Shoreline STEM Science Fair

Student Handbook
K-6

Shoreline Community College

May 20, 2017

10:00 am – 2:00 pm

www.shorelineSTEM.org

shorelineSTEMfestival@gmail.com

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What is the Shoreline STEM Science Fair?

Welcome, K-6 Students!

The Shoreline STEM Science Fair is a celebration of YOU and of your learning in Science, Technology, Engineering, and Mathematics (STEM). Your project can start from something you learned in school or something you are interested in all on your own. The festival is your chance to teach our community about what you know. Your ideas matter!

A Quick Note about STEM Competitions

There are many other STEM competitions that you can enter. Make sure to check the guidelines for each one before you enter.

- Washington State Science & Engineering Fair (grades 1-12)
- Broadcom MASTERS (grades 6-8)
- FIRST LEGO League (leagues for different age groups)
- Toshiba ExploraVision (grades K-12)
- eCybermission (grades 6-9)

Categories of projects at the Shoreline STEM Science Fair

Science investigations: Answer a question about the world by planning and completing an experiment (or series of experiments).

Engineering design and invention: Design and make something to solve a problem. These types of projects are accepted at the Shoreline STEM Science Fair but may not be allowed at other STEM competitions.

Computer Science design and invention: Design and make a computer program or hardware to solve a problem. These types of projects are accepted at the Shoreline STEM Science Fair but may not be allowed at other STEM competitions.

Some projects might fit in more than one category. The boundaries between science investigations, engineering, and computer sciences are not always clear. Your project may fall in the gray area between these categories, and that's OK. Some topics in engineering and computer science are best addressed as a science investigation. Review the information in this handbook and talk to an adult if you aren't sure which category your project fits into.

Steps of the scientific method or design process

If your project is a **science investigation** you will use the scientific method to help answer a question or test a hypothesis.

The steps of the scientific method are:

Ask a question
Research your topic
Make a prediction (your hypothesis)
Test your hypothesis
Analyze your data
Report your results

If your project is an **engineering or computer science design and invention** you will follow the design process to help make a new product to solve a problem.

The steps of the design process for both Engineering and Computer Science are:

Define the problem
Research your topic
List your requirements
Brainstorm solutions
Choose the best Solution
Develop an idea
Build a prototype
Test and redesign

The design process does not need to follow these steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to make a modification or change to your design. This way of working is called iteration.

Additional Guidance

For more resources understanding the steps of the scientific method or design process check out the Sciencebuddies.org **Science Fair project guide** or **Engineering project guide**: (http://www.sciencebuddies.org/science-fair-projects/project_guide_index.shtml)

(Optional) Research Notebook Guidelines

Notebooks are not required for entry into the Shoreline STEM Science Fair but can be helpful. Notebooks may be required for other STEM competitions. Your project notebook shows that your ideas and work belong to you. It is a hand-written, day-by-day record of everything related to your project.

General Guidelines:

1. Use a durable, stitched, laboratory-type notebook. Do not remove pages.
2. Use the first few pages as your Table of Contents and fill in titles and pages as you work.
3. Begin using the notebook right away and write down everything you do for the project.
4. If you are part of team, each person should have their own notebook.
5. Number the pages.
6. Date each page as you use it.
7. Write only in blue or black ink. No pencil.
8. The notebook doesn't have to be neat, as long as it is readable.
9. If you make a mistake, draw line through it, not a scribble.
10. Most of your notebook entries will be hand-written.
11. Notebooks typically include:
    - ✓ Topic ideas and brainstorming, questions about your topic
    - ✓ Observations and ideas
    - ✓ Question (or hypothesis) for your investigation
    - ✓ Reading notes, bibliographical citations
    - ✓ Materials and procedures
    - ✓ Labeled sketches and photos of experimentation
    - ✓ Data tables, calculations, graphs
    - ✓ Data analysis notes, conclusion notes
    - ✓ Poster design

Choosing Your Project Topic: K-6

Pick something you are curious about! Ask questions about the world around you like:

What would happen if…?
Why is that thing that way?
What is the best way to…?

Brainstorm with a friend, parent, or other adult. Think about why it would be important to know more about your topic.

Be sure that your Shoreline STEM Science Fair project **represents your work**. There are great online resources to help with project ideas, but make sure you do and report your own version of the project.

Many projects can be done within the scope of your home and within a reasonable budget.

Online STEM resources

Sources for science fair project ideas

Science Buddies:
This site has project ideas and helpful *topic selection wizard* (K-12)
http://www.sciencebuddies.org/science-fair-projects/project_ideas.shtml

Education.com:
Provides science fair project ideas by grade level (K-12)
http://www.education.com/science-fair/:

Scienceproject.com:
Provides science fair project ideas by grade level (K-12)
http://scienceproject.com/

40-cool-science-experiments-web (scholastic.com):
Provides science fair project ideas (K-8)
http://www.scholastic.com/teachers/article/40-cool-science-experiments-web

Tools to aid in brainstorming a topic

Google Science Fair – Make a Better Generator:
An idea generator which will present related articles and links based on your responses to three questions.
https://www.googlesciencefair.com/make-better-generator/en/

The DuPont Challenge:
They use a thematic approach to choosing a topic based on four categories that revolve around four prompts.
http://thechallenge.dupont.com/

Sources for more complex science fair projects and additional project guidelines:

NASA Jet Propulsion Laboratory, How to Do a Science Fair Project:
Six videos that explain "How to do a science fair project"
http://www.jpl.nasa.gov/edu/teach/activity/how-to-do-a-science-fair-project/

eCybermission:
You can watch series of short videos that guide students through each stage of a science or engineering process.
https://www.ecybermission.com/WebinarsVideos

Science Buddies:
Also has nice project guidelines explaining the steps of the scientific method and engineering process.
http://www.sciencebuddies.org/science-fair-projects/project_guide_index.shtml

Discovery Education – Science Fair Central:
Provides a clear pathway to develop and present successful projects
http://school.discoveryeducation.com/sciencefaircentral/Getting-Started.html

Toshiba ExploraVision:
This site has a series of great tips to help guide you through the processes of brainstorming, choosing a topic, and even how to research.
http://www.exploravision.org/how-brainstorm

Safety Regulations

The Shoreline STEM Science Fair follows *The International Rules for Pre-college Science Research: Guidelines for Science and Engineering Fairs*

(https://student.societyforscience.org/international-rules-pre-college-science-research).

These rules:

- protect the rights and welfare of the student researcher and of the human participant
- to make sure federal regulations are followed and safe engineering and lab practices are used
- protect the environment
- determine eligibility for participation in the Shoreline STEM Science Fair and other STEM competitions and events

To help us determine if your proposal meets the basic safety guidelines, please consider the following question:

Do you plan to use any of the following in your project for the Shoreline STEM Science Fair?

- Human Subjects, in any way, even for surveys or opinions
- Vertebrate Animals (animals with a backbone)
- Animal Tissues
- Microorganisms (bacteria, fungi, viruses)
- DNA
- Disease-causing agents
- Radiation
- Controlled or Hazardous Substances
- Explosives
- Chemicals not generally found in the household

YES	NO
• Submit your project proposal and indicate that safety review is required. The Shoreline STEM Science Fair Safety Review Team will follow up with additional details.	• Submit your project proposal to register for the Shoreline STEM Science Fair

To submit your proposal and register for the fair, see the last page of this handbook for a proposal form, which can be submitted to shorelinestemfestival@gmail.com. Alternatively, you can complete the online form at our website: www.shorelinestem.org.

If your project idea requires a consultation with the Shoreline STEM Science Fair Safety Review Team, it doesn't necessarily mean that you won't be able to do your project. We will work with you to ensure that all safety regulations are followed.

Suggested Project Timeline/Calendar

Science investigations, computer science, and engineering projects take time. Plan ahead and break the process into smaller tasks.

Here's one example of a timeline you can use.

	Tasks to be completed in each week or two week time frame
Week 1 Feb	• Decide whether to do a team or an individual project • Brainstorm a topic • Develop a research question or problem to solve, share with an adult • Decide on a project category for the Shoreline STEM Science fair and choose a testable research question, engineering design plan, or computer science design plan
Weeks 2&3 Feb	• Make a list of questions you have about your topic • Read and take notes on your topic • Develop and finalize your scientific question or computer science/engineering design criteria
Weeks 4&5 Mar	• Make a rough draft of your materials and research procedures or design plans • **Complete a Project Planning Proposal and Safety Review form and submit to the Shoreline STEM Safety Committee.** You can do this online or with the form in this handbook. • If your plans involve human subjects (even if it's just to ask them questions for a survey), animals or animal tissue, micro-organisms, DNA, radiation, controlled or hazardous substances, explosives, or chemicals not generally found in a household, wait for approval BEFORE you start your project.
Weeks 6&7 Mar	• Once you get Project Approval (and Safety Approval if applicable) from the Shoreline STEM Safety Committee, you are ready to start • Finalize your experimental procedure or prototype designs • Conduct your scientific investigation or build and test your prototype(s)
Week 8 Apr	• Write the introduction and background sections of your presentation
Weeks 9&10 Apr	• **Deadline to submit a Project Planning Proposal and Safety Review form for the Shoreline STEM Science Fair online at www.shorelinestem.org is April 14** • Continue to collect data for your scientific investigation or modify your prototype and retest • Organize your raw data into graphs and charts • Analyze your data
Week 11 Apr	• Science Investigation - collect the final data for your project • Computer Science or Engineering - Redesign your product and conduct final testing if needed • Finalize all graphs and charts for your display board
Week 12 May	• Write the experimental procedure, results, and conclusion sections of your presentation
Weeks 13&14 May	• Create your display board • Practice talking about your project with friends and family!
…. take your project to the Shoreline STEM Science Fair on May 20, 2017	

Science Investigation projects

Choosing Your Question or Hypothesis

Once you've chosen a topic and then a single question, you need to make sure that the question is in a form you can test.

Is My Question Testable?

Broad questions are hard to test. Be as specific as you can. Here are some examples:

How can plants be protected against pests?	becomes	***Can companion planting protect beans from beetles?***
How does weather change?	becomes	***Can observing cloud formations predict the weather that follows?***
Does music help you study?	becomes	***Can listening to music while you study change your ability to remember facts?***
How can cars travel faster and farther?	becomes	***Can changing the design (or materials) of a vehicle influence the speed and distance it can travel?***

Examples of Science Questions:

How does the cool down routine affect how long it takes for the heart to return to normal after exercise?
How does light affect how fast a plant makes starch?
What is the best insulator to keep ice from melting?
Which method of cooking destroys the most bacteria?

The boundaries between science and engineering projects are not always clear. Scientists often engineer tools to do their work, while engineers often use scientific practices to help them design their products. Much of what we often call "computer science" is actually engineering—programmers creating new products. Your project may fall in the gray area between science and engineering, and that's OK. Many projects can and should use science and engineering practices. **However, if the objective of your project is to invent a new device, procedure, computer program, or algorithm, then it makes sense to follow the computer science or engineering design and invention processes.**

Science Investigation Project Checklist

_____**Pick a Topic**. Choose something that you are curious about.

_____**(Optional) Set up and Keep a Project Notebook**

_____**Research Your Topic.** Take notes and keep track of your resources.

_____**Choose your question.** Write your question and prediction (hypothesis)

_____**Submit Project Proposal and Safety Review to shorelinestemfestival@gmail.com or online at http://shorelinestem.org**

_____**Plan Your Experiment:** Your plan should be detailed and include a list of materials

- Know your **controlled variables** (the things you will keep the same). There should be many controlled variables.
- **Manipulated/independent variable** (this is the ONE variable changed in the investigation.)
- **Responding/dependent variable** (this is what will be measured or observed.)
- Know how you will measure your dependent variable
- How many times will you do your experiment? Repeating experiments will give you more accurate data
- Decide how long the experiment will last

_____**Conduct Your Experiment:** Keep careful notes.

_____**Analyze Your Results:** Look at all of your data and make a graph. Did you find what you expected? Why or why not? Did you prove or disprove your hypothesis?

_____**Draw Conclusions:** What patterns do you see? Did you collect enough data? Do you need to conduct more experimentation? Was there a problem with your methods that you could change next time? How do your results matter in the real world?

_____**Prepare to Present your Project:** Construct a display board. Practice talking about your project to friends, family, and other supportive adults.

_____**Take your project to the Shoreline STEM Festival on May 20, 2017**

Display Board Example for Science Investigation Projects

Title

Student Name

Purpose and Background Research

Question

Hypothesis

Procedure & Methods

Data & Results

Includes Graphs & Tables

Pictures with captions

Materials & Technology Used

Data Analysis & Conclusions

In Front of Display Board on Table: Project Notebook and any other materials you feel would be useful to explain and show how you ran and/or created your project.

Engineering Design and Invention projects

Choosing Your Engineering Question

Once you've selected a topic and narrowed your search to a single problem to work on, identify possible solutions, and then plan to develop the best one based on your criteria and constraints.

Examples of Engineering Questions:

How can you redesign a sandbag to better protect homes during a flood?
What can you do with a swim cap to optimize its ability to decrease drag in water?
What is the best propeller design for a wind generator?

Engineering projects do not need to culminate in a final working model or prototype as long as you provide detail in your future goals on how you plan to troubleshoot or improve your design.

The steps of the design process for Engineering and Invention are:

Define the problem
Research your topic
List your requirements
Brainstorm solutions
Choose the best Solution
Develop an idea
Build a prototype
Test and redesign

The design process does not need to follow these steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to change your design. This way of working is called iteration.

If you are still unsure whether your project is a science investigation, engineering design and invention computer science design and invention, please ask a teacher or parent for help.

Engineering Design and Invention Project Checklist

_____**Pick a Topic:** Define a need or ask "How can I make this better?" What is going on in the world that you would like to change?

_____**(Optional) Set up and Keep a Project Notebook**

_____ **Research Your Topic:** Take notes and keep track of your resources. See what has already been done or what products already exist that fill a similar need. What makes them good and what makes them weak?

_____ **Submit Project Proposal and Safety Review to shorelinestemfestival@gmail.com or online at http://shorelinestem.org**

_____**Organize:** Organize everything you have learned about your topic. At this point, you should narrow your thinking by focusing on a particular idea.

_____**Make a Time Line**: Choose a project that not only interests you, but can be done in the amount of time you have. Develop a time line.

_____**Develop or establish design criteria:** There could be more than one, depending on your topic. For example, what is your product supposed to do? What limits do you need to work with (i.e. size, weight, materials, etc.)?

_____**Prepare Preliminary Designs:** Prepare preliminary designs and a materials list. Consider costs, manufacturing and user requirements.

_____**Build and Test Your Prototype:** Build a test prototype of your best design.

_____**Retest and Redesign:** Retest and redesign as necessary. Test your product.

_____**Draw conclusions:** Did your prototype work? If not, why not? What would you change to improve it? What did you learn about while doing your project?

_____**Prepare to Present your Project:** Construct a display board. Describe Practice talking about your project to friends, family, and other supportive adults.

Display Board example for Engineering Design and Invention Projects

Title

Student Name

Background and Real World Connections

Engineering Question/Goals

Data and Results

Design Criteria/ Design Process

Prototype Development

Includes Preliminary Designs, prototype building and testing, prototype redesigning and retesting

Photos with captions

Data Analysis and Conclusions

Materials & Technology Used

In Front of Display Board on Table: Project Notebook and any other materials you feel would be useful to explain and show how you ran and/or created your project.

Computer Science Design and Invention Projects

Choosing Your Computer Science Question

Once you've selected a topic and narrowed your search to a single problem to work on, identify possible solutions and pick one to develop.

Any of these areas, and more, would be appropriate for the Shoreline STEM Science Fair:

- Creating an app or a program
- Work in digital forensics
- Software engineering
- Hardware
- Computer graphics and visualization
- Gaming
- Human-computer interaction
- Accessibility
- Bioinformatics
- Cryptography
- Artificial Intelligence

Examples of Computer Science Questions:

How can you design an app or program to help kids learn math faster?
How can you design an app to connect pet owners with pet services?
What can you do to improve the best bus routes and bus frequencies?

Computer science projects do not need to culminate in a final working model or prototype as long as you provide detail in your future goals on how you plan to troubleshoot or improve your design.

The steps of the design process for Computer Science are:

Define the problem
Research your topic
List your requirements
Brainstorm solutions
Choose the best Solution
Develop an idea
Build a prototype
Test and redesign

The design process does not need to follow these steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to change your design. This way of working is called iteration.

If you are still unsure whether your project is a science investigation, engineering design and invention computer science design and invention, please ask a teacher or parent for help.

Computer Science Design and Invention Project Checklist

_____**Pick a Topic:** Define a need or ask "How can I make this better?" Ideas should come from things in your areas of interest. What need can you help meet?

_____**(Optional) Set up and Keep a Project Notebook**:

_____ **Research Your Topic:** Take notes and keep track of your resources. See what has already been done or what products already exist that fill a similar need. What makes them good and what makes them weak?

_____ **Submit Project Proposal and Safety Review to shorelinestemfestival@gmail.com or online at http://shorelinestem.org**

_____ **Organize:** Organize everything you have learned about your topic. At this point, you should narrow your thinking by focusing on a particular idea.

_____**Make a Time Line**: Choose a project that not only interests you, but can be done in the amount of time you have. Develop a time line.

_____**Develop or establish design criteria:** There could be more than one, depending on your topic. For example, what is your product supposed to do? What limits do you need to work with (e.g. memory limits, code complexity)?

_____**Prepare Preliminary Designs:** Prepare preliminary designs and a materials list. Consider costs, manufacturing and user requirements.

_____**Build and Test Your Prototype:** Build a test prototype of your best design or code and test software based on your design..

_____**Retest and Redesign:** Retest and redesign as necessary. Test your product.

_____**Draw conclusions:** Did your prototype work? If not, why not? What would you change to improve it? What did you learn about while doing your project?

_____**Prepare to Present your Project:** Construct a display board. Describe Practice talking about your project to friends, family, and other supportive adults.

Display Board example for Computer Science Design and Invention Projects

Title

Student Name

Background Research

Purpose Statement

Data & Results

Includes Graphs & Tables

Pictures with captions

Procedure & Methods

Materials & Technology Used

Outcome and Application of Project

In Front of Display Board on Table: Research Paper, Project Notebook and any other materials you feel would be useful to explain and show how you ran and/or created your project.

Guidelines for Preparing a Display Board of Your Findings/Work

The display board shows your entire project, from question to conclusion. Keep your exhibit neat, uncluttered, and to the point. All photos and illustrations should include captions and photo credits.

Display and Safety Rules

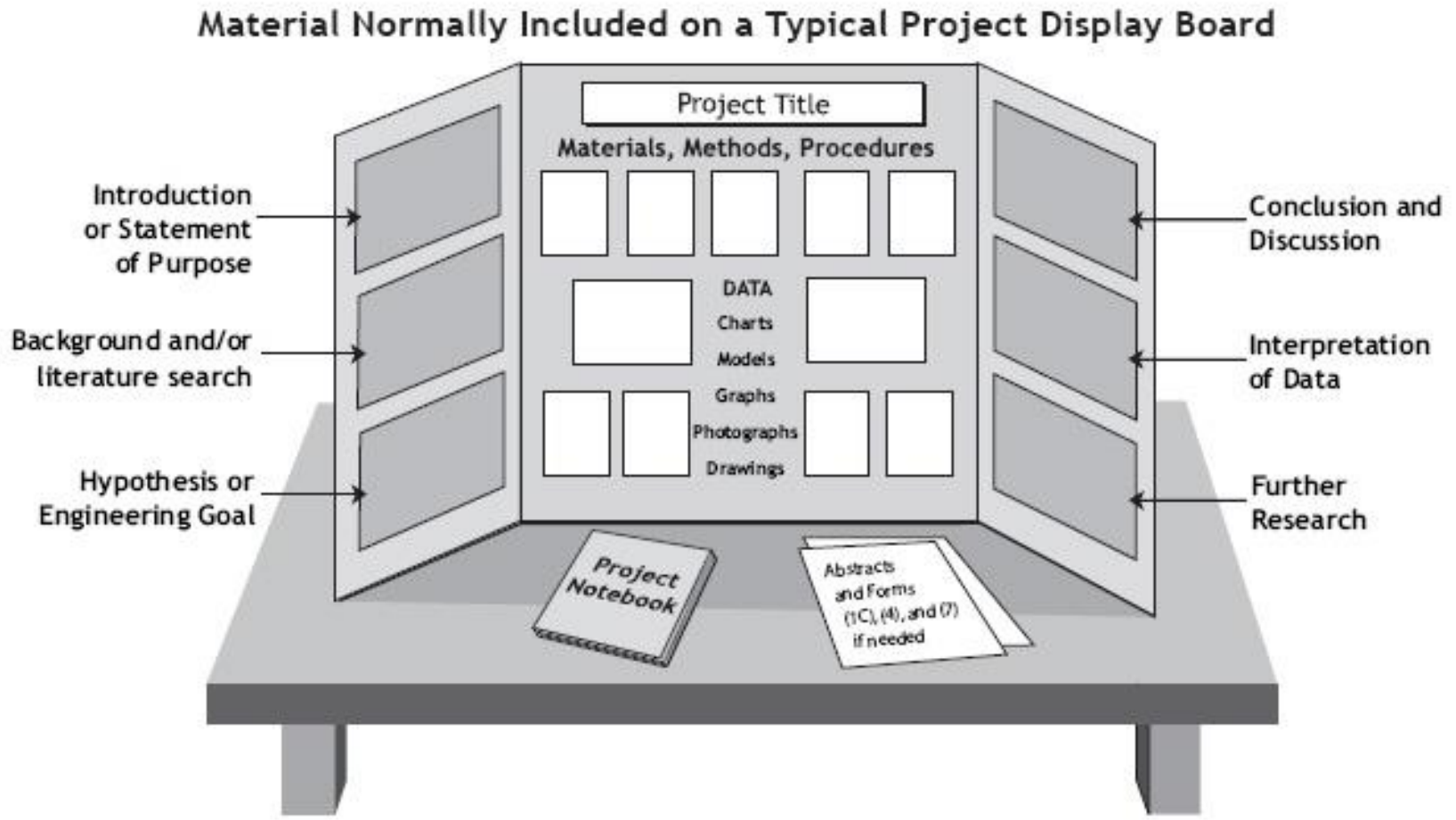
1. The following ARE NOT allowed as part of your display at the Shoreline STEM Science Fair (please DO share pictures!):
    a. Living organisms such as plants, soil, mold, bacteria
    b. Food
    c. Taxidermy specimens, preserved animals, human/animal parts or body fluids
    d. Hazardous or flammable chemicals
    e. Glass or sharp objects
2. If you are doing a multi-year project, NO previous year materials can be displayed on the backboard. Graphs can include data from previous years for comparison purposes.
3. Make sure all procedures are complete in your research plan. They should be clear enough so that anyone can read the procedure and be able to duplicate the experiment.
4. Avoid tall table model backboards made of foam. Any backboard above 36" should have 3 hinges, with pins in place, if the board is made of anything other than cardboard or foam. No Velcro can be used to hold the backboard together.
5. Models that do not work or explain the projects should not be displayed. Take good pictures to display on the backboard or put them in the notebook.
6. Backboards must be no more than 30" deep, 48" wide and 108" high, including the table.
7. On the back of your display write: Name, School, and Grade.
8. No electrical outlets are available at display stations.

Tips for a successful display board presentation

1. Demonstrates an understanding of the topic, the experimental/design plan, and the results.
2. Clearly demonstrate that the project is the result of your own work.
3. Shows careful planning even if the research or design did not take long to complete.
4. Is neatly hand written or typed, attractive, and well organized. Simple and well stated title.
5. Includes pictures, charts, and graphs that are necessary to explain your work.
6. Tells a complete story – problem and solution with accurate and valid observations
7. Although your project is **not required** to be a new discovery it **should be** original in approach and presentation and **not** just a report summarizing the topic or the product of a premanufactured kit (e.g. plastic model from a hobby kit)
8. Your presentation should be self-explanatory.
9. Gives credit to those that helped.

General Display Board Example for all Categories

This is an example of how a display board is to be organized in the Central Sound Regional Science & Engineering Fair, the Washington State Science & Engineering Fair, the Intel International Science & Engineering Fair, and the Broadcom MASTERS. If you are entering these competitions along with the Shoreline STEM Science Fair, use this format.



How Adults Can Help

- Be a **questioner** to help achieve focus and clarity. Guide the students rather than lead. Encourage students to make their own decisions and use the inquiry approach.
- Be a **helper** by answering questions on the "how to." A student might require help remembering how to set up a graph or chart. Show them how but don't do it for them.
- Be an **assistant** when students need extra hands. Some tasks are just too difficult to do alone. Help them organize time and information.
- Be a **coach** for students who need help. Show or remind them how to use information and assist in finding appropriate search tools.
- Be a **runner** for various materials that the student might need. A student might need materials for the project or to visit a site or interview an expert to enhance their study.
- Be a **wise listener** when students want to share ideas. Allow the student to discuss progress and show interest in the student's project.
- Most importantly, be an **encourager!** Allow students to do their own quality work. Students will perform best if they know they have support from teachers and parents. Let them know how well they are doing and how proud you are of their accomplishments.

Registration for Shoreline STEM Science Fair

Online registration for the Shoreline STEM Science Fair will be available at www.shorelinestem.org from Feb 1 to April 14, 2017. Submitting a Project Planning Form will register you for the science fair.

Project Planning Proposal – All participants must submit

Shoreline STEM Science Fair 2017

Submit proposals between February 1 through April 14, 2017

Student's Name or Team Members' Names (no more than a total of 2 team members per team):

_____

Grade _____ Possible Project Title _____

Category (circle one):

Science Investigation **Engineering Design/Invention** **Computer Science Design/Invention**

School: _____

A brief explanation of your proposed project. Use back of form if more space is needed (2-3 sentences):

_____

_____

_____

_____

Check **Yes** if your project requires the use of any of the following. **A safety review is required**. You will be notified of project approval or if any changes are needed.

Yes	No	
		Human Subjects in any way (even if it's just to ask them questions for a survey)
		Vertebrate animals (animals with a backbone)
		Animal tissue
		DNA
		Radiation

Yes	No	
		Controlled or hazardous substances
		Any micro-organisms (bacteria, viruses, fungi)
		Disease causing agents
		Explosives
		Chemicals not generally found in a household

☐ I understand that when my project planning proposal is approved I will be expected to host my exhibit at the Shoreline STEM Science Fair on Saturday, May 20, 2017 10:00am – 2:00pm at Shoreline Community College.

Parent/Guardian name and email: _____

Submit proposals to shorelinestemfestival@gmail.com or complete online form at www.shorelinestem.org

Shoreline Public School Students: Paper proposals can be turned in at your school office or library (send to Julie Fredrickson).

Project Planning Proposal, Response from Shoreline STEM

The Shoreline STEM Safety Review Team will look at your project proposal and get back to you within a week. Your proposal may be approved without any changes, or you may be asked to make changes for safety. You may receive follow up questions to help clarify your proposal first. You'll get back something like this:

Proposal Review by Shoreline STEM Safety Review Team: _____(Date)

_____ Congratulations! Your project proposal has been approved.

_____ Your project proposal isn't ready for approval yet because: _____

_____

_____

_____

_____

Please address these issues and re-submit your proposal or contact us at shorelinestemfestival@gmail.com