



# **Science & Engineering Fair Mentor's Guide**

**15920 W 10<sup>th</sup> Avenue  
Golden, CO 80401  
(303) 982-0275**

## Table of Contents

<b><i>Overview</i></b>	<b>3</b>
<b><i>Science &amp; Engineering Fair Information</i></b>	<b>3</b>
<b><i>Mentor Activities</i></b>	<b>3</b>
<b><i>Mentor Responsibilities, Expectations &amp; Time Commitment</i></b>	<b>4</b>
<b><i>Mentoring Levels</i></b>	<b>6</b>
<b><i>General Project Guide</i></b>	<b>7</b>
<b><i>Step-by-Step Guide to a Successful Project</i></b>	<b>7</b>
<b><i>Scientific and Engineering prompts</i></b>	<b>9</b>
<b><i>Example In-Classroom Presentations</i></b>	<b>10</b>
<b><i>Online Resources</i></b>	<b>11</b>

Mission: Through the Montessori Philosophy, we inspire every child to learn and grow as a responsible global citizen in a collaborative, peaceful, and safe environment.

Vision: We seek to transform our community by developing students who pursue their full potential, understand their global responsibilities and respect others, self and the environment.

Motto: Montessori for the 21<sup>st</sup> Century – A Place to Learn, A Place to Belong.

## ***Overview***

The Free Horizon Montessori Science & Engineering Fair (S&EF) is an opportunity for students to apply the science, technology, engineering, and math knowledge and skills they have acquired through their hard work at school. It is also a great way for the students to have fun as they create and present a project to professional engineers and scientists.

To assist them in their research and application of science and engineering subjects, Free Horizon has established a mentoring program that is associated with the annual S&EF. S&EF classroom mentors are specialized volunteers within the FHM community that are key to supporting student success throughout the Science and Engineering Fair project process. This guide was developed to help these volunteer mentors to be successful and inspirational guides for the students at FHM.

Since each classroom has a different learning environment, mentors will coordinate with a classroom teacher to establish the best methods for assisting the students within their classroom. Most likely the mentor's activities will consist of science or engineering demonstrations, communicating fair information to the students and their parents, assisting the students during selection and design of their project and guiding the students through their journey if necessary. Most of all you should have fun!

## ***Fair Information***

Click [Here](#) to open the S&EF information web page on the FHM website. The website includes planning packets, important dates, and other resources for students (and parents)!

## ***Mentor Activities***

### **Coordinate with Teachers**

Each mentor should coordinate with the teacher in their assigned classroom to be certain that the information conveyed to the students is consistent with the chosen curriculum and that the times selected to visit the classroom are good for both the mentor, teacher and students. It is required that the mentors contact their teacher prior to beginning mentoring activities.

### **Scientific or Engineering Demonstrations**

Free Horizon's teachers have noticed over the years of conducting the fair that a safe (stress safe) and exciting demonstration of a scientific or engineering concept is one of the best motivational impacts for students. Based on that experience, it was requested that mentors use demonstrations in the classrooms to help inspire the students and build excitement around the S&EF.

The demonstrations don't have to be elaborate. A simple demonstration about a physical principal that shows an unexpected result can have the same effect as something really flashy. Although, flashy is always appreciated by the students as long as it is safe.

There are many sources of information for scientific presentations on line that can be used in the classrooms. Some sources are simple descriptions, while others are kits that you can purchase. The selection of a demonstration topic is entirely up to you and the classroom teacher.

## **Helping Students Select and Design a Project**

As any scientist or engineer knows, planning is the most crucial step of any project. The mentors and teachers must impress upon the students the critical nature of this first step that many students overlook in their excitement to start conducting an experiment or project. Selecting a suitable subject, planning the experimental methods, selecting proper variables and controls and taking good notes are critical aspects of a project that need to be emphasized. In the backup information section of this document is a project guide that will help the mentor and students alike through the selection and planning process.

## **Guiding Students in the Use of the Scientific and/or Engineering Process**

The scientific or engineering problem solving process is the foundation on which all projects should be based. Mentors should assist the students in properly applying those processes correctly and successfully. The project guide included at the end of this document will help mentors maintain consistent application of the scientific or engineering problem solving process.

## **Conveying Fair Specific Information to Students, Parents and Teachers**

Communicating consistent information to all involved is one the most challenging aspects of coordinating any complex event such as the S&EF. The mentors are one of the many methods that FHM uses to convey the correct information to students, parents and teachers, and are the single point of contact in each classroom for information pertaining to the S&EF.

## ***Mentor Responsibilities and Expectations***

### **Estimated Time Commitment**

Although each classroom will require different commitments, mentoring a classroom will require approximately 4-8 hours per month prior to the fair and approximately 4 hours during the day of the fair. Generally, lower elementary and primary classrooms will take less commitment than upper elementary and middle school. If you choose to help 6th -8th grade students that elect to move on to the regional fair, additional time may be required.

Volunteer mentors are expected to commit themselves to the students as describe in this guide. If a mentor is unable to meet this commitment, it is the mentor's responsibility to notify their assigned classroom teacher and the S&EF planning committee as soon as practical so that a new mentor can be assigned.

### **Objective Assistance & Guidance**

Mentors are expected to objectively assist and guide the students through their projects. It is the students' responsibility to conduct and complete the project. No student or team should be given preference over another.

The only time a mentor may physically help a student or team with their project is if safety would be compromised otherwise or if science fair rules require it.

### **Ethics**

Ethics is paramount to maintaining the objective nature of the scientific process. Mentors are expected to display the highest ethical conduct while working with the students. Mentors are also expected to

instill the same ethical behavior in the students by discussing with them if necessary that lying, copying, plagiarism, improper manipulation of data or any other unethical behavior is unacceptable. Mentors are responsible for reporting any unethical behavior to the classroom teacher. It is not, however, the mentors responsibility to discipline the students if unethical behavior is witnessed.

Ethical and humane treatment of any animals used for student experiments is required. Even though the FHM Scientific Review Committee (SRC) will review all student projects, if the mentor becomes aware of the usage of animals for an experiment, it is their responsibility to pay closer attention to the nature of the experiment and report any concerns to the classroom teacher, the SRC or the school principal.

## **Safety**

Safety of the students, their potential human or animal subjects, and the environment is of utmost importance.

Even though each project is reviewed by the SRC, mentors will most likely be the first to discover the subject of each project in their assigned classroom. If the mentor becomes aware of potential safety concerns, it is expected that the mentor will attempt to direct the student(s) to re-design their experiment to more adequately eliminate or reduce to an acceptable level the safety concerns or risks. If the mentor is unable to reduce the risk, it is their responsibility to report the concern to the classroom teacher, the SRC or the school principal.

## **Communication**

Mentors are an integral part of the communication path for the S&EF. It is important that the mentors be able to answer questions that they are able to answer or direct any questions that they are unable to answer to the appropriate school staff or S&EF committee members. Mentors can expect questions not only from the students, but from parents and teachers. It is the mentor's responsibility to quickly and accurately answer any questions.

Communicating with the students the enjoyment and satisfaction of completing and presenting a well-designed and executed experiment or project is one of the primary roles of a mentor. A mentor's enthusiasm for science and engineering will have a lasting impact on the students. It is expected that the mentor will project their enthusiasm for science and engineering to the students. A boring mentor will not inspire the big brains of FHM to work their hardest.

## **Familiarity**

It is expected that mentors will take the time to familiarize themselves with the specifics of the FHM S&EF so that if questions arise, the mentors will be able to quickly and accurately answer the question or forward the question on to a staff member or S&EF committee member that will be able to answer. Most of the information specific to the S&EF will be posted on the FHM website. Some of the information is included in this guide.

## **Have Fun**

Second only to safety, having fun mentoring the outstanding students at Free Horizon is required. Although it can be struggle to find the time and energy to commit to the students, the outstanding projects that result make the effort well worth it.

## ***Mentoring Levels***

### **Mentoring Primary Classrooms (PK3-K)**

Primary classrooms can be the most enjoyable classrooms to mentor. The awe and wonder that the simplest demonstration brings out of the students is a pleasure to witness. Since the primary students are just beginning their journey into science and engineering, the emphasis by mentors should be on excitement and fun. Do your best to get them involved, but don't put too much emphasis on perfection.

Remember... Fun, fun, fun!

Simple study projects are acceptable as many of the students may not quite comprehend the scientific method. Although discouraged at higher levels, significant parental help in creation of primary projects is OK. Primary student participation in the S&EF is not required.

### **Mentoring Lower Elementary Classrooms (Grades 1-3)**

Similar to the primary classrooms, participation by the lower elementary classrooms is not required, but is highly encouraged. Scientific or engineering demonstrations at this level have a significant impact. More emphasis on the scientific process should be applied at this level because it is becoming an integral part of the science curriculum. Fun and excitement are still the primary goals to getting the students at this level interested and involved.

### **Mentoring Upper Elementary Classrooms (Grades 4 &5)**

Participation in the S&EF is required for upper elementary classrooms. Upper Elementary classes will be doing their projects in groups and during classroom time. Emphasis for upper elementary classrooms should be on the scientific or engineering problem solving process, project design, data collection and presentation. More complex scientific principles are an integral part of the curriculum. A higher standard of performance should be stressed.

### **Mentoring Middle School Classrooms (Grades 6-8)**

As in upper elementary, middle school participation in the S&EF is mandatory. All students are eligible for participation in the regional fair. Mentors middle school classrooms will need to become familiar with the process to participate in the Denver Regional Science & Engineering Fair. A link to the Regional fair web site is on the FHM web site and in the Online Resources section of this guide.

Participation by middle school students in the regional fair is voluntary, but highly encouraged. Emphasis at the middle school level should be commensurate with the more advance scientific and engineering principles being taught. Project design, experimental methods, data collection and organization, and presentation, both oral and visual, should be more advanced.

## Additional Information

### ***General Project Guide***

This is just a general project guide to help mentors review the process necessary to create a project. The school will distribute a planning guide that the students will use to direct them during their projects. The planning guide is also posted to the FHM S&EF webpage [here](#).

### **Find a Project Category That Interests You**

Sometimes it's easier to get an idea if you narrow your thinking to one category first. Here are some categories that might interest you.

<b>Science Categories</b>	<b>Engineering Categories</b>
Astronomy	Aerospace
Biochemistry	Biomedical
Biology	Chemical
Botany	Civil
Consumer Chemistry	Computer
Food Chemistry	Electrical
Environmental Science	Environmental
Geology	Forensic
Math/Computer Science	Industrial
Meteorology	Manufacturing
Sociology/Psychology	Materials
Paleontology	Mechanical
Physics	Software
Zoology	Structural

### ***Step-by-Step Guide to a Successful Project***

Scientists and engineers love to ask questions. The scientific method, and similarly the engineering problem solving process, is a step-by-step process through which they find the answers. Other scientists or engineers can go through the same steps and get the same answer. This means you can be certain your conclusion is precise.

#### ***STEP 1: Choose a Topic***

Is your topic unusual? Or, did you find a new approach to an old problem? A creative topic is important. You don't want to do the same experiment as a dozen other kids. You want to try to do something not many students have tried. That will make your entry stand out. Also, it will be more fun to find out the answer.

Your topic is your question or problem statement. It is usually something you wonder about. Do you really have more germs on your hands before you wash them? Are cats smarter than dogs? Are vegetables really better for you than candy? How can I improve how something works?

Some classrooms will already have a set of topics for the students to select for the S&EF.

## ***STEP 2: Find Out More, Research***

Doing research tells you if this topic is really interesting to you. It helps you narrow down your question. You want a question that you can find the answer to. In fact, your research helps you think what the answer might be, then you can form a hypothesis or potential solutions.

## ***STEP 3: Form a Hypothesis (scientist) or Suggest a Solution to the Problem (engineer)***

Now that you have learned more about your topic, what do you THINK the answer might be? To a scientist, this is their hypothesis. It's an informed guess. A hypothesis is not a question. It is a statement of what you think is true, based on your research. "Washing hands in warm water kills more germs than washing hands in cold water." "Cats sleep more than dogs." "You can't tell the taste of a soft drink with a blindfold." Your hypothesis might be true or it might be false, therefore you need to test it. Engineers, on the other hand, will formulate a potential solution to the problem they are trying to solve. Through their research, an engineer may have developed several solutions, but this is the one that they think is best.

## ***STEP 4: Test Your Hypothesis or Problem Solution***

For most science projects, you will do an experiment to test your hypothesis. Engineers use a very similar process to test if their problem solution is the best or if they have to iterate. In other words do they have to try several variations of their proposed solution to generate the best solution? Remember, you want other scientists and engineers to be able to do your experiment or testing and get the same results. Be sure to write everything down through proper documentation in your log or journal. Include:

- Your purpose (why are you doing this experiment or test?)
- Your procedure. Be sure to write down every step. You are writing a "recipe" for your experiment or test.
- Your materials. If you have to buy things, write down where you got them and what they cost. Often you can use materials you have at home, but you still need to list them.
- Variables. These are things that change.
- Controls: These are things that stay the same.
- Data: What happened?

***Design your experiment or test before you perform it.*** Think about the factors that could change the results...light, heat, cold and humidity, for example. You want to control as many variables as you can. When you do your experiment or test, you might want to take pictures. If you are testing products, side-by-side pictures or before-and-after pictures are good.

Once you have completed your experiment or test, you will have your Results.

## ***STEP 5: Formulate Results***

Results are what you discover, usually in the form of data. In research, data usually means numbers, which can be turned into graphs and charts to make your results easier to understand. Good graphs makes an ordinary person say, "I see what happened".

A good scientist or engineer always double-checks results. This is especially important if your hypothesis or problem solution is different from what most people think. It is also important if your research disproves your hypothesis or solution. You may need time to do the experiment a second or third time.



Follow the directions in your log. Does it turn out the same way? If not, what happened? Did you forget to write down one of the steps?

Were there other variables that might have changed the results?

Once you are sure your results can be repeated by other people, you need to draw a conclusion.

### ***STEP 6: Draw a Conclusion***

In an experiment or engineering test, you learn whether your hypothesis is true or false or if your problem solution is the best. But you always learn more. How can you put what you learned to work in everyday life?

Examples:

- If hot water boils faster than cold water, you can have spaghetti sooner if you put hot water on to boil.
- If your cat likes cheaper food as well as she likes expensive food, you can save some money.
- If grass grows an inch every 9 days, do you have to mow the lawn every 7 days?

Once you have reached your conclusion, you will want to write a report. Your report tells about your project in a way that an ordinary person can understand. It summarizes the entire scientific method or engineering problem solving process.

What did you want to find out? What did you do to find it out? What happened? Where did you get your materials? How much did they cost? How much time did it take? These are things that people would like to know.

For the science and engineering fair, of course, your report becomes a display.

### ***Always Remember...***

- Don't copy. It's okay to get the idea for your project from someone else, but don't copy another student's work.
- Start from the beginning and do everything yourself. Copying someone else's work is called plagiarism. It is wrong.
- Don't let your parents help too much. It's okay to ask them for advice or some help. But if they try to take over your project, remind them this is YOUR project, not their project.
- Credit your sources. While you do your project, you will probably get some help from people, books or websites. Be sure to list the help you got as part of your written report.

### ***Scientific and Engineering prompts***

- What did you learn?
- Did you follow the scientific method or the engineering problem solving method as appropriate?
- Was your experiment suitable to test your hypothesis or problem solution?
- Did you do enough testing to know your conclusion is right?
- Did you double-check your results?

## ***Paperwork***

Your activity log or journal, your data and your report are part of your display. The information should be complete and well organized. If you used references (books or the Internet), be sure to credit your sources.

## ***Project Display Information & Layout***

Is it clear and easy to understand? Is it complete? Did you take care in creating it? Is it well-designed and attractive? Is it fun to look at? Good science deserves a good-looking display.

## ***Oral presentation***

At science fairs, you will be asked to present what you learned to the judges. It should be a short version of your entire project. You should practice your presentation by making it to friends and family. That way, you won't be nervous. The judges might ask questions. Since you did all the work yourself, you will know the answers.

## ***Example In-Classroom Presentations***

### **Who can make a penny fly the farthest?**

Required Supplies: 8.5 x 11 paper, pennies, tape measure.

After a quick demonstration on how to fold a paper airplane, have each of the students in the classroom fold a paper airplane. Encourage the students to try different ways of folding their airplanes. Have each student tape a penny to their airplane discussing with them how the penny can affect how the airplane might fly. One at a time, have the students toss their airplane from the same location and measure the distance each one flies. Have a student record the distances on the dry erase board. Discuss with the students why some airplanes flew farther than others.

### **Strongest Lego Bridge**

Required Supplies: Legos, weights (can be anything that is easy to incrementally add weight)

Give each student in the class an equal number of Legos that are the same size. Challenge the students to make a bridge that spans a fixed distance (maybe two inches). Gradually apply weight to each bridge until it fails. Record the weight at which each bridge fails. Discuss with the students why the strongest bridges were able to support the weight.

### **Pendulum Principles**

Required Supplies: String, several different weights to which you can tie string.

Using the scientific process, have the students develop a hypothesis about the period of a pendulum and what might change its period (weight, pendulum length, air resistance, etc.). Have the students pick the variable that they want to change to test their hypothesis. Assist the students in conducting their experiment. Does the results of their experiment support their hypothesis?

## **In-Classroom Project Comments**

These are just three of a bazillion projects that you could do in the classrooms with the students. They are fairly simple, but easily demonstrate basic scientific or engineering principles. More complex and flashy demonstrations can be done if desired, but safety always has to be the first consideration. Involving the students is always desirable and projects that do so will have a much greater impact. There are many resources online to guide you on finding more cool projects or demonstrations to share with the students. See the next section for only a few of the many online resources.

## ***Online Resources (click on the heading to go to the web site)***

### **[Science Buddies](#)**

Great site that has a wealth of information for students, teachers, parents and mentors. Lots of project ideas too.

### **[Discover Channel Science Fair Central](#)**

Great site by the Discovery Channel that walks students (and parents) through the process of creating a science project. Has quite a few project ideas and help for other subjects besides science too.

### **[Education.com – Science Fair Project Ideas](#)**

Yet another great site for project ideas and in class demonstrations. Over 2400 different project ideas.

### **[All Science Fair Projects](#)**

If you can ignore the ads, this is another great site that has not only project ideas, but more links to other useful science and engineering web sites.

### **[Science Fair Extravaganza](#)**

Site by the Illinois Institute of Technology that has information on project ideas but plenty of help on how to conduct each part of a project.

### **[Science Fair Adventures](#)**

Even more projects to search. Some can be used as demonstrations in classrooms.

### **[Science Bob – www.sciencebob.com](#)**

Lots of cool demonstrations that can be used in front of the classrooms. Also has some science kits that you can buy to do experiments.

### **[Denver Regional Science & Engineering Fair](#)**

Home page for the Denver Regional Science & Engineering Fair. Go here to familiarize yourself with the regional fair process.

### **[Science Friday](#)**

Science Friday is a source for news and entertaining stories about science. They started as a radio show in 1991 and now produce videos and original web content covering everything from octopus camouflage to cooking on Mars. SciFri is brain fun, for curious people.

**If you find any more cool sites that you think would be helpful, please let us know and we'll try to put them here.**