed by the date of publication, in parentheses, ending with a period. Next include the book title which is in italics. Capitalize only the first word of the title (and the first word of the subtitle, if any) and any proper names. Close with a final period. End with publication information. Identify the city and, if the city is not well known or could be confused with another city, include the state where the publisher is located. Place a colon (:) after the city name. Then identify the name of the publisher, clearly and briefly. Spell out the names of associations and university presses, but omit superfluous terms such as "Publishers," "Co.," or "Inc." If two or more locations are given, give the location listed first or the publisher's home office. Close with a period.

Book - One author:

Arnheim, R. (2001). *Art and visual perception*. Berkeley, CA: University of California Press.

Book - Multiple authors:
When a work has between two and six authors, cite all authors. When a work has more than six authors cite the first six authors followed by "et al." to indicate the remaining authors.

Festinger, L., Riecken, H., & Schachter, S. (2003). *When prophecy fails*. Minneapolis: University of Minnesota Press.

West, S., Sandler, I., Tein, J., Ivy, P., Patterson, H., Roeder, K., et al. (2001). *Nerve cells and insect behavior*.

Cambridge, MA: Harvard University Press.

Book - Corporate author:

Institute of Financial Education. (2001). *Managing personal funds*. Chicago: Midwestern Publishing.

Book - Edited volume:

Maher, B. A. (Ed.). (2003). *Progress in experimental personality research*. New York: Academic Press.

Letheridge, S., & Cannon, C.R. (Eds.). (2001). *Bilingual education: Teaching English as a second language*. New

York: Praeger.

Book - No author:

Experimental psychology. (2004). New York: Holt.

Book - Work in an anthology:

Rubenstein, J. P. (2003). *The effect of television violence on small children.* In B.F. Kane (Ed.), *Television and Juvenile Psychological Development* (pp. 112-134). New York: American Psychological Society.

JOURNALS-MAGAZINES-NEWSPAPERS

Articles in journals or magazines with continuous pagination:

Passons, W. (2001). Predictive validities of the ACT, SAT, and high school grades for first semester GPA and freshman courses. *Educational and Psychological Measurement, 27*, 1143-1144.

Posner, M.I. (2000, October 29). Seeing the mind. *Science, 262*, 673-674.

Articles in journals or magazines with non-continuous pagination:
Because pagination begins anew with each issue of the journal, it is necessary to include the issue number in italics followed by the volume number in parentheses, if applicable. Note that there is a comma between the issue number and the page numbers, but no comma between the italicized volume number and the issue number.

Sawyer, J. (2003). Measurement and prediction, clinical and statistical. *Psychological Bulletin*, *66*(3), 178-200.

Mellers, B. A. (2005). Choice and consequences. *Psychological Bulletin, 126,* 1040-1049.

Daily Newspaper article:

Schwartz, J. (2005, September 17). Urbana firm obstacle to office project. *The Champaign-Urbana News-Gazette*, pp. A1, A4, A9-11.

Daily Newspaper article (no author):

President Clinton puts 'human face' on health-care plan. (2002, September 6). *The New York Times*, p. B14.

Articles in weekly periodicals:

Kauffmann, S. (2005, October 18). On films: class consciousness. *The New Republic*, p.30.

Articles in monthly periodicals:

Chandler-Crisp, S. (2003, May). Aerobic writing: A writing practice model. *Writing Lab Newspaper*, pp. 9-11.

OTHER SOURCES

Encyclopedia:

Photosynthesis and plants. (2004). *Encyclopedia Americana* (Vol. 22, p. 453). New York: Americana Corporation.

Entry in an Encyclopedia:

Wagner, D.H. (2002). Relativity. In *The new encyclopedia Britannica* (Vol. 26, pp. 501-508). Chicago: Encyclopedia Britannica.

Encyclopedia article, CD-ROM:
Basic form

Author/editor (if given). (Date). Title of material accessed. In *Source*. Retrieved Publication medium, *edition or version (if relevant)*. Location: Name of Producer.

Example with author

Daniel, R. T. (2003). The history of Western music. In *Britannica Online: Macropaedia.* Retrieved CD-ROM. Carlsbad, CA: Compton's NewMedia, Inc.

Example without author

Genetic engineering. (2001). In *Compton's Interactive encyclopedia* , *Version 2.0*. Retrieved CD-ROM. Carlsbad, CA: Compton's NewMedia, Inc.

Film or videotape:

Weir, P.B. (Producer), & Harrison, B.F. (Director). (2003). *Levels of consciousness* [Videotape]. (Available from the American Psychological Association, 750 Second Street, Boston, MA 73002-4224).

Interviews – Published:

Archer, N. (2004). [Interview with Helen Burns, author of *Sense and Perception*]. *Journal of Sensory Studies*, *21*, pp. 211-216.

Interviews- Unpublished:

Unpublished interviews do not need a reference page entry because they are what the Publication Manual of the APA calls "personal communications" and so "do not provide recoverable data."

Davis, N. (2003, October 11). Personal interview.

Recording:

Shocked, M. (1992). Over the waterfall. On *Arkansas traveler* [CD]. New York: PolyGram Music.

ELECTRONIC SOURCES

Electronic formats can be found at: http://www.apa.org/science/pubs.html

World Wide Web, Home page/Secondary page: Basic form

Author/editor (if known). (Revision or copyright date, if available). Title of page. Publication, Page number(s). Retrieved Date, from Protocol: Site/Path/File

Example

Goizueta, R. C. Annual report to share owners. Coca-Cola Newsletter, 1- 23. Retrieved October 13, 2005, from http://www.cocacola.com/co/chairman.html

Periodical – Electronic: Basic form

Author, A. A., Author, B. B., & Author, C. C. (2000). Title of article. *Title of Periodical, xx,* xxxxxx. Retrieved month day, year, from source.

Journal article - Electronic: Basic form

Author. (Date). Title. *Journal Title*, *volume,* paging. Retrieved Date, from URL

Example

Koehn, D. (2001). The ethics of handwriting analysis in pre-employment screening. *Journal of Applied Psychology, 78,* 443-449. Retrieved October 9, 2001, from PsycARTICLES database.

Magazine article – Electronic: Basic form

Author. (Date). Title. *Magazine Title, volume* (if given), paging. Retrieved Date, from URL Protocol: Site/Path/File

Example

Rosner, H. (2003, March 4). Will e-mail become j-mail? *Brandweek 37*, 30. Retrieved from ABI/INFORM. telnet://melvyl.ucop.edu

Daily Newspaper article – Electronic: Basic form

Author. (Date). Title. *Newspaper Title* . Retrieved Date, from URL Protocol: Site/Path/File

Example

Markoff, J. (2005, June 5). Voluntary rules proposed to help insure privacy for Internet users. *New York Times.* Retrieved November 21, 2006 from http://www.nytimes.com/library/cyber/week/y05dat.html

Newsgroup article – Electronic: Basic form

If the author's name is available list it last name first. If only a screen name is available, use the screen name. Provide the exact date of posting. Follow the date with the subject line of the message. Do not italicize it. Provide any identifier for the message in brackets after the title. Finish the reference with *Message posted to* followed by the address of the newsgroup. Note that the protocol is *news.*

Author (if given). (Date). Subject line of message. Message posted to news:// Protocol:Topic.Subtopic(s)

Example

Chalmers, D. (2000, November 11). Seeing with sound [Msg 1]. Message posted to news://sci.psychology.consciousness

Personal communication - Electronic: Basic form

Communicator (personal communication, Date)

Example

Omar, B. W. (personal communication, June 5, 2005)

APA RESOURCE WEBSITES

These materials will introduce you to APA documentation, step-by-step instructions, Format, Citations, and Reference Lists. However, it is suggested you reference the ***Publication Manual of the American Psychological Association, Fifth Edition, 2001,* or later,** whenever possible.

http://www.wisc.edu/writing/Handbook/DocAPA.html

http://www.apastyle.org/elecsource.html

http://www.apa.org/science/pubs.html

http://www.stylewizard.com

http://www.noodletools.com

http://www.easybib.com

http://www.rapidcite.com

http://www.citationmachine.net

http://www.english.uiuc.edu/CWS/wWORKSHOP/writer_resources/citation_styles/apa/apa.htm#internet

FORMAT FOR PARENTHETICAL CITATION WITHIN THE TEXT OF THE REVIEW OF LITERATURE

NOTE: ALL REFERENCES CITED WITHIN THE TEXT MUST APPEAR IN THE REFERENCE LIST, AND ALL ENTRIES IN THE REFERENCE LIST MUST BE CITED IN THE TEXT.

DIRECT QUOTATIONS OF SOURCES

- Quotations of less than 40 words should be incorporated in the text and enclosed with double quotation marks. Using the "author-date method" of citation, the quotation is followed with a reference to the author, the publication year, and the page number. These elements must be enclosed in parentheses, together or separately. A complete reference must appear in the reference list at the end of your paper**.**

    He stated, "The 'placebo effect,'...disappeared when behaviors were studied in this manner" (Smith, 2001 , p.276), but he did not clarify which behaviors were studied.

    Smith (2001) found that "the 'placebo effect,' which had been verified in previous studies, disappeared when [his own and others'] behaviors were studied in this manner" (p. 276).

- If quoting from an Internet source or CD-ROM, use the same format as for other quotations, but use [Online] or [CD-ROM] in place of a page number reference**.**

    He stated, "The 'placebo effect,'...disappeared when behaviors were studied in this manner" (Smith, 2001, [Online]), but he did not clarify which behaviors were studied.

- When making a quotation of more than 40 words, use a free-standing "block quotation" on a new line; indent five to seven spaces and omit quotation marks.

    Smith (2001) found the following:

    > The "placebo effect," which had been verified in previous studies, disappeared when behaviors were studied in this manner. Furthermore, the behaviors ,*were never exhibited*[italics added], even when real [sic] drugs were administered. Earlier studies were clearly premature in attributing the results to a placebo effect (p. 276).

REFERENCE CITATIONS IN THE TEXT

- Whenever **using your own words** to refer indirectly to another author's work (**paraphrasing**), you must identify the original source. The "author-date method" of citation is used for this purpose, but without quotations marks. A complete reference must appear in the reference list at the end of your paper.

EXAMPLES

One Work by a Single Author:
The surname of the author and the year of publication are inserted in the text at the appropriate point. If this information appears as part of the narrative, it need not be cited again:

Smith (2001) compared reaction times...

Within a paragraph, you need not include the year in subsequent references to a study as long as the study cannot be confused with other studies in the article:

Smith (2001) compared reaction times....Smith also found.

One Work by Two Authors:

When a work has two authors, cite both names every time the reference occurs in the text:

-as James and Ryerson (2002) demonstrated...

-as has been shown (James and Ryerson, 2002)...

One Work by Two to Six Authors:

When a work has more than two and fewer than six authors, cite all authors the first time; in subsequent *citations include only the surname of the first author followed by "et al." and the year:*

Williams, Jones, Smith, Bradner, and Torrington (2004) found...

Williams et al. (2004) found... (subsequent citations)

Corporate Author:

When the reference is to a work by a corporate author, use the name of the organization as the author.

Retired officers retain access to all of the university's education and recreational facilities (Columbia University, 2002). They have been...

Unknown or Unspecified Author:

If the author is unknown or unspecified, use the first few words of the reference list entry (usually the title).

Misbehaviors were found to reduce to three factors; incompetence, offensiveness, and indolence (The Study Finds, 2003). In the....

ILLINOIS STATE GOALS AND STANDARDS

As a result of participation in Lake Land College's Energy Innovation Conference Energy Fair, students fulfill several of the *Illinois State Goals and Learning Standards*. These include:

- **State Goal 3 (English/Language Arts):** To write to communicate for a variety of purposes.
- **State Goal 4 (English/Language Arts):** To listen and speak effectively in a variety of situations
- **State Goal 5 (English/Language Arts):** To use the language arts to acquire, assess and communicate information.
- **State Goal 7 (Mathematics):** Estimate, make and use measurements of objects, quantities and relationships and determine acceptable levels of accuracy.
- **State Goal 8 (Mathematics):** To use algebraic and analytical methods to identify and describe patterns and relationships in data, solve problems and predict results.
- **State Goal 10 (Mathematics):** To collect, organize and analyze data using statistical methods; predict results; and interpret uncertainty using concepts of probability.
- **State Goal 11 (Science):** To understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.
- **State Goal 12 (Science):** To understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.
- **State Goal 13 (Science):** To understand the relationships among science, technology and society in historical and contemporary contexts.

EXPERIMENTAL ERROR

One of the expectations researchers and judges have for science experiments is quantifiable results. There are two types of variable data that students may be working with: Quantitative and Qualitative data.

Qualitative data refers to data that is categorical as in surveys where we are asking questions that result in a yes or no answer or other questions that result in categorical responses, such as whether you are a girl or a boy, your grade in school, or your favorite color. When dealing with qualitative data we are looking for the incidence or likelihood of a particular response.. We can still quantify the counts that were collected by turning them into sample proportions or percentages.

A ***sample proportion*** is the number of times a single response we are describing is obtained divided by the total number of trials.

For example, if we had surveyed 50 students and 20 of them were girls, the sample proportion of girls to the sample is 0.40 (20/50) and multiplying this value by 100, becomes 40 percent (40%).

Quantitative data is data that you collect that is numeric in nature as how high a ball bounces in centimeters, the growth of your plants each week under varying conditions in centimeters, the distance a ball can be thrown under varying conditions in meters. REMEMBER THAT YOUR DATA MUST BE MEASURED IN METRIC UNITS. When the variable(s) involved in an experiment is numeric, the statistic most commonly reported by students to describe the results of repeated trials is the mean or median. However, when dealing with repeated measurements or trials there are three related statistical quantities that can help describe the variability and experimental error. These are the mean, standard deviation and standard error of the mean.

The *mean* is the sum of all the recorded measures of your experiment divided by the number of trials. Unfortunately many students only report the mean result for each variable in their experiment and ignore the amount of variability that could exist between the various trials conducted on the same experiment. That is why we also need to find the standard deviation and standard error of the mean.

Standard deviation can be described as a measure of spread or variation in your sample trials. Statistics tells us we can be about 70 percent (70%) certain that if we repeat the same measurement one more time, the numeric value of the next measurement will be less than one standard deviation away from the sample mean. Statistics also tells us that we can be around 95 percent (95%) certain that if we repeat the same measurement one more time, the value of the next measurement will be less than two standard deviations away from the mean.

We can think of standard deviation as a measure that is a partner to the mean value of your sample trials. It helps us to describe the error or variability attached to your trial mean. The standard deviation formula used by older students is:

Formula for Standard Deviation: $$s = \sqrt{\frac{\Sigma(X - \overline{X})^2}{(n-1)}}$$ Where n is the number of trials

The standard deviation is a statistical measure that can also be computed on any scientific calculator or statistical software package or Excel.

Students in middle school may not have the expertise to calculate the standard deviation using this formula. Alternatively, a close approximation for the standard deviation can be calculated by finding the range of your trial measures and then dividing that range by 4. (Recall that the range is the difference between the high and low trial measures.) Your judges should accept this approximation to the standard deviation.

The more trials you perform with your experiment, the smaller the experimental error will be. Another statistical measure that takes the sample size into account when interpreting your experimental error is the standard error of the mean. This measure not only depends on the standard deviation but also on the number of trials run on the experiment as well.

The ***standard error of the mean***, SEM, is an estimate used to describe the variation that can occur in the means of your trials when your experiment is repeated again with the same number of trials. It has a similar interpretation to the mean and standard deviation but the SEM relates to the variation we can expect in the experimental means when repeating the experiment with the same number of trials. We can be about 70 percent certain that if you or someone else repeats your entire experiment again with the same number of trials, the MEAN from the new experiment will be less than one standard error of the mean away from the mean value of your experiment. We are also about 95 percent certain the new mean will be less than two standard errors of the mean away from the mean value of your experiment. The standard error of the mean will decrease as the number of trials to your experiment increases.

The **formula for the standard error of the mean is**: **SEM =S divided by the square root of n where n is the number of trials used in the experiment.**

Suppose we are trying to determine whether two metal rods expand by different amounts when heated. We can design the experiment to measure the expansion of these rods. Suppose we take three measurements and calculate the average expansion for each rod. The data below is in millimeters. Here the sample size n equals 3 (referring to 3 trials).

Rod Expansion in mm

	Trial 1	**Trial 2**	**Trial 3**
Metal Rod #1	**558**	**543**	**567**
Metal Rod #2	**549**	**542**	**550**

Computing the means you will find the mean expansion of Metal Rod #1 is 556 mm and that of Metal Rod #2 is 547 mm. Some of you may be apt to jump to the conclusion that Rod #1 has a higher expansion rate than Rod #2 since its mean is 9 mm higher, BUT this is not a valid conclusion because no measure of variability was attached to the trial measures and means.

Let us start by finding the range of the expansion measures for each rod. In the above example, the range of expansion measures for Rod #1 is 24 mm and for Rod #2, it is 8 mm. Taking the range of each rod's measures and dividing by 4, gives us an approximation for the standard deviation. We can now develop the following results:

Metal Rod #1

Range = 567 – 543 = 24
Approximate Standard Deviation = 24/4 = 6

We can use these results to describe the variability that we can expect in the expansion measures from trial to trial. We are around 70 percent sure that the expansion measures for Rod #1 could deviate anywhere from the mean +/- 6 mm and we are around 95 percent sure that the expansion measures could deviate from the mean +/- 12 mm.

This means around 70 percent of the expansion measures for Rod #1 should fall between 550 and 562 millimeters, and with 95 percent certainty the expansion measures for Rod #1 should fall between 544 and 568 millimeters.

Metal Rod #2

Range = 550 – 542 = 8
Approximate Standard Deviation = 8/4 = 2

Here we can expect 70 percent expansion measures for Rod #2 to deviate anywhere from the mean +/- 2 mm, and we are about 95 percent certain that the expansion rates could deviate from the mean +/- 4 mm.

This means we have a 70 percent chance that the expansion measures of Rod #2 will fall between 545 and 549 mm and a 95 percent chance that the expansion measures of Rod #2 will fall between 543 to 551 millimeters.

We can then compare the means of the expansion measures between the two rods and be at least 95 percent certain that there is indeed a significant difference between the two mean measures using confidence intervals. We can compute the 95 percent confidence intervals describing the expected mean variability by adding and subtracting twice the approximate value of the standard error of the mean (SEM) from the mean of each rod type. If the intervals computed for the two rods overlap, there is no significant difference between the two mean measures. However, if the intervals do not overlap, there is a significant difference and in this example, we could then conclude that Rod #1 indeed has a greater expansion value than Rod #2.

The sample size used in this example consists of three trial measures. In order to compare the mean results from other experimenters who might be performing this same experiment also with three trials, we need to compute the standard error of the mean. The standard error of the mean takes the number of trials into account. For Rod #1 with a mean expansion of 556 mm, the SEM = 6 / $\sqrt{3}$ or 3.5 mm. The 95 percent confidence interval is formed by multiplying the SEM value by 2 and adding or subtracting it from the mean expansion value. Hence with 95 percent certainty we expect the **mean** expansion values obtained for Rod #1 when performing the same experiment with three trials again and again to lie between 556 +/- 2 (3.5) mm, or between 549 and 563 mm.

For Rod #2 with a mean of 547 mm, we calculate the SEM based on a sample of three trials to be 2 / $\sqrt{3}$ or 1.2 and its 95 percent **mean** expansion zone to be 547 mm +/- 2(1.2) mm or between 544.6 and 549.9 mm.

The 95 percent confidence intervals for the **mean expansion values** expected from experiments of the same nature conducted with 3 trials produce the following results:

549 mm   563 mm
Rod #1   (---)

544.6 mm   549.4 mm
Rod #2   (----------------------------------)

The above intervals show the mean expansion measures for Rod #1 could range from 549 to 563 mm with 95 percent certainty and Rod #2's mean expansion measures could range from 544.6 to 549.4 mm Hence what looked to be a significant difference earlier in the mean expansion measures between the two Rods by just comparing the means turns out not to be true. Taking into account the variability we can expect in other experimental runs when repeating this experiment with three trials, shows that the difference in means between the two rods is not significant. Again the reason for no significant or reportable difference is that there is a slight overlap in the 95 percent mean interval estimates.

If the 95 percent confidence intervals for the means had no overlap as charted below, there would have been a significant difference. We could then have concluded that the mean expansion values of the two rods is significantly different with 95 percent certainty.

Rod #1   (--)

Rod #2   (-----------------------------)

In the above experiment if we assume the standard deviations of the two rod types stay at 6 mm and 2 mm respectively, increasing the number of trials from 3 to 5 would reduce the SEM's for Rod #1 to 6/$\sqrt{5}$ or 2.7 mm (before it was 3.5 mm) and the new SEM for Rod #2 becomes 2/$\sqrt{5}$ or 0.9 mm (before it was 1.2 mm). Taking ten repeat trials would further yet reduce the SEM's still more (1.9 mm and 0.6 mm). By increasing the number of trials in an experiment we will also reduce the width of the 95 percent confidence interval. This also reduces the experimental error associated with your experiment. Hence, the more trials you conduct when performing your experiment, the better.

Of course, the number of trials conducted does depend on the amount of time and funds you have available. But instructors and judges usually realize that students between 6th and 12th grade do not have the resources of large laboratories and as a result, allow students to draw conclusions based on experiments with smaller numbers of trials. However, every student should try to conduct the most trials as they can within their own limitations.

NOTE: many middle school and senior high students are capable of computing the standard deviation from the statistical formula denoted earlier. The above procedure using the Range divided by 4 as an approximation to the standard deviation was just shown to simplify reading of this section for all energy exhibitors especially those in junior high.

We can also compute a standard error measure to describe the variability among qualitative measures as the sample proportion. The standard error of proportion, commonly known as SEP, can be used to describe how someone else's reported experimental proportion could deviate from your experimental proportion when repeating your experiment under the same conditions with the same sample size. It is interpreted the same way as the standard error of the mean.

The formula for the standard error of proportion, SEP, is: **SEP = Square root of the fraction (p) (1 – P) / n**

In the formula above, p refers to the sample proportion. Again, as the sample size n increases, the SEP decreases.

Describing experimental error using the above concepts is often difficult for many students. Students are advised to work within their own limitations. The important issue is that all experiments should have quantifiable results and be conducted with as many repeat trials as possible.

CORRECT SI METRIC SYSTEM USAGE

SI is the symbol for the Systĕme International d'Unites, the modernized version of the metric system that the USA and other nations have agreed to use. (Do not abbreviate it as S.I.)

This list is provided to point out the correct way to use the metric system and to show many of the incorrect examples of its usage that may be given on package labels and in other printed matter. These correct ways to use SI are set by the international standards that define SI.

General Guidelines:

1. The short forms for SI units (such as mm for millimeters) are called **symbols**, *not* abbreviations.

2. SI symbols *never end with a period* unless they are the last word in a sentence.
   - **RIGHT:** 20 mm, 10 kg
   - **WRONG:** 20 mm., 10kg.

3. SI symbols should be preceded by digits *and a space must separate the digits from the symbol.*
   - **RIGHT:** It was 300 mm wide. The millimeter width was given.
   - **WRONG:** It was 300mm wide. The mm width was given.

4. Symbols *always are written in the singular* form (even when more than one is meant).
   - **RIGHT:** 1 mm, 500 mm, 1 kg, 36 kg
   - **WRONG:** 500 mms, 36 kgs
   - **BUT:** It is correct to pluralize written-out metric unit names: 25 kilograms, 250 millimeters

5. The symbol for a compound unit that is *a quotient of two units is indicated by a solidus* or by a negative exponent.
   - **RIGHT:** km/hg\ or km·h[1]
   - **WRONG:** kmph or kph (do not use p as a symbol for "per")
   - **BUT:** It is correct to say or write "kilometers per hour."

EXAMPLES OF CORRECT AND INCORRECT USAGE		
▼ For	▼ Correct	▼ Incorrect Usage
kilometer	km	Km. km.. KM. kms. K. k
meter	m	M, m.
millimeter	mm	Mm, mm., MM
liter	L or l	L., l.
milliliter	mL or ml	ML, Ml, mL., ml., mls
kilogram	kg	KG, KG., Kg, Kg., kgr,
gram	g	G, G., g., gr, GR, GRM,
microgram	µg	mcg
hour	h	hr, hrs, HR, h., HR., HRS.
second	s	sec, S, SEC, sec., s., S.
cubic centimeter	cm^3	cc
kilometer per	km/h	KPH, kph, kmph, km/hr
kilohertz	kHz	KHz, KHZ, Khz
megahertz	MHz	MHZ, Mhz
hectopascal	hPa	HPa, HPA, Hpa, mb
kilopascal	kPa	KPa, KPA, Kpa
degree Celsius	°C	C, deg CS
kelvin	K	°K, deg K

6. The meaning of an SI symbol can be changed when substituting a capital letter for a lower case letter.
   - **RIGHT:** mm (for millimeter, which means 1/1000 of a meter)
   - **WRONG:** MM or Mm (M is the prefix for mega, which means one million; a megameter is a million meters)

   Note: A 5K race would be a five Kelvin race, while a 5k race would be a five kilo race, neither of which would be accurate. Kilometer should be pronounced KILL-oh-meet-ur, not kill-AHM-it-ur.

   The information above was adapted from the U.S. Metric Association Website, http://www.metric.org
   Students are encouraged to visit the website for more information.

ABSTRACT

The Energy Innovation Conference Energy Fair

CATEGORY ________________________________ SCHOOL ADDRESS ________________
SCHOOL __________________________________ COUNTY ________________________
CITY/ZIP _________________________________ SCHOOL PHONE ___________________
SPONSOR _________________________________ EMAIL __________________________

NAME OF EXHIBITOR* _____________________ GRADE ___________

NAME OF EXHIBITOR _____________________ GRADE ___________

PROJECT TITLE ____

.

1. Limit Abstract to 3 paragraphs (about 200 words or less). a) Purpose - what you set out to investigate; b) Procedure - how you did it; c) Conclusion - based on your results. LABEL EACH PARAGRAPH.
2. Must be typed, single-spaced on the front of this form. DO NOT write on the back of this form.

The above form must be duplicated. Student generated forms must be in essentially the same format.

<u>This form MUST be displayed on the front of the exhibitor's display board. It may be reduced to half a sheet of paper.</u>

SAFETY SHEET

Energy Innovation Conference Energy Fair

DIRECTIONS: The student is asked to read this introduction carefully, fill out the bottom of this sheet, and sign it. The science teacher and/or advisor must sign in the indicated space.

SAFETY AND THE STUDENT: Experimentation or research may involve an element of risk or injury to the student, test subjects and to others. Recognition of such hazards and provision for adequate control measures are joint responsibilities of the student and the sponsor. Some of the more common risks encountered in research are those of electrical shock, infection from pathogenic organisms, uncontrolled reactions of incompatible chemicals, eye injury from materials or procedures, and fire in apparatus or work area. Countering these hazards and others with suitable controls is an integral part of good scientific research.

In the **box** below, list the principal hazards associated with your project, if any, and what specific precautions you have used as safeguards. Be sure to read the entire section in the *Energy Fair Guidebook* entitled "SAFETY RULES FOR EXPERIMENTATION" before completing this form.

SIGNED ____

Student Exhibitor(s)

SIGNED____

Sponsor*

*As a sponsor, I assume all responsibilities related to this project.

This Sheet Must Be Typed

This form MUST be displayed on the front of the exhibitor's display board. It may be reduced to half a sheet of paper.

MICROORGANISM ENDORSEMENT

Energy Innovation Conference Energy Fair

THESE RULES WILL BE STRICTLY ENFORCED. ALL PROJECTS PRESENTED AT THE ENERGY INNOVATION CONFERENCE ENERGY FAIR MUST MEET THESE REGULATIONS.

Students and sponsors doing a microorganism project must complete this form. The signature of the student or students and the sponsor indicates that the project was done within these rules and regulations. Failure to comply with these rules will mean the disqualification of the project. This form must follow the Safety Sheet in the project paper.

1. This area of science may involve many dangers and hazards while experimenting. It is the sole responsibility of all teacher(s)/sponsor(s) to teach students proper safety methods and sterile techniques.
2. The Energy Innovation Conference Energy Fair prohibits the use of primary or secondary cultures taken from humans or other vertebrate animals in any project because of the danger from unknown viruses or other disease-causing agents that may be present. Pure cultures of microorganisms known to inhabit vertebrate animals may be obtained from reputable suppliers and used in proper settings.
3. Microorganism experiments should be conducted in a laboratory.
4. Projects involving viruses and recombinant DNA should be done with the help of a professional and should comply with the National Institutes of Health (NIH) Guidelines unless the project is limited to a kit obtained from a legitimate supply house.
5. All cultures should be destroyed by methods such as autoclaving or with a suitable NaOCl (bleach) solution before disposal.

In this space, identify and briefly describe the use of microorganisms in your project. Use the back of this page if necessary.

The **signatures** of the student, or students, and sponsor below indicate that the project conforms to the above rules of the Energy Innovation Conference Energy Fair.

______________________ (Sponsor)	______________________ (Student)
______________________ (Date)	______________________ (Student)

ESSAY COVER PAGE

Energy Innovation Conference Energy Fair

TITLE:

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SPONSOR ____

TITLE ____

STUDENT SIGNATURE____

SPONSOR SIGNATURE ____

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