Franklin-McKinley School District

PREPARING ALL CHILDREN AS GLOBAL LEARNERS

SCIENCE AND ENGINEERING FAIR

Information Packet

2018

"Follow the evidence everywhere it leads, and question everything."

Neil deGrasse Tyson

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IMPORTANT SAFETY RULES

Safety first!

Always have an adult adviser present to help you while you work.

Safety Rules:

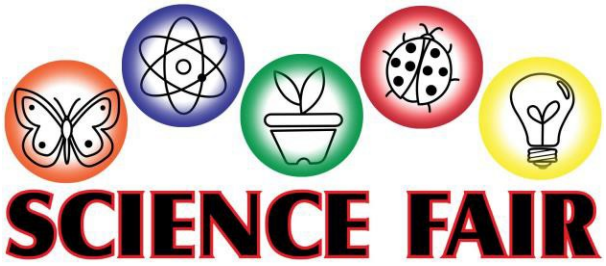
- All projects must comply with district policies and all local, state and federal laws.
- Do not perform any activity that could harm any person, including yourself.
- Wear appropriate safety equipment, including protective gloves and safety goggles.
- Do not touch, taste, or inhale chemicals or chemical solutions.
- The use of exposed high-voltage electricity, hazardous chemicals, flammables, compressed gas, firearms, explosives, tobacco, alcohol, drugs or any other dangerous material is **not** allowed.
- Wash your hands after doing any experiment, especially if you have been handling chemicals.
- Never eat or drink while working on your project.
- Keep your work area clean and well lit.
- Respect all life forms. Animals **cannot** be used in experiments.
- Dispose of waste properly.
- Use safety on the Internet! NEVER visit a site or share information with anyone without approval from your adviser.
- Always seek adult help when doing any type of work not suited for children. It is OK for adults to do this work for you.

Questions about safety?

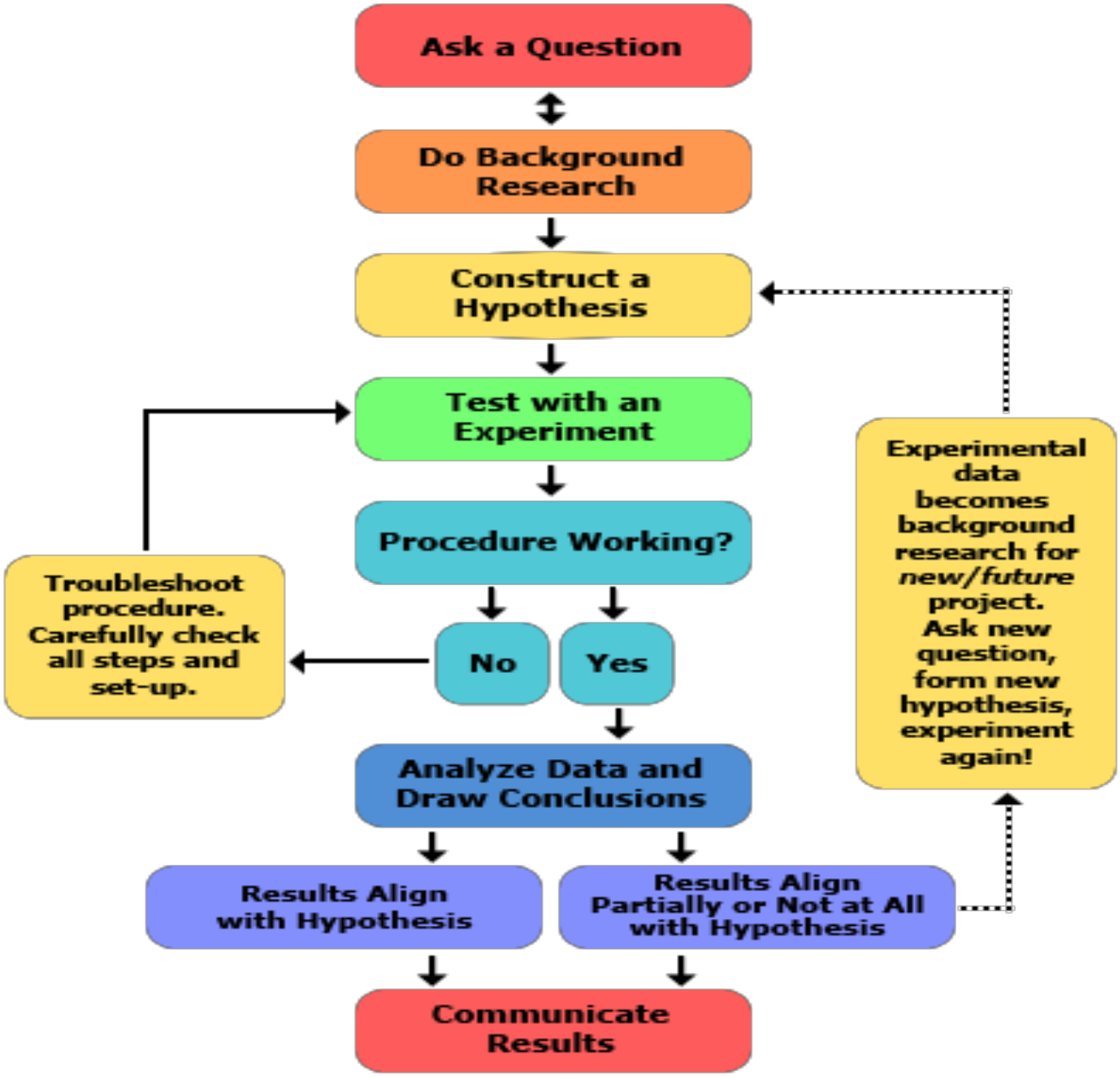
- **Ask your teacher** before doing anything you or your adviser are unsure about.

Types of **PROJECTS**

SCIENCE	ENGINEERING	DEMO (for novice participants)
• Ask a question	• Identify a problem/need	• Pick a topic
• Do background research	• Do background research	• Do background research
• Make a hypothesis	• Specify design goals	• Design the demonstration
• Plan experiment	• Create a design	• Build the demonstration
• Conduct experiment	• Build prototypes	• Show others how it works
• Analyze data	• Test and refine device	• Explain what it demonstrates
• Present conclusion	• Share end product	



Scientific Method



Science Project Steps

1. **Ask a question**
    - What do you want to find out?
    - Why is it important?

2. **Make a hypothesis**
    - What do you predict will happen during the experiment, based on your research?

3. **Design and conduct your experiment**
    - What steps will you follow for the experiment?
    - What is your control?
    - What are your variables? (Choose at least 3 variables)
    - What materials will you need?

4. **Analyze your data**
    - What did you observe during the experiment?
    - What data did you collect, and how can you use math to analyze it?

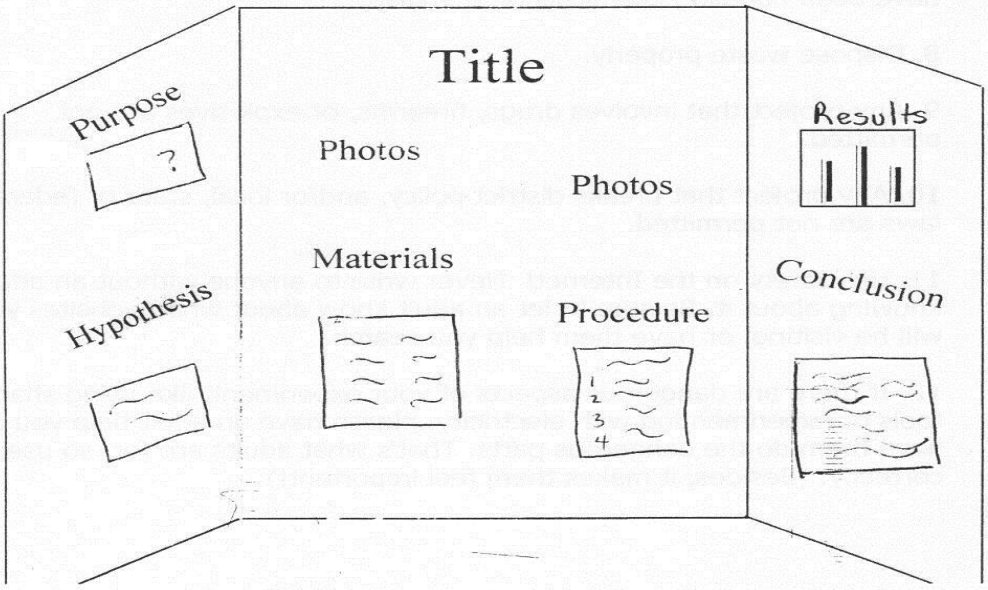
5. **Share your conclusion**
    - What did you learn from the experiment?
    - What would you do differently to further your understanding?
    - How would you improve your methods?

SAMPLE SCIENCE DISPLAY

CHECKLIST
PROJECT POSTER BOARD

1. **Statement of Purpose** – State the purpose of the project **in the form of a question**.
2. **Hypothesis** – State the hypothesis (educated guess that answers the project question)
3. **Materials** – List the materials used in the experiment
4. **Procedure** – Describe how the experiment was carried out. Provide a step-by-step explanation of how you conducted the experiment. Include drawings or photographs to help clarify your procedures.
5. **Data/Results** – Present data tables and graphs that show the outcome of your experiment
6. **Conclusion** – compare your results to your hypothesis. Did you findings support your hypothesis or not?

Miscellaneous: Be sure to include name(s)
Include photographs or drawings
This is a visual way to communicate to others so take your time and do a good job.



SCIENCE Prompts *(for judges only)*

Start by introducing yourself. Use some of the prompts below to get information that will help you fill in the score sheet. Let the student do most of the talking. End with positive words of encouragement.

Hello! I'm (your name).

What is your name?

Your project looks interesting!

Before you tell me about it, I want to ask you some questions.

Tell me how you got interested in (this subject).

- ✓ What questions did you have when you first got started?
- ✓ Did you find any people, books, or websites to help you?
- ✓ What hypothesis did you decide to investigate?

Tell me about your procedure.

- ✓ Did you repeat your experiment more than once?
- ✓ Which variables did you change and which ones did you keep the same?
- ✓ May I look at your notebook? Can you explain this (model, photo, sketch)?
- ✓ Can you show me a place where you used math?

What did you notice about the data you collected?

- ✓ Did your hypothesis turn out to be correct or did you need to change it?
- ✓ What did your project help you learn about your topic?
- ✓ What kinds of things do you think real scientists do in their labs?

I really enjoyed hearing about your science project!

Great job!

I hope I see you again at next year's fair.

SCIENCE SCORE SHEET *(for judges only)* **SCORE:** _____ / 33

Student Name(s) _____

Project Title _____ Project # _____

- *Enter **0 to 3** in each blank below (0 = strongly disagree, 3 = strongly agree).*
- *An "average" project should score around 20 points.*
- *Reserve 25+ for exceptional projects.*

RESEARCH QUESTION

1. Question is **intriguing and clearly stated.** _____
2. Question **can be tested** using science methods. _____

EXPERIMENTAL DESIGN

3. **Procedure** is clearly stated. _____
4. **Variables and controls** are well-defined and appropriate. _____

DATA ANALYSIS AND INTERPRETATION

5. **Sufficient data** was collected from **multiple trials**. _____
6. **Basic math** was appropriately applied in data analysis. _____

DISPLAY

7. **Includes**: Title, Hypothesis, Materials, Procedure, Data and Analysis. _____
8. **Organization** of display is clear and concise. _____

INTERVIEW

9. Demonstrates age-appropriate **understanding** of science concepts. _____
10. Student (or team) is **excited** about their topic. _____

JUDGE'S BONUS

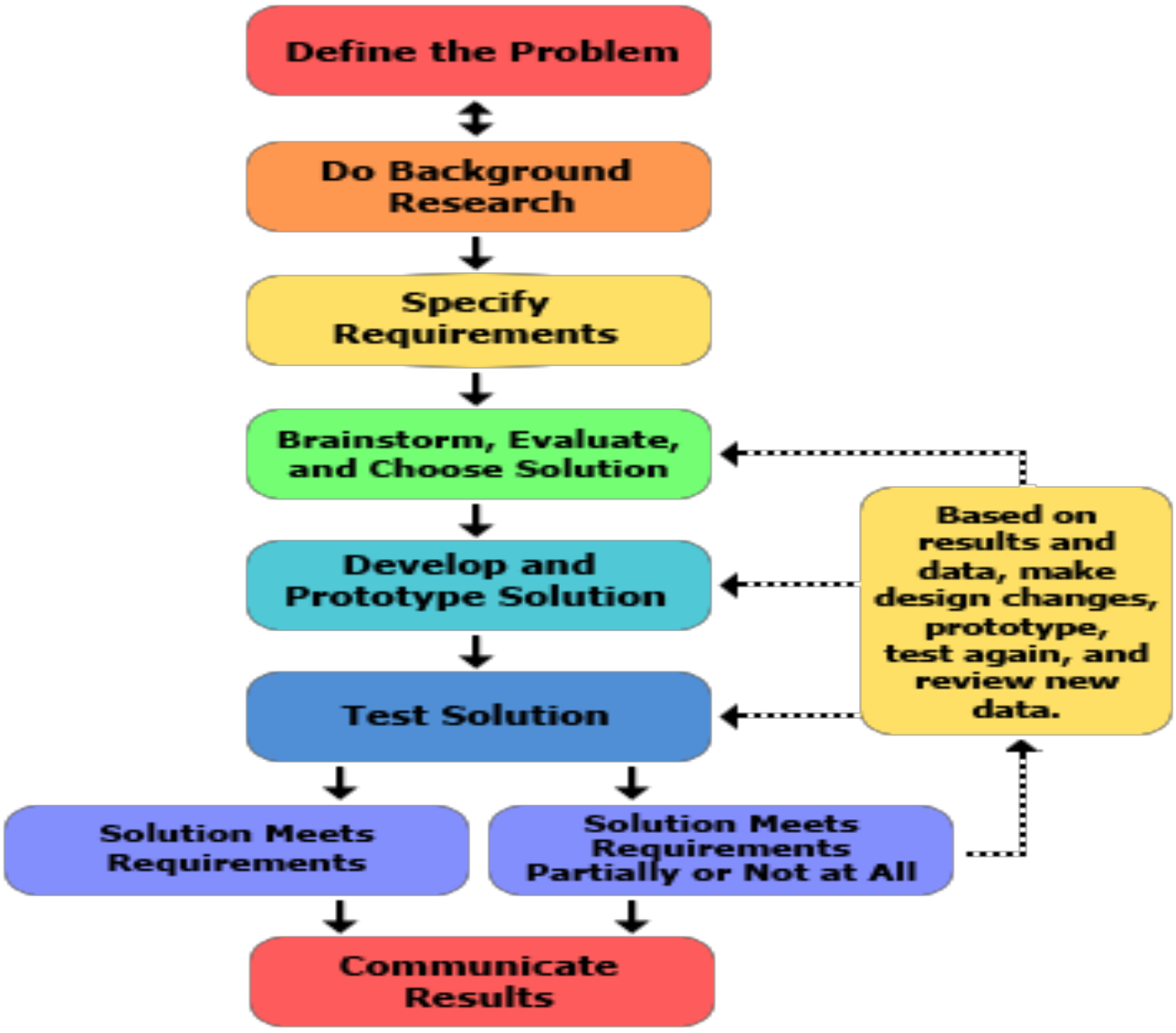
11. Give up to 3 bonus points to students who impressed you in an area not listed above. An example could be "beautiful model," "creative use of materials," or "persistence."

    Briefly describe what you noticed: _____

    _____

    _____

Engineering Method



Engineering Project Steps

1. **Identify a problem or need**

    - What are you designing, who is it for and what is the need?
    - How will your design improve on previous designs?

2. **Establish design criteria and constraints**

    - Criteria define the products physical and functional characteristics.
    - Constraints are factors that limit the engineer's flexibility such as time, cost, safety, and legal issues.

3. **Brainstorm and create alternative designs**

    - Research existing solutions.
    - Explore the science principles that enable devices like yours to work.
    - Use this knowledge to create new solutions!

4. **Build a prototype**

    - Start with a rapid (simple) prototype to confirm that your design will work.

5. **Test and evaluate the prototype using the design criteria**

    - Test your prototype under actual or simulated operating conditions to see if it works to your satisfaction.

6. **Analyze test results, make design changes and retest.**

    - Look for any problems in your design and make corrections or repairs.

7. **Communicate**

    - Explain your end product and operate it for your audience.

Sample Engineering Display

<table>
<tr><td>PURPOSE

• Why are you doing this?
• What did you observe that made you ask your question?</td><td colspan="3">TITLE</td><td>TEST DESIGN

• Test your design.
• Get feedback from others.
• What problems occurred?
• Which part was successful and why?</td></tr>
<tr><td>PROBLEM & CONSTRAINTS

• What is the problem or need?
• Why is it important to solve?
• What are your constraints?</td><td colspan="3"></td><td>REDESIGN

• Redesign project and record the changes made
• Retest the results
• Repeat until satisfied with Project</td></tr>
<tr><td>DESIGN AND METHODS

• State the characteristics your design must meet. (bigger, smaller, faster, stronger…)
• List the key features that will make your design successful.</td><td>SOLUTION

• Brainstorm possible solutions
• Evaluate solutions.
• Show Pictures</td><td>MATERIALS

• List material
• Do not include materials used for the board design</td><td>PROTOTYPE

• What process did you use to create the prototype?
• What challenges did you face?
• How did you have to redesign it as you were building it?</td><td>NEXT STEPS

• What new questions do you have as a result of your experience?
• What else can you do to improve your project?</td></tr>
<tr><td>RESEARCH & BACKGROUND

· What is the science behind your project?
· What did you learn from other designer’s successes and failures?</td><td></td><td></td><td></td><td></td></tr>
</table>

ENGINEERING Prompts *(for judges only)*

Start by introducing yourself. Use some of the prompts below to get information that will help you fill in the score sheet. Let the student do most of the talking. End with positive words of encouragement.

Hello! I'm (your name).

What is your name?

I am glad you're interested in engineering, I like it too!

Before you tell me about your project, I want to ask you some questions.

First, tell me about the engineering problem you worked on.

- ✓ What was the challenge you wanted to meet?
- ✓ What success criteria (performance goals) did you set for your device?

  (Speed, size, cost, etc.)

Show me about what you made.

- ✓ What does your device do?
- ✓ Can you explain how this part works?
- ✓ Tell me about the different ideas you considered before you built this solution.
- ✓ Everyone needs some help – who helped you with your project?

How did your design work out?

- ✓ Were you able to meet your performance goals?
- ✓ Did your first design work right away?
- ✓ What parts needed redesigning?
- ✓ What was the most fun or interesting part of the project?

I've really enjoyed hearing about your engineering project.

Great job!

I hope I see you again at next year's fair

ENGINEERING SCORE SHEET *(for judges)* **SCORE:** _____ / 33

Student Name _____

Project Title _____ Project # _____

- *Enter **0 to 3** in each blank below (0 = strongly disagree, 3 = strongly agree).*
- *An "average" project should score around 20 points.*
- *Reserve 25+ for exceptional projects.*

PROBLEM OR NEED STATEMENTS

1. Problem/need is **important** and has a **real-world connection.** _____
2. Design criteria (performance goals) clearly stated. _____

DESIGN PROCESS

3. Evidence of **brainstorming** and **creative thinking**. _____
4. Design incorporates **basic engineering principles**. _____

PROTOTYPING AND REDESIGN

5. Evidence that **design solution evolved** as a result of testing**.** _____
6. Student(s) can explain how well their **device met their design goals.** _____

DISPLAY

7. **Includes**: Design Criteria, Brainstorming, Final Design, Prototype, Test Results. _____
8. **Organization** of display is clear and concise. _____

INTERVIEW

9. Demonstrates age-appropriate **understanding** of engineering principles. _____
10. Student (or team) is **excited** about their topic. _____

JUDGE'S BONUS

11. Give up to 3 bonus points to students who impressed you in an area not listed above. An example could be "beautiful model," "creative use of materials," or "persistence."

    Briefly describe what you noticed: _____

    _____

    _____

DEMONSTRATION PROJECT STEPS

1. **Pick a topic**

    - What do you want to demonstrate?
    - Why is it important, fun, or unusual?

2. **Gather background**

    - What can you learn about your topic?
    - How can you design a demonstration this illustrates your learning?

3. **Design and build your demonstration**

    - What steps will you follow for the demonstration?
    - What materials will you need?
    - How will it work?

4. **Share your demonstration**

    - Share your demonstration with an audience.
    - What did your demonstration teach them?

DEMO Prompts *(for judges only)*

Demonstrations are a "gateway" to help novice students get engaged in the fair. We hope that they will advance to science and engineering projects in the future.

Start by introducing yourself. Use some of the prompts below to get information that will help you fill in the score sheet. Let the student do most of the talking. End with positive words of encouragement.

Hello! I'm (your name).

What is your name?

Your project looks interesting!

Before you tell me about it, I want to ask you some questions.

Tell me how you got interested in this topic.

- ✓ What questions did you have when you first started?
- ✓ Where did you get the information you needed?

Tell me about your device (or model).

- ✓ What does it demonstrate?
- ✓ How does it work?
- ✓ What does this part do?
- ✓ What was the hardest part of the project?
- ✓ What did your project help you learn about your topic?

I enjoyed watching your demonstration.

Great job!

I hope I see you again at next year's fair.

DEMO SCORE SHEET *(for judges only)* **TOTAL SCORE:** _____ / 33

Student Name _____

Project Title _____ Project # _____

Note to Judges: A demonstration is a gateway to help students who might not otherwise be able to compete in the fair. This experience will pave the way for future projects.

- *Enter **0 to 3** in each blank below (0 = strongly disagree, 3 = strongly agree).*
- *An "average" project should score around 20 points.*
- *Reserve 25+ for exceptional projects.*

TOPIC

1. The subject of the demo is **clearly stated.** _____
2. The demonstration is **interesting, fun, or unusual** (*not* a volcano). _____

BACKGROUND KNOWLEDGE

3. The student clearly made an effort to **learn about this topic.** _____
4. The student is able to **explain what their demo shows** and **how it works.** _____

MODEL QUALITY

5. The demo includes a **working model** or **other physical element.** _____
6. The project shows **attention to detail** and **production quality.** _____

DISPLAY

7. **Includes**: Topic, Background Information, Model, and Explanation. _____
8. **Organization** of display is clear and concise. _____

INTERVIEW

9. Age-appropriate **understanding** of relevant science/engineering concepts. _____
10. Student (or team) is **excited** about their topic. _____

JUDGE'S BONUS

11. Give up to 3 bonus points to students who impressed you in an area not listed above. An example could be "beautiful model," "creative use of materials," or "persistence."

    Briefly describe what you noticed: _____

    _____

Journal

A journal provides readers with vital information about what you did.

Journals document each step of your process. For example, a science journal should include all the data you collected. An engineering journal should record the results of your brainstorming. A demo journal should document what you learned and how you made your demo. All journals should include:

Title Page: Including your name.

Acknowledgments: Everyone who helped do your project, and everyone you interviewed, including teachers, scientists, and other experts.

Table of Contents

Statement of Purpose: State in the form of a science question or an engineering need.

Hypothesis (science) or Design Criteria (engineering): A hypothesis is an educated guess. Design criteria are the requirements your engineering solution must satisfy.

Research: This is the background information you collected about your topic. Any books or articles read from the internet/journal, authorities on the topic that you talked to, or outside materials collected should be summarized in your own words.

Materials: This is a list of the type and amount of all the materials and supplies used.

Procedure: Describe the steps you took to complete the project. Show the steps needed to complete the science experiment (or the steps in your engineering design process).

Observations and Results: Explain what you learned from the project. Include all graphs, charts, or other visual data (pictures) that help to explain your results.

Conclusion: This is a brief statement explaining why your project turned out the way it did. You should explain why the events you observed occurred. Using the word “because” is a good way to turn an observation into a conclusion.For a science project, the conclusion should tell whether the hypothesis was proven or not proven. For an engineering project, the conclusion should evaluate how well the design met the performance criteria.

References: The bibliography should list all the printed materials the student used to carry out the project. Items should be listed in alphabetical order in a standard format.

Before you hand in your report make sure to check your calculations, spelling, and grammar.

Judge's Interview

Many kids are scared of speaking in public or to a teacher/judge. Just imagine the judge is a friendly fellow scientist who wants you to share what you learned.

Relax, smile, and have fun. Remember, you are the expert and you had fun doing the project. But if you are a little nervous, here are some ideas to help you.

Look sharp, feel sharp, and you will be sharp: Dress for success, be polite, and speak clearly. Show that you have confidence. Don't forget to look at your audience.

Introduce yourself: Point to the title of your display. Tell your audience why you chose to study this.

Answer all questions briefly and to the best of your ability. It is OK to say "I don't know" or "I'm not sure, but I think…".

State the problem: Share the hypothesis you studied and give details.

Share your project overview: Explain the steps you took to conduct your experiment engineering project or demonstration. Mention all the materials involved and highlight the pictures you may have taken.

Labeled Parts: Point out the labeled parts of your display board and graph or table to show that you know what it represents. Point out how many times you tested the experiment (at least 3) or how many attempts made toward your final engineering product.

Explain what your data means: Make sure you can read your graphs and tables. Let them know if you were surprised by the results, or if you know what would happen because you studied it.

Talk about what you learned: Share what you learned while researching your topic.

Talk about the sources: Mention books, websites, and interviews that helped you understand your topic

Science and Engineering Fair Resources

California State Science Fair: Read about this science fair which has been going on since 1952! You can learn how to enter, get help with your own project, or see a directory of past projects. http://www.usc.edu/CSSF/

Cyber Fair: See sample fair projects, look through other student's examples, and see the steps involved in judging projects.
http://www.isd77.k12.mn.us/resources/cf/welcome.html

Experimental Science Projects: Outlines steps in preparing a project (complete with an ideas list), and suggests the best ways to prepare one at different grade levels.
http://www.isd77.k12.mn.us/resources/cf/SciProjIntro.html

Science Buddies: Use the topic selection wizard to help you figure out what science projects interest you most. Once you have a topic, get help doing research, setting up the experiments, and completing them. http://www.sciencebuddies.org/

Science Fair Central: Includes cool project ideas, a science fair handbook, reviews of students' experiments, and more from Discovery Channel School.
http://school.discovery.com/sciencefaircentral/

Scientific Method: Describes the five steps of the Scientific Method that are helpful when creating a science fair project. Include examples of wording and sample projects to explain certain steps.
http://school.discoveryeducation.com/sciencefaircentral/Getting-Started/Investigation.html

Super Science Fair Projects: Guide to projects, topics, experiments, and tips for successfully completing a science project, including the six steps of the Scientific Method. http://www.super-science-fairprojects.com/

What Makes a Good Science Fair Project? Short guide written by a group of experienced judges for the California State Science Fair.
http://www.usc.edu/CSSF/Resources/Good_Project.html

[Note: More resources will be added to help with engineering.]