# Purpose of the Monterey County Science & Engineering Fair

- Provide traditional motivation for young people to apply creativity and critical thought to the solution of science, engineering, mathematics, and technology problems;
- Encourage students, teachers, parents, scientists, and engineers to meet, exchange information and ideas, and discuss career opportunities;
- Publicly recognize the achievements of talented science students, grades 6-12, in the greater Monterey County area; and
- Foster school-community cooperation in developing the scientific potential and communication skills of tomorrow's leaders.

Over 350 student projects are exhibited at the fair each year, from public, parochial, private, and charter schools. Over 200 category and special awards are given. Top projects in the Junior and Senior Divisions may be selected to advance to the California State Science Fair. Top Senior Division projects may be selected to represent Monterey County at the Intel International Science & Engineering Fair where students will compete with over 1700 young scientists selected from 435 affiliate fairs in more than 70 countries, regions and territories

For effective science education, the multifaceted nature of science must be addressed. The Science Framework for California Public Schools sets forth four major goals:

1. Attainment of positive attitudes toward science
2. Attainment of rational and creative thinking processes
3. Attainment of manipulative and communication skills
4. Attainment of scientific knowledge

All of these goals are experienced by students while preparing, following and completing a science fair project.

There are also a number of specific benefits to classroom teaching, curriculum, students, and the community, which are the results of thorough science research projects.

**<u>Benefits to Classroom Teaching</u>**

- Involves students directly in science activities to better understand the developmental aspect of science.
- Allows the opportunity to work beyond regular classroom content and/or depth of study.
- Stimulates student curiosity
- Encourages students to investigate on their own initiative.
- Provides platform for solid Next Generation Science Standards (NGSS) integration through project based learning and inquiry.

**Benefits to the Curriculum**

- Integrates science with other curriculum areas including mathematics, computers, and language arts.
- Provides opportunities for interdisciplinary development in reading, writing, and library research skills.

**Benefits for Students**

- Encourages students to explore topics of special interest.
- Helps develop managerial skills such as organizing activities and materials and meeting a timeline.
- Acquaints students with various science-related careers.
- Assists students in making realistic decisions about preparing for careers in science, taking into account the abilities and interests of the student.
- Provides a forum for students to demonstrate their work to peers and teachers.
- Indicates an achievement level on college admissions forms and scholarship applications.
- Gives students a chance to claim ownership of their own work.

**Community/Public Relations Benefits**

- Shows what schools are doing to motivate students.
- Demonstrates community/business support through assistance in project development or financial support of a science fair.
- Public recognition to gifted science students.

## MINIMUM QUALITY STANDARDS for Projects

Find the type of project you are doing from the list below and review the minimum requirements for project acceptance. Make sure that the information described in the requirements list is included in your Research Plan attachment of your application.

### Types of Science Fair Projects

**Science Project**: investigates the effects of changes or answers the question "Why?".
**Engineering Project**: solves a need or problem, and includes measurements of success.
**Product Testing Project**:(grades 6-8 only) tests and compares similar items using measurable endpoints.
**Human Participants Project**: Projects where people are being studied.

### Science Project minimum requirements

1. Subject defines a testable question that begins Why… or What is effect of a change in X on Y? (for example, what is the effect of a change in the amount of sunlight on the growth of tomato plants).

2. Bibliography includes references from your literature research.

3. Hypothesis based on your library research and knowledge. It is your best estimate of what will happen.

4. Experimental design

    - Define a control (a "standard" group) to which all test groups will be compared.
    - Define test groups where only one variable differs from the "control" group.
    - Define the measurable endpoint(s).
    - Each test group should contain a minimum of 3 objects being tested (seed, plant, rat, etc.). A group size of *at least* 10 is required for projects with human participants.
    - Plan to change only one variable in each test cycle. However, change the variable in several ways (several concentrations of a chemical, several temperatures, or several time points etc.).
    - Report measurements in metric units when possible.
    - Repeat the test more than once to see if your results are reproducible.

### Engineering Project minimum requirements

1. Clearly define the problem or need the engineering project will solve.

2. Include Bibliography from your literature research.
3. List design criteria and design constraints
    - Physical and functional characteristics of the design (shape, weight, etc).
    - Design constraints/limitations (cost, time, available materials, etc).
4. Clearly state success criteria. What will you measure to see if your design worked?
5. Report measurements in metric units where possible.

**Product Testing Project minimum requirements** *[Grades 6 –8 only]*

1. Clearly identify what kind of item (soap, fabric, etc.) you plan to test.
2. Define a test group of at least three similar items (Grades 6 and 7) or four similar items (Grade 8 ).
3. Include test criteria that:
    - Define what will be measured.
    - Describe how you will take measurements.
    - Report measurements in metric units, when possible.
    - Define criteria for "the best" (cleanest, largest, coldest, etc).
    - Repeat the test more than once to see if your results are reproducible.

**Human Participants Projects.**

Details of the rules for Human Participants projects are available in Pages 8 through 10 of the **2019 Rules and Guidelines** (PDF) available from the Intel ISEF website at https://student.societyforscience.org/forms.

Minimum quality guides involve having at least 10 human participants and having a quantifiable, measurable endpoint. Projects usually need to specifically address issues of randomization of trials (not mixing up treatments, or ignoring learning from participating previously ). Many student applicants fail to fully complete the Human Subjects' Detailed Research plan, or fail to include a complete sample test or sample Informed Consent Form for us to review.

Subjects may not be asked to ingest foods without proper medical supervision and/or as a reward for participation.

# Suggested Timeline For Schools

**<u>Oct, Nov, Dec</u>: Teachers email Ginny Brown (gbrown@montereycoe.org) with estimated number of projects.**

**<u>Oct:</u>** Schedule the date of your school science fair (prior to the Monterey County Science Fair application deadline which will be February 20, 2019). Check rules for the County Science Fair so that teachers are well informed on regulations, requirements and timelines.

**<u>Nov:</u>** Work with students to understand the components of a science fair project.
Assist students in selecting a suitable topic.

**<u>Dec:</u>** Assist students in writing a project purpose. Help students conduct a review of the literature using previously identified library and Internet sources. Check to ensure that all projects conform to safety rules and proper care of human subjects, animals, tissue, and hazardous chemicals (Any experiment where animals or humans might be injured or experience pain should not be allowed.)

**<u>Jan:</u>** Help students develop a list of materials needed for projects (optional). Discuss the nature of experimentation with students, explaining the difference between controlled and uncontrolled experiments. Review the process of observing, measuring, and collecting data. Provide time, space, and guidance for experimentation. Make arrangements for regular (weekly) progress reports from students.

IF YOU HOLD A SCHOOL FAIR:
Develop a judging sheet that incorporates your expectations for projects.
Arrange for judges and/or teachers to grade the projects.
Help students develop conclusions and organize and assemble the final report.
Arrange for a review of student's required laboratory notebook (possibly by language arts teachers.)
Publicize your fair to your stakeholders, including parents, city officials, Board of Trustees, administrators, faculty.
Plan physical layout of the space for the fair.
Confirm time and date with judges.
Assist students to develop final copies of report.
Review exhibit design and construction with students.
Review qualities of a good exhibit including layout, lettering, color, etc.
Review, with students, the criteria for a successful oral presentation. Schedule a practice session in class.

**SCIENCE FAIR DAY**
Organize and set up tables for projects.
Prepare judging sheets and make necessary copies.
Review judging criteria for judges.
Thank judges and volunteers.
Select top projects to advance to the Monterey County Science & Engineering Fair.

**2019 Monterey County Science & Engineering Fair**

# Senior Division: Does your project require Pre-Approval?

**Find out fast!**

Some research projects require Pre-Approval from the Scientific Review Committee (SRC). If you answer yes to any of the questions below, **you must submit ISEF Certification Forms prior to experimentation.**

1. **Human or Vertebrate Animal Tissue or Fluid Source:** ______YES ______NO
   Does anything come from a human or animal body? This could include cheek cells or other cells, teeth, bone, blood, saliva, or urine. Is RNA or DNA from one organism inserted into the RNA or DNA of another organism?

2. **Human Subjects:** ______YES ______NO
   Are you asking your friends or other people questions? Are you conducting experiments on yourself or experiments with people in any way?

3. **Non-Human Vertebrate Subjects:** ______YES ______NO
   Does your project involve your pet? Or, any other animals that have bones (except people)?

4. **Hazardous Chemicals, Activities or Devices?** ______YES ______NO
   Does your project include DEA-controlled substances, prescription drugs, alcohol & tobacco, firearms and explosives, radiation, lasers, etc. The rules include substances and devices that are regulated by local, state, county or international law, most often with restrictions of their use by minors. Hazardous activities are those that involve a level or risk above and beyond that encountered in the student's everyday life.

**If you answered no to all, your project does not need SRC pre-approval.**
**If you answered YES to any, SRC Pre-Approval is Required. Please submit signed ISEF Certification Forms and Research Plan prior to experimentation. Forms are available at**
**www.montereycountysciencefair.info**

For additional information, please contact
Ginny Brown at 755-0303 or gbrown@montereycoe.org

**SRC Meetings Will Be Held to Review Senior Division Projects on November 8, 2018, December 7, 2018 and January 11, 2019**
**Please Submit Your Paperwork Via Email One Week Prior to These Dates.**

| Schedule & Deadlines for the Monterey County Science & Engineering Fair | |
|---|---|
| Teacher/School Intent to Participate & Estimated Project Numbers | October, November, December |
| Begin Online Application/Registration | November 1, 2018 |
| Submit SENIOR DIVISION student project proposals for projects involving human subjects, tissues, vertebrate animals, and hazardous chemicals for pre-approval by the SRC. Submit via email to: gbrown@montereycoe.org | November 2, 2018<br>December 1, 2018<br>January 4, 2019 |
| Scientific Review Committee Meeting –<br>Review of **SENIOR DIVISION** projects involving Human Subjects, Vertebrate Animals, Tissues, and Hazardous Chemicals | November 9, 2018<br>December 7, 2018<br>January 11, 2019 |
| DEADLINE FOR SCHOOL SELECTION OF PROJECTS TO ADVANCE TO THE COUNTY SCIENCE & ENGINEERING FAIR | February 1-15, 2019 |
| Registration/Application Deadline | February 20, 2019 |
| Final Scientific Review Committee Meeting at NPS<br>Review of all projects submitted for fair competition | March 1, 2019 |
| Deadline to receive signed copy of submitted online application | March 1, 2019 |
| | |
| Monterey County Science & Engineering Fair | March 15-17, 2019 |
| Project Set-Up at CSUMB, University Center, Building 29 | Friday, March 15, 2:30 – 5:30 PM |
| Student Interviews, CSUMB, University Center | Saturday, March 16, 11 AM–1 PM |
| Winning Projects Tagged<br>Project not tagged may be taken home. | Saturday, March 16, 3:00 PM or upon completion of judging |
| Public Viewing of Projects | Saturday, March 16, 3:00 – 4:30 PM upon completion of judging |
| Public Viewing of Winning Projects | Sunday, March 17, 11 AM-1 PM |
| Awards Ceremony, CSUMB, University Center | Sunday, March 17, 1 PM |
| Project Removal | Sunday, March 17, 2:30–3 PM |
| | |
| Questions? Please call Ginny Brown at 831-755-0303 | |

*Any project left at CSUMB will be disposed.

# Integrating Project Based Learning, Science Fair Projects, and the Common Core Standards

***Science Fair projects** are a natural end result of Project based Learning in science and provide a venue for students to present their work to the public. Science Fair projects incorporate almost all aspects of the CA Science Standards for Investigation and Experimentation. These projects should not be looked upon as something "extra" to do but are an essential process to address the content and Common Core Standards as well as the Project-based Learning approach to teaching.*

**Project Based Learning** is a key instructional approach to implement the **Common Core State Standards** and prepares students for college, career and citizenship in the 21st century. In PBL, students go through an extended process of inquiry in response to a complex question, problem, or challenge. Rigorous projects help students learn key academic content and practice 21st Century Skills (such as collaboration, communication and critical thinking).

## Project Based Learning that is rigorous, meaningful and effective:

- **is intended to teach significant content.** Goals for student learning are explicitly derived from content standards and key concepts at the heart of academic disciplines. *Science Fair projects also spring from core content.*
- **requires critical thinking, problem solving, collaboration, and various forms of communication.** To answer a driving question and create high-quality work, students need to do much more than remember information. They need to use higher-order thinking skills, teamwork, make their own ideas clear when speaking, be able to express themselves in various modes, and make effective presentations. These skills, competencies and habits of mind are often known as "21st Century Skills," because they are a prerequisite for success in the 21st century workplace. *These skills are also vital to designing, conducting and presenting a successful science fair project to peers, judges and the general public.*
- **requires inquiry as part of the process of learning and creating something new.** Students ask questions, search for answers, and arrive at conclusions, leading them to construct something new – *just like a science fair project!*
- **is organized around an *open-ended* driving question.** This will help focus students' work and deepen their learning by framing important issues, debates, challenges or problems. *Choosing a problem that is specific enough to investigate and makes connections to the real world is the first step to a solid science fair project.*

- **creates a "need to know" essential content and skills.** PBL reverses the order in which information and concepts are traditionally presented. Project Based Learning begins with the vision of an end product or presentation. This creates a context and reason to learn and understand the information and concepts. *Most science fair students create an experimental design and procedure to test their hypothesis and then learn the concepts and special skills involved in testing the hypothesis as they go.*
- **allows some degree of student voice and choice.** Students learn to work independently and take responsibility when asked to make choices. The opportunity to make choices, and to express their learning in their own voice, also helps to increase students' educational engagement. *Science Fair projects should be linked to a student's passion for the subject. Students should be able to choose their project and complete it on their own with little outside assistance.*
- **includes processes for revision and reflection.** Students learn to give and receive feedback in order to improve the quality of the products they create, and are further asked to think about what and how they are learning. *Science Fair projects inherently involve reflection; re-design, re-testing and peer review to thoroughly answer a project problem.*
- **involves a public audience.** Students present their work to other people, beyond their classmates and teacher – in person and online. This "ups the stakes," and increases students' motivation to do high-quality work - *just as creating displays and judging does for science fair projects. (The above section was adapted from the Buck Institute description of PBL)*

**Resources**

- *Common Core State Standards website* *http://www.cde.ca.gov/re/cc/*
- *Common Core Standards link* *http://www.ocde.us/commoncoreca/Pages/default.aspx*
- *Institute for Inquiry (Exploratorium)* *http://www.exploratorium.edu/IFI/index.html*
- *Inquiry-Based Learning (an online workshop)*
  *http://www.thirteen.org/edonline/concept2class/inquiry/index.html*
- *Open Inquiry in Scientific Research Curriculum Materials (PBL)*
  *http://bml.ucdavis.edu/education/cameos/resources/open-inquiry/*
- *Project Based Learning (Buck Institute) http://www.bie.org/*

**Downloadable Resources from pbl-online.org**

- **Project Planning Forms**
  http://www.pbl-online.org/ProjectPlanning/PlanningForm.htm
- **Assessment Tool Doc**
  http://www.pblonline.org/PlanTheAssessment/assessmentTools/assessmentTools.htm
- **Sample Rubrics**
  http://www.pbl-online.org/PlanTheAssessment/assessmentForms/sampleRubrics.htm
- **Project Planning Tools**
  http://www.pbl-online.org/ManagetheProject/ProjectPlanningTools/PlanningTools.htm

# Starting a School Science Fair

**To establish a Science Fair**, the teacher must decide the type of organization most suitable for the students. Teachers can help formulate the student's thinking by answering the following questions, considering the ability and maturity of the students and time constraints:

- How much class time do you wish to devote to science projects? Should class time be concentrated in one unit or used intermittently to check projects?
- What types of projects will be allowed: Experiments, demonstrations, review papers, and research projects?
- Will the project be required of all students for a grade or encouraged as extra credit?
- Are other teachers in your school willing to participate on various levels? Will English teachers accept a science project paper as a writing assignment? Can participation in the science fair be a department or school policy?
- How supportive is the administration? Is space available to house a science fair? How many projects can be displayed -- and for how long?
- How much support will be available from community organizations? Will parents help with the fair? Will community members with technical expertise counsel students?

**A school-wide science fair** with prizes in each category is ideal, but not necessary. It is more important that the students learn the processes of science and are proud of their individual efforts. This can be accomplished very simply by one teacher displaying projects of selected students in one classroom. As your fair continues to grow, plans might include an exhibit area, specific judges, a reception for parents and students, prizes, and an awards ceremony.

**Once you have decided on the scope of your science fair**, organization of the various elements of the fair follows. The more pre-planning, the more efficiently the fair will be run. Pre-planning might include:

- Develop a Science Fair Calendar to include introducing the idea of a science fair to students, collecting project proposals, checking on progress, previewing the project notebook, and setting up the completed project display.
- Schedule the science fair on the school master calendar to reserve the facility and to tie in with other activities.
- Write a list of necessary tasks and determine who will complete each task.
- Decide the number and kind of forms to be used.
- Collect magazines and books from the library that may provide help to formulate project ideas. Search the Internet for ideas.
- If possible, form a committee of interested teachers, parents, principals, and community members to assist in the organization of the fair.
- Check the References and Resources section in this Handbook for ideas.
- **Schedule the school science fair prior to the County Science Fair application deadline**.

# Getting Ready for Science Projects

A Science Fair project should be viewed by students as part of the science curriculum. From the beginning of the year, students must work on developing the skills necessary to complete a good project.

- When performing activities or experiments point out the important elements: Introduction, Procedure, Data Gathering, Results and Discussion.

- Graph simple relationships using a variety of grade-appropriate graphs.

- Use vocabulary such as variable, control group, and hypothesis.

- Assign an open-ended inquiry to be done as homework. As an example: Perform and write up an experiment to measure the friction of three different surfaces.

- Assign group projects of topics to research or demonstrations to perform with classroom presentations.

Getting started with an idea that is both broad enough to be interesting and narrow enough to be possible is the challenge. A thorough introductory presentation to students will assist them in finding a practical and interesting topic.

- Request a presentation from students who have participated in previous science fairs.

- Suggest that students consider their personal interests and hobbies to discover an idea for inquiry.

Check project proposals to see that necessary materials for the project are easily obtained. The projects can be similar to an activity or experiment scheduled for later in the year within the regular curriculum. ***Ensure that senior division projects involving human subjects, tissues, vertebrate animals, and hazardous chemicals are submitted for pre-approval to the Monterey County Science Fair Scientific Review Committee (SRC).***

Students should keep the problem simple; complicated technology is not required. Stress the importance of safety. ***A winning project is one that combines creativity, attention to detail, and sound scientific thought.***

For a more complete introduction to science projects, discuss the ***Selecting a Topic*** section with students. Refer to the Science Fair website for links to other helpful websites.

# Selecting a Topic

Science begins with wonderment. Students should make a list of things they are curious about. This will start the thinking process toward selecting a topic.

Choose a topic in which you are genuinely interested. The topic may be one related to a long-time hobby or something entirely new for which you would like to have a better understanding. Some scientific displays such as collections, illustrations, demonstrations or models are NOT science fair projects. Listed below are four types of science fair projects.

**A Science Research Project** seeks to find new knowledge for the student at his/her appropriate grade level. A science project is one way of asking a question and answering it via the scientific method. One recent winning project asked, "What frequency of sound wave would travel through water with the least intensity?"

**An Engineering Project** uses scientific principles to improve or create new applications. The project may be theoretical or an experimental study on a model.

**Computer Projects** may deal with innovative programming, designing or improving applications, or improving hardware. An existing program may be improved to run faster and use less memory.

**A Mathematics Project** deals with math not usually covered in the classroom. The project should represent a new point of view of a known topic.

Try some of these sources for topic ideas:

| | |
|---|---|
| *Magazines* | *Lab Manuals* |
| *Demonstration Books* | *Newspapers* |
| *Internet* | *Educational Periodicals* |
| *Science Fair Handbook* | *Talks with teachers, friends, professional people* |

Parents should approve all plans prior to submission to the teacher. Any submitted plans should include all required adult supervision descriptions.

Keep safety in mind. It is recommended that you use *Science Safety Handbook for California Public Schools* as a guide to safe procedures and selecting safe and appropriate materials ( http://www.cde.ca.gov/pd/ca/sc/documents/scisafebk2012.pdf ). Are the materials and equipment safe enough to handle on their own, or must they have adult supervision? Be especially careful of lasers, high-pressure gases, high temperatures, high electrical currents, and certain biological specimens. In accordance with the California State Education Code 51540, experiments involving live vertebrate animals (including humans) cannot in any way cause pain or harm to the animal. Projects involving live vertebrate animals should not be repetitive. If, for example, the experiment has been done repeatedly in the past with the same results, it is not an ideal choice for a science fair project.

## Literature Search

Find out what has been written about the selected topic. Search the library and Internet for good references. Students should not confine their search to Wikipedia or a few Internet sources. Students should look for the most recent research and information. Take notes on your reading. Be certain to record all the information required for a bibliography from the books or magazines used as references.

The literature search can help further define the research problem. If an enormous amount of material is available on the topic, it is probably still too general. If a student cannot find anything on the topic, he should ask the teacher for assistance in determining the subject category. Mentors may be available at other science fair web sites.

Talk to teachers and specialists in the field. If there are specific questions, write them down. Call nearby scientific companies, engineering firms, hospitals, or universities and ask if there is someone to help answer questions. It may be surprising how willingly people will help, if the student can explain what he/she needs to know. Include an acknowledgment of assistance from specialists in the project write-up.

## Developing a Hypothesis

Science often begins with a refined testable question. The "If. . . then" statement designs the experiment. With a well-stated hypothesis the rest of the experiment follows easily. The hypothesis tells you what data to look for and what it will mean when it is found.

The form is: If...(Followed by a statement of the hypothesis) then...(followed by a logical cause and effect statement that will be true if the hypothesis is correct).

For example: If the work done in drawing a compound bow is greater than that required for a simple bow or slingshot, then the arrow shot from the compound bow should travel further than an arrow shot from a single bow or slingshot.

An additional negative statement is frequently helpful in defining the control: Bean sprouts with no nitrogen in the soil will not grow as fast or as high as normal.

## Selecting a Title

Now that you have laid all the groundwork, you can select a working title for your project. The title should describe the project in less than ten words. For example "The Effect of Nitrogen Fertilizers on Bean Sprout Growth."

# Experimenting

## Materials and Methods

Make an exact list of the amount and type of materials needed. Items may be purchased from hardware, drug, or variety stores. Some items may need to be ordered from science supply companies; therefore, planning ahead is necessary. Keep an accurate record of the kind of material and the quality of each used in the experiment. Use metric weights and measures (meters, kilograms, liters, etc.)

> ***At all times, safety should be the first consideration when using any materials and performing any procedure.***

Plan the list of procedures that will follow in performing the experiment. Another person should be able to copy the procedure exactly after reading that section. If there is any question about the safety of any step, ask a knowledgeable adult to review the methods.

The experimental design may often include controlled experimentation. In other words, set up an experiment with few variables. The independent variable is the variable changed by the experimenter in performing the experiment. The dependent variable is the variable that changes as a result of the experiment. All other variables must be kept constant so the cause and effect of the two important variables can be noted.

Using the SI (metric system) units, decide how and what kind of measurements should be made. Set up log and/or data sheets for recording the anticipated data. Use a camera to take pictures, telling the story of the project and adding interest to the display.

## Data Collection

Begin your experimentation/investigation at least two months before the fair to allow yourself enough time to repeat the experimentation if necessary. Keep careful observations in a logbook. Record failures as well as success.

Keep track of all the steps performed and all tests made. Where possible, keep a control group to make comparisons with experimental group. The groups should be identical except for one variable. Repeat the experimentation to remove any doubts over the results. Be sure that measurements are always made in a consistent manner.

As any experimenter, a student will probably find that unexpected questions and problems will arise, and it is this unexpected aspect of science that makes it exciting. It may be necessary to change the experiment or add new tests to answer unsolved problems. The path the experiment takes may be more interesting then the one originally planned. Always record all findings and observations. The negative and hard to explain results may lead to findings as important as the results that support the hypothesis.

Organize the data into charts. Display the numerical results in the way that best summaries and explains the work.

One of the foundations of science is that an experiment can be reproduced by different scientists in different laboratories. Record the experiment in enough detail so that another investigator could perform it.

# Analysis of Data and Results

## Graphs

Graphics provide a pictorial way to show comparisons. It is, therefore, appropriate to convert tabular data into graphic form. Decide the type(s) of graph(s) most effective to display information. All graphs must further have a descriptive title. Generally, the independent variable is graphed on the vertical axis. Label each axis, the numerical division along each axis, and the units of measurement.

## Interpretations

Interpretation should directly accept or reject the hypothesis. Explain the meaning of your observations and numerical results. Support the meaning of experimental results with the data collected. Discuss the shapes of graphs. Be careful in drawing a conclusion only from data. Data needs to be interpreted.

## Statistical Analysis

Do a statistical analysis if possible. The analysis should be grade appropriate. The math department, if needed, can be very helpful in suggesting appropriate levels. In all cases, the student should be able to explain the significance of using the analysis and be able to interpret results. The arithmetic mean or chi square test can help show the validity of data. Ask the science advisor if there is a method of statistical analysis that can assist in the presentation of a project. Many spreadsheet programs now offer statistical analysis packages.

## Discussion

The discussion should include any patterns, or lack of them, found in the data, any limitations to the data, the consistency of any findings, any possible sources of error, and suggestions for follow-up or improvement.

**Common Mistakes of Science Fair Projects**

Before continuing a project, the student should check to avoid common mistakes of science fair projects:

- Jumping to a conclusion based on a single observation or test. There is often a tendency to try something once, see what happens, and draw a conclusion from it. How many times did Jonas Salk test his polio vaccine before it could be used? Results must be verified by repeated experiments.

- Failing to include a control in the experiment design. Part of finding out what will happen to the growth of bean seeds if they are fertilized is to also find out what happens if they are not fertilized. The unfertilized seeds are the control part of the experiment.

- Failing to recognize and/or control variables. Not only must experiments be repeated many times over, but also variables must be controlled in the same way each time if the results are to be reliable.

- Not keeping complete and/or accurate records. Reminder, all data must be considered. A successful project's data does not have to support the hypothesis. Science involves a lot of paperwork. Keeping good records while doing a science project involves reading, writing, spelling, and composition. Teflon was invented a full 30 years after DuPont first created it in a laboratory, because he kept accurate records that were easy to read and understand.

In general, science projects must embody those characteristics that yield reliable results. It must be done carefully with attention to detail.

**Written Report**

Now that the student has:

- Taken notes on library research
- Written a hypothesis
- Listed the type and amount of materials used
- Recorded step by step procedures
- Maintained a log
- Collected data in tabular form
- Created graphs
- Interpreted the findings
- Discussed the general impressions

The report is almost completed. Organization and transitions between areas are remaining. Technical language may be used, but it is more important to be clear and concise, rather than using too much technical terminology. Label each section of the report clearly. The written report must have correct spelling and grammar, be easy to read (double-spaced typing), and appear neat and well organized. Follow the chart on the next page in planning your report.

# **Writing the Abstract** (250-word limit)

Your abstract will be read, ***prior to the Science Fair***, by the Scientific Review Committee and by persons assigned to judge your project. The abstract represents the first exposure the judges will have to your project research. Therefore, first impressions are very important!

The following items must be included in your abstract:

**Objective or Goal:**
State the objective, goal, or hypothesis upon which your project is based.

**Examples of Objective or Goal:**

1. This project was designed to discover the seed preferences of California scrub jays (Aphelocoma californica) visiting my backyard bird feeder.

2. After designing 3 types of balsa wood airfoils, I compared lift, drag, and airflow patterns, using a homemade wind tunnel.

3. My objective was to write a computer program for PC computers that would help a student memorize Spanish vocabulary words

**Materials and Methods:**
Indicate the materials, methods, and experimental design used in your project. Briefly describe your experiment or engineering methods.

**Examples of Materials and Methods Section:**

1. Fifty-gram soil samples were collected from the A horizons of five 1 m square lawns, initially fertilized with WonderGrow Super Fertilizer. Similar samples were collected from five 1 m square lawns, initially fertilized with coffee grounds. The samples were analyzed for nitrogen, phosphorus, and potassium content. This comparison was repeated once a month for four months, between November and February. Changes in soil composition over time were compared.

2. I constructed a maglev track, using 40 neodymium magnets, spaced .5 cm apart and glued to a plywood board. The track was mounted at an angle of 10 degrees, forming a ramp. I then designed a balsa wood vehicle with 5 neodymium magnets below the wooden base. To test its weight-bearing capacity, the vehicle was loaded with different weights and tested at each weight ten times. The weights compared were: no load, 2g, 4g, 6g, and 8g. I used a ruler to measure how far down the track the vehicle was able to go, after being released at the top of the track.

3. A survey form was distributed during science classes, asking a total of 50 sixth, 50 seventh, and 50 eighth graders to estimate how long each of three musical pieces were played. Participants were asked to leave their names off of the surveys, to keep data anonymous. Results were then compared to see whether ability to estimate playing time improves with participant age.

**Results:**

Summarize the results of your experiment and indicate how these results pertain to your objective.

**Examples of Results Section:**

1. Aluminum and wooden baseball bats were compared to see how far a regulation baseball would travel when struck. In all but one of the 25 trials, the baseball went further after being hit with an aluminum bat. On average, the ball traveled 4.5 cm further with the aluminum bat. In the one trial where the wooden bat made the ball go farther, the wind may have been blowing against the ball during part of the aluminum bat portion of the test.

2. The height of cookies made in 3 ways was compared after baking. Cookies made without baking powder were an average of 3 mm in height at their highest point. Cookies made with baking powder were an average of 10 mm at their highest point. Cookies made with my homemade rising formula rose an average of 4.5 mm. In this series of tests, baking powder was a much better leavening agent than my homemade formula. However, my homemade formula was slightly better than using no leavening at all.

3. Combining the results of the first 3 trials, after 15 minutes, there were 75 mealworm beetles (*Tenebrio molitor*) in the darkened area and 5 in the lighted area. Combining results of the second 3 trials, there were 89 mealworm beetles in the darkened area and 11 in the lighted area.

**Conclusion/Discussion:**

Indicate if your results supported your hypothesis or enabled you to attain your objective. Discuss briefly how information from this project expands our knowledge about the category subject.

**Examples of Conclusions/Discussion Section:**

1. My hypothesis that the beetles would be more likely to move to the darkened area was strongly supported by the results. It would be interesting to repeat this experiment with mini darkling beetles (*Tenebrio obscurus)* to see if they act in a similar way.

2. Before doing the experiment, I thought iron would be a better conductor of electricity than silver. My results indicate the opposite. The results do not support my hypothesis. Next time, I would like to see if copper is also a better conductor than iron.

3. After reviewing my results, I could find no consistent pattern in my data. There was no clear advantage or disadvantage to doing homework while listening to Justin Bieber songs. My hypothesis that it would be helpful was not supported by the results. It might be useful to try again, substituting another kind of music, such as rap or jazz.

# The Display

***PLAN AHEAD—A GOOD DISPLAY TAKES TIME TO CREATE!***

The display communicates the essential parts of the project in a quick, visual way. The display should be sturdy, free standing, colorful, simply illustrated, well labeled, and attractive. Most project display boards are 36" x 48". Oversized boards can be made by taking a modular approach and connecting more than one board, but keep in mind that you don't want your board too tall, too crowded, or with information too low to the ground to read. Foam core or folding backboards may also be purchased from science or office supply stores. **Keep in mind that two projects must fit side by side on each table at the Monterey County Science & Engineering Fair. If your project takes up too much space, you may be disqualified.**

The title and section headings on the backboard should be clearly visible and readable from a distance of three to four feet. Use complementary colors as background and bright or dark letters for the titles of each section.

If using a computer to generate headings, use a boldface font of at least 18 points. Cut paper strips and frame and/or mount the title of each section. A photocopier can also be used to enlarge text for titles and section headings. The title should have the largest print on the display board and be neatly done.

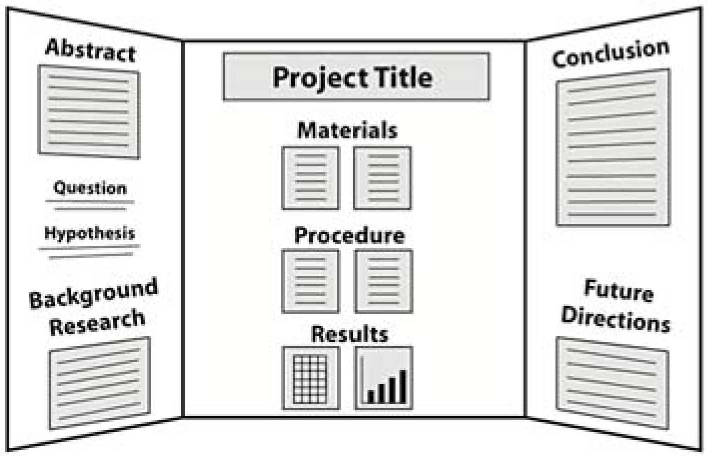
Enlarge graphs and use color for the different lines or bars. Use photographs that are clear and sharp, with the correct exposure. A 5 x 7 photo creates a better display. There should be an explanation under each photo and graph.

Set the entire display board flat on the floor and arrange the various parts before beginning the final assembly. Be certain all titles, graphs, photos, and text are lined up properly and in place before gluing them down. Use rubber cement instead of glue so pieces can be replaced if necessary. Make sure the edges of the paper are glued down securely to the backing to prevent peeling or drooping later. All this attention to detail will result in a display board that is attractive, easy to read and as neat as possible.

# Rules for Exhibits

**Size**

- All projects must utilize the standard 3-panel display board that unfolds to be 36" high by 48" wide.  **Any exception must be pre-approved by the fair director.**




***Note: Projects exceeding these dimensions without prior approval will not be admitted.*

**Construction**

- Projects must be durable with all parts firmly attached.  Provide back support for your exhibit.
- No attachment to walls is permitted.
- All cardboard over 30 cm must be backed with wood, pegboard, foam board or hardboard.

**Electrical**

- All exhibits requiring electricity must be designed for 110 volts (60 cycle) and limited to 500 watts.  The popular style of parallel, ground plug (3-prong) must be used. Students must supply their own surge suppressor.  No exceptions!   Students must supply any extention cord.
- Projects requiring power will be situated against the wall and out of category.

**Gas or Water**

- No gas or water outlets will be provided.  No gas or water is allowed.

**Living Organisms**

- Displays of bacterial/viral cultures, molds and live or preserved plants and animals, animal parts, embryos, etc. may not be displayed during the science fair. Photographs may be used.

**Suitability for Exhibition**

- The Scientific Review Committee of the Monterey County Science and Engineering Fair reserves the right to disqualify any exhibit considered unsafe or unsuitable for public exhibition or any project that is considered inhumane treatment of animals or human subjects

# Responsibility

The Monterey County Science and Engineering Fair Committee, its Advisory Board, the Monterey County Office of Education, The Naval Postgraduate School, California State University Monterey Bay, all participating schools and school districts, volunteers and representatives of sponsoring organizations shall be held harmless for injury or death of persons or damage and/or loss of property occurring in connection with the Monterey County Science & Engineering Fair.

# Safety Precautions

**1.** Fire regulations prohibit use of highly flammable materials or decorations in project displays. Background panels must be of foam core or corregated board, to which poster paper, cardboard or fabric may be attached.

**2.** No dangerous or combustible solids, liquids or gases may be exhibited. Cylinders, tanks and/or other containers that have held such substances, unless thoroughly cleaned and/or purged with carbon dioxide, are also prohibited. Rockets MUST NOT contain fuel. No flames, open or concealed, are permitted in the display building.

**3.** No syringes, pipettes or similar devices may be displayed.

**4.** Devices producing temperatures in excess of 100 C must be adequately insulated.

**5.** The following electrical safety rules must be observed:

- Wiring must be properly insulated and fastened.
- Wiring, switches and metal parts of high voltage circuits must be located out of reach of observers and must include an overload safety device.

- High voltage equipment must be shielded with a grounded metal box or cage to prevent accidental contact.
- Approved connecting cords of the proper load-carrying capacity must be used for 110-volt operation of lights, motors, transformers and other equipment.
- Standard switches must be used for 110-volt circuits. Open knife switches or bell-ringing push buttons are not acceptable for circuits exceeding 12 volts.
- Batteries with open top cells (wet cell batteries) are not permitted
- Electrical connections in 110-volt circuits must be soldered or fixed under approved connectors and have connecting wires properly insulated.
- Electrical circuits for 110-volt AC must have an Underwriters Laboratory approved cord (or proper load carrying capacity) at least 2 meters long and equipped with a standard grounded plug.
- Devices (vacuum tubes, lasers, etc.) which generate dangerous rays must be properly shielded.

**6.** Only lasers with less than 1 miliwatt output may be operated at the Fair. These lasers must (1) have a protective housing or barricade preventing human access to the beam during operation, (2) be disconnected from the power source when not in operation, (3) be operated only in the presence of the exhibitor, and (4) when displayed, be accompanied by the following sign: <u>LASER RADIATION; DO</u> <u>NOT STARE INTO BEAM</u>. (See *Science Safety Handbook for California Public Schools* for specific details regarding laser use.)

**7.** No live or preserved plants, vertebrate or invertebrate animals or parts (including embryos, microbial cultures or fungi, (whether known to be disease causing or not) may be exhibited at the Fair. Sealed insect collections will be permitted on display.

**8.** Human parts, other than teeth, hair, nails, histological sections and liquid tissue slides may NOT be exhibited.

**9.** Photographs or other visual presentations depicting humans or vertebrate animals in other than normal conditions may not be displayed on the student's exhibit.

**10.** The use of Controlled Substances (drugs, chemicals, anesthetics, etc.), are regulated by the Comprehensive Drug Abuse Prevention and Control Act of 1970 and must conform to existing local, state and federal laws. Such substances may not be exhibited at the Fair.

**11.** All Recombinant DNA research must be carried out in accordance with the revised NIH Guidelines for Research involving Recombinant DNA Molecules. Only research normally conducted without containment in a microbiological laboratory and performed under the supervision of an appropriately qualified scientist is permitted. The facility to be used must be described in the research plan. Research requiring containment is prohibited.

**12.** Research involving gasohol must conform to Department of the Treasury, Bureau of Alcohol, Tobacco and Firearms (ATF) regulations. For specific information, call the Western Region Office, (415) 436-8020.

**13.** Exhibits containing water are not allowed.

# Judging and Criteria for Awards

The initial reward for participating in the Monterey County Science Fair is the opportunity to display a science project, meet with other exhibitors, and share information and views.

First, second, third place awards, consisting of medals and ribbons, may be awarded for exhibits in each category in both Senior and Junior Divisions. In addition, a number of special awards are presented from organizations and the business community.

For specific details on judging criteria for all project categories, please see the Monterey County Science Fair Judge's Worksheet that follows in this handbook.

# The Interview

As part of the judging process, ALL students will be asked to explain their project to judges. Organize and plan what will be said to the judges in the personal interview.

The judges will want to know:

- How the topic was selected for the project?
- Did the student receive help and if so, how much?
- What has been known about the general subject area of the project?
- What would the student do if there were additional time to spend on the project?
- What has been learned through investigation?
- If this project was continued, what is the next step?

Give the judges as much information as possible. Be enthusiastic! An interview can be fun! The judges are experts in their fields and the interview may also be an opportunity to learn more about a subject.

# How Does Your Project Measure Up?

**Scientific Thought**

- Does the project follow a logical scientific process?
- Does the project illustrate controlled experimentation and retesting?
- Does it represent real study and effort?
- Does it make appropriate comparisons?
- Does it form conclusions based only on the data gathered?

**Originality**

- Is the project your own idea?
- Does the project demonstrate your conclusions?

**Thoroughness**

- Does the project tell a complete story?
- Are the written report and visual display well done?
- Is the project documented by charts, graphs, and/or photos?

**Clarity**

- Is the hypothesis or problem easily understood by someone who is not technically trained?
- Does the written report explain the project simply and clearly, and show depth of understanding?
- Is the display easy to follow and attractively executed?

# Monterey County Science Fair Information

The Monterey County Science & Engineering Fair grade-level divisions, project categories, and judging criteria are similar to those used by the California State Science Fair

The number of projects entered by each school varies and may be limited. Team Projects are limited to three (3) participants per team.

Medallions may be awarded to 1st, 2nd, and 3rd Place winners in each category for the Junior and Senior Divisions. Special awards from business and industry are also granted each year.

Applications for student projects must be **completely** filled out and submitted **online** by the deadline date of February 20, 2019. Signed copies of the application must be mailed or emailed no later than March 1, 2019.

Monterey County Science and Engineering Fair
Attn: Ginny Brown, Program Director
Monterey County Office of Education
901 Blanco Circle, Salinas, CA 93901
gbrown@montereycoe.org

- ***On the online application, students are required to submit an abstract (not to exceed 250 words) of their project. This abstract will be reviewed by the judges after deadline and at least three weeks prior to the scheduled date of the Science Fair.***

- ***All senior division projects involving vertebrate animals, human subjects, animal/human tissue or hazardous chemicals must have approval prior to the initiation of student research. Submission deadlines are November 2, December 1 and January 4. Projects without prior approval and proper signatures on ISEF Certification Forms (Senior Division only) will not be accepted at the fair.***

## Categories will be aligned with the California State Science Fair. Please visit: http://www.usc.edu/CSSF/Info_Genl/Categories.html

# Category Interpretations

It is impossible to develop category descriptions that can be applied to all projects without some interpretation. The increasingly interdisciplinary nature of science and engineering means that, in many categories, it may be necessary to identify the primary emphasis of the project.

For example, Limnology is defined as the scientific study of the physical, chemical, meteorological, and biological conditions in fresh waters. Therefore, a project in Limnology would have to be considered from the point of view of its primary emphasis (physics, chemistry, etc.) to be placed in the appropriate category.

The following project areas provide a basis for interpretations of the category descriptions. (Partial List)

**Instruments:** The design and construction of a telescope, bubble chamber, laser, or other instrument would be properly placed in Engineering applications if the design and construction were the primary emphasis of the project. If a telescope were constructed, data gathered using the telescope, and an analysis of the data presented, the project would be placed in Earth/Space Sciences.

**Marine Science:** Behavioral/Social Sciences (schooling of fish), Plant Biology (marine algae), Animal Biology (sea urchins, cnidarians, prehistoric animals), or Earth/Space Sciences (geological ages).

**Rockets:** Chemistry (rocket fuels), Earth/Space Sciences (use of a rocket as a vehicle for meteorological instruments), Engineering Applications (design of a rocket), Physic (computing rocket trajectories), or Plant Physiology (effect of rocket acceleration on plants).

**Genetics:** Biochemistry & Molecular Biology (studies of DNA), Plant Biology (hybridization), Microbiology (genetics of bacteria).

**Vitamins**: Biochemistry & Molecular Biology (how the body deals with vitamins), Chemistry (analysis), and Pharmacology (effects of vitamin deficiencies).

**Crystallography:** Chemistry (composition of crystals), Mathematics & Computer Sciences (symmetry), and Physics (lattice structure).

**Ecology – Pollution:** In a study of the eutrophication of lakes: Behavioral/Social Sciences (human beings who caused the problem), Chemistry (process of eutrophication), Plant Biology (growth of algae), Environmental Science (water purification systems), Microbiology (effects on microorganisms), Zoology (fish populations).

**Pesticides:** Biochemistry & Molecular Biology (mechanisms of toxic effects), Plant Physiology (plant intake and concentration), Chemistry (composition of pesticides), Earth/Space Sciences (mechanisms of runoff), Pharmacology (effects on human beings and animals), and Ecology (effects of pesticides on the environment).

**Speech and Hearing:** Behavioral/Social Sciences (reading problems), Engineering Applications (hearing aids), Animal Physiology (speech defects), or Physics (sound).

**Radiometry:** Biochemistry & Molecular Biology, Animal Biology and Plant Biology could all involve the use of radioactive tracers. Earth/Space Sciences or Physics could measure radioactivity. Engineering Applications could be the design and construction of detection instruments.

**Space-Related Projects:** Many projects involving "space" do not go into Physics. Plant Physiology (effects of zero gravity on plants), Mammalian Biology (effects of gravity on humans), Engineering Applications (closed environmental system for space travel), Earth/Space Sciences (studies of planets).

**Computer-Based Projects:** Computers would go into Mathematics & Computer Sciences unless the computer is a tool for a project in some other category. Computer programs and language might be Mathematics & Computer Sciences unless developed to facilitate analysis for a project in some other category.

# Examples of Projects in Various Categories

**Behavioral/Social Sciences**

How do students communicate non-verbally to their teachers?
Effects of loud music on hearing acuity
Do television commercials control buying habits?
Insect learning- how many trials are necessary for crickets to learn a simple maze?
Does UV light attract insects better than wavelengths in the visible spectrum?
Does the density of ovipositing females to available eggs affect a female insects behavior?
Can a chicken tell a fertile egg from an infertile egg?
What is the relationship between damselfish densities on a reef and the size of their territories?
Do garibaldi fish recognize intruders to their territory by color or by shape of an intruding fish?
What color of walls in a study room will demonstrate the greatest retention of long-term memory?
Can an earthworm learn simple, consistent choices when confronted with alternatives?

Are honeybees more attracted to flower color or sugar concentration when locating a new food source?
Attitudes towards smoking- should all restaurants have a non-smoking area?
Survey of smog control removal from autos
Survey of households that make some effort to conserve water
Can studying collaboratively in groups rather than alone improve a student's standardized test scores?
Does taking Cornell notes increase test scores compared to random note-taking style?
Are females called on more frequently inn class than males by male teachers?
What specific body types in adolescent males attract the greatest number of adolescent female admirers?

**Biochemistry & Molecular Biology**

Organic Dyes- Can pigments from lichens be extracted to make dyes?
An analysis of the pH of saliva of students from your school
Analysis of reducing sugars in common foods
A new method of building synthetic peptides
Separation of blood proteins
Can antibiotics be identified by paper chromatography?
What esters are common in basic flavors?
Can proteins be denatured by mechanical forces?
DNA extraction techniques from beef liver

**Chemistry**

Analysis of oil samples- Techniques of fractional distillation of oil
How much dissolved oxygen is present at various depths of a lake or ocean?
What pollutants are present in the air?
An experiment to illustrate the production of simple amino acids in an early atmosphere
Testing the mineral concentrations in hard and soft water
Analysis of pollutants found in the Salinas River
Investigation of pH variations of soils
Negative ion (cations) can be separated and analyzed with exchange resins
Can light energy influence chemical reactions?
What is the most effective household product to take organic stains out of clothes?

**Mathematics & Computer Sciences**

Providing geometric theorems by using concrete objects
Finding a practical application of triangles
A new mathematical system for analyzing solutions
Investigation of numeration systems with negative base
Do left-handed people perceive differently than right-handed people?
Compare and contrast the modular to the real number field

Develop a "successive sum" theory of Pascal's Triangle
Find all the primitive triplets
Create a 3-D model of mountains and valleys to simulate optimal topography for wind turbines.
Create a simulation showing the discharge and diffusion of heavy metal contamination from a point source in a nearby river system.
Create a program to compare exponential growth in mice, cockroach, sparrow and human populations
Create a 3-D visualization of continental drift, showing predicted movements of plates in the future

**Earth/Space Sciences**
Cloud chamber investigation of particles and cloud formation
Are the "leaky acres" helping to recharge the Monterey County ground water?
Did mastodons really roam near Monterey thousands of years ago?
Can soil erosion be stopped?
Analysis of the Mt. St. Helens eruptions as compared to the Hawaiian eruptions
Build your own seismograph and test the Earth's activity
An analysis of nitrogen oxides, carbon monoxide and hydrocarbons in our air
Constructing and testing fuel-tracking instruments for rocket flights
Investigating the homing instincts of pigeons using celestial navigation
Investigating the effects of gravitational forces on plant growth

**Environmental Science**
Do "bug lights" differentiate between "good" and "bad" insects?
Which decomposers are most beneficial in creating compost?
How does increased UV light affect the growth of microalgae over time?
Which is the most effective bio-control for whitefly infestations?
Does integrated pest management really work to control pests in an urban vegetable garden?
Do insect populations dramatically change in diversity and numbers when their habitat is altered?
What are the effects of an El Nino event on kelp bed concentrations?
What is the effect on a tide pool ecosystem when keystone predators are removed?
What is the pattern of secondary succession in an abandoned parking lot?
How does increase levels of heavy metals in seawater affect the sex ratio of invertebrate offspring?

**Engineering Applications**
Constructing and testing a working model of a home space-heating unit
Design a mechanical method of separating solid waste for recycling
Optimum energy conservation in houses- Survey and analysis of home energy conservation techniques
Design and construction of a battery-operated automobile
Constructing and testing for a model solar desalination system

Which wind turbine design creates the most energy at all low, medium and high speeds?
What mattress best holds the body in correct alignment?
Which boat design creates the fastest velocity while maintaining the greatest stability and cost-efficiency?

**Engineering Research**

Testing the wind resistance of automobile models in a wind tunnel
An analysis of exhaust emissions of cars as related to the size of cars and tune-up conditions
Experiments to determine the efficiency of commercially available insulation
Is chemical energy storage the answer to our future local transportation needs?
Which barrier (screen, paint, plastic) effectively blocks ELF radiation?
How does primary, secondary and tertiary treatment affect bacteria in wastewater?
Which is the most effective method of restoring an acidified lake to natural pH concentrations?
Compare the safety of skateboard park designs
Which brand of golfball flies the farthest and most accurately?
Which kitchen floor covering has the least friction with the greatest possible shine?

**Microbiology**

What level of bacterial growth is found in various sources of Monterey County drinking water?
Do x-rays affect viruses?
Is the tobacco mosaic virus inhibited by modified purine and pyridines?
What populations of microscopic organisms are found in rain puddles?
What is the diversity of phytoplankton in local pond water?
What type of filtration material catches the most bacteria in wastewater?
What is the optimum method for ensuring plasmid transfer in E. coli bacteria?
Which water fountain at school contains the greatest diversity and number of bacteria?

**Pharmacology**

Do increased levels of calcium intake by adolescent females decrease the symptoms of PMS?
Does increased intake of Gingko biloba increase short-term memory retention in humans?
Can large doses of vitamin C prevent getting sick as often during the flu season compared to a placebo?
Which insect repellent works better on mosquitoes?
Which water-repellent sunscreen gives the greatest protection in seawater?
Which antacid absorbs the greatest amount of excess acid per gram?
Which lipstick stays on the longest and looks the freshest after eating?

**Physics**

How does stress affect the strength of a given plastic?
How would adding a foliage barrier affect sound transmission?
How does varying densities of water affect wavelengths of light?

What is the optimum amount of sunlight/day to run a solar panel to power a hot water heater and store energy for nighttime use?
What are the average g-forces experienced during a drop from the highest loop of the Cyclone rollercoaster?
Which tint of sunglasses gives the greatest UV protection?
How will global warming affect the type of light waves that enter our atmosphere?

**Plant Biology**

Comparison of stored seed and seed germination
Comparison of cotton growth in sandy loam and alkali soils
Analysis of lawn seed germination at winter, spring, summer and fall temperatures
What is the best soil type for leaf propagation in African Violets?
How do plants signal for help when they are being preyed upon?
What is the pressure needed to trigger a capture response in the Venus Fly-trap?
What is the optimum planting density for the greatest yield in cherry tomatoes?
Which wind-dispersed seed type is designed to travel the greatest distance?
Which garden plant attracts the greatest diversity of pollinators?
Periodicity in onion roots- Do onion root cells divide at certain times during a 24-hour period?
Bean plant growth in various nutrient-deficient soils
Auxins and geotropism- Do pea seed roots grow down because of plant growth hormones?
How does blanching affect enzyme activity in vegetables?
What is the relationship between fertilizer concentration and the growth of plants?
Are natural fertilizers better and cheaper than chemical fertilizers?
Which shape of leaf shows the least transpiration rate in windy conditions?
Which is the best hydroponics medium to grow the largest and fastest-growing lettuce?

# California State Science Fair

Junior and Senior Division projects placing first in the Monterey County Science & Engineering Fair may be eligible to enter the California State Science Fair. The 2018 State Fair will be held at the California Science Center, Los Angeles, CA, in spring, 2019.

# Intel International Science and Engineering Fair

The ISEF Judging Committee will select two to four student projects that demonstrate high levels of excellence to represent Monterey County at the Intel International Science and Engineering Fair. The ISEF will be held May 12-17, 2019 in Phoenix, AZ.

# References and Resources

Please refer to the following websites for references and resources:

Monterey County Science Fair: www.montereycountysciencefair.info
California State Science Fair: www.usc.edu/CSSF/
Science Buddies: www.sciencebuddies.org
National Science Teachers Association: www.nsta.org
Super Science Fair Support Center: www.scifair.org
California State Science Fair Resources Page: http://www.usc.edu/CSSF/Resources/
Getting Started: http://www.usc.edu/CSSF/Resources/GettingStarted.html

# Regulations for Projects

The following regulations will help keep the projects uniform and within the laws of the State of California. Fair sponsors want all students to have the best opportunity to compete for the annual awards. During the time that the Fair is open to the general public, the perception of the projects must be positive and precautions must be taken for the security of each project. All projects must abide by the following:

1. Present an experimentally based research design exemplifying the scientific methodology.

2. Be carefully prescreened by the school and the teacher whose student is submitting the project. The following judging sheet lists the criteria used to evaluate the projects.

3. Clearly distinguish between the work of the student entrant and the work of others. Students who have prepared a project in conjunction with research participation opportunity in industry, a university, hospital or institution other than their school must show only the student's research in their project display.

4. Be original and distinct.

5. Be entered in the Fair after an application is sent. A school should avoid sending applications for projects until it is certain that the projects will be completed in time and will physically arrive at the Fair. Projects that are registered but not actually entered create errors in the program, a waste of time for the judges, and leave unsightly open spaces in the exhibit area.

6. Be submitted by students only in grades 6-12.

7. Be entered at the Fair and picked up only within the designated hours. The Fair is not responsible for projects left after the designated pickup time.

8. Use illustrations of micro-organisms, animals and plants. The display of bacterial cultures and live or preserved animals and plants will not be permitted.

9. Remain at the Fair during the scheduled interview times.

10. Use a title which provides the viewer with a clear concept of the subject and procedure of the research. Present the steps of the scientific methodology used, organized from left to right and top to bottom. Use metric units for all measurements. Have all values on charts and graphs correctly labeled. Present all narrative writing in a legible manner with correct grammar, punctuation and spelling. Carefully review the category descriptions and select the proper one for the project.

11. Fit within the prescribed space limitations. All projects must utilize the standard 3-panel display board that unfolds to be 36” high by 48” wide. Any exception in height must be pre-approved by the fair director. Oversized projects will be screened at the door and refused entry.

12. Be able to support their weight and not collapse due to inadequate construction. Any project that does not meet minimum standards for construction will be removed from the display area and not judged.

13. Display photographs which do not show procedures detrimental to the health and well-being of vertebrate animals. (For example, the performance or results of surgical procedures will not be shown.) Those not in compliance will be removed from the display area and not judged.

14. Have notebooks and other small items removed following the end of the awards ceremony. The fair will not be responsible if these items are missing from projects. Do not display items you cannot afford to lose.

15. Do not have computers with projects for the preliminary judging. A computer may be brought by the student for the judging interview if the student assumes full responsibility for the computers.

16. Give attention to all considerations of safety. Projects which use 12- volt electrical current must have all wires and connections well shielded. Those not in compliance will be screened at the door and refused entry.

17. Adhere to all of the rules and regulations of the Fair and all relevant federal, state, and local laws. Those not in compliance will be screened at the door and refused entry.

18. Be submitted with the understanding that the decisions of the Monterey County Science & Engineering Fair Committee is final.

## Monterey County Science & Engineering Fair

| Project Number: | Division: |
|---|---|

**Title of Project:**

| Item | Outstanding | Good | Satisfactory | Needs Improvement |
|---|---|---|---|---|
| **Research-Bibliography** | ☐ You used information from four or more different sources.<br>You showed where the material was used in your report. | ☐ You used information from two or three different sources.<br>OR<br>☐ You listed more, but it was not apparent where it was used. | ☐ You used information from one source.<br>OR<br>☐ Your project does not incorporate the material you listed. | ☐ No bibliography<br>OR<br>☐ No background research is evident. |
| **Originality/ Creativity** | ☐ You devised a unique experiment. | ☐ You used a known experiment, but modified the procedure, data gathering or application to test an extended or new hypothesis. | ☐ You duplicated a known experiment from any source to confirm the hypothesis.<br>OR<br>☐ The hypothesis was totally pre-dictable and the results were known beforehand. | ☐ Computer downloads or photocopies of already published material. |
| **Data Collection** | ☐ Your data are quantitative in nature, with sufficiently large samples to show statistical significance.<br>Data were properly logged and organized in a logbook.<br>Variables were identified and controlled. | ☐ Your data are quantitative in nature, but your sample size was too small to adequately test your hypothesis. | ☐ Your data are qualitative (not measured). | ☐ No original data were collected. You used already published materials. |

| Item | Outstanding | Good | Satisfactory | Needs Improvement |
|---|---|---|---|---|
| **Data Analysis** | ☐ You presented your data in the form of properly-constructed graphs. | ☐ You attempted to present your data in the form of graphs, tables, etc. | ☐ You simply listed the results. | ☐ Data not analyzed. |
| **Display Quality** | ☐ Your display is neat, title is clear and visible from a distance, diagrams and objects are properly anchored. | ☐ Your overall display arrangement is neat, but objects or diagrams are not neatly done or not present. Text contains minor spelling errors. | ☐ Your display is not neatly/well constructed. Text contains noticeable errors in spelling or syntax. | ☐ No display. Report and/or apparatus only. |
| **Conclusion** | ☐ Conclusion is not trivial. It directly relates to hypothesis, and is supported by the data. | ☐ Conclusion fits with the hypothesis but is not well-supported by the data, or the data is visibly inadequate to support the conclusion. | ☐ An attempt has been made to present a conclusion. | ☐ No conclusion. |
| **Verbal Defense** | ☐ You know your research and your project thoroughly. You can explain it to the judge's satisfaction. | ☐ You are able to summarize your project to the judge's satisfaction. | ☐ You are not able to fully explain the research or the content of your project. | ☐ You are unable to explain what your project is about. |
| **Overall Rating** | ☐<br>☐<br>☐<br>☐<br>☐ | ☐<br>☐<br>☐<br>☐<br>☐ | ☐<br>☐<br>☐<br>☐<br>☐ | ☐<br>☐<br>☐<br>☐<br>☐ |

**Comments:**

**(Please use extra sheet if necessary)**

**Judge's Signature: ______________________________________**

**Judge's e-mail: _________________________________________**

**Date Received:_______________**
**(Office Use Only)**

**2019 Sample Application**
**Monterey County Science Fair**
**STUDENT PROJECT APPLICATION**

**DEADLINE:**
**Online Application must be received by February 20, 2019. Additionally, a signed copy of the application must be received by March 1, 2019.**
Mail to: MCOE Attn: Ginny Brown
901 Blanco Circle, P.O. Box 80851
Salinas CA 93912-0851
Or scan and email to: gbrown@montereycoe.org
Signatures are required for all project partners.

## Section I – Personal Information

| | | | |
|---|---|---|---|
| First Name: | ______________________ | Street Address: | ______________________ |
| MI: | _______ | City: | ______________________ |
| Last Name: | ______________________ | State: | _______ |
| Gender: | _______ | Zip Code: | _______ |
| Grade: | _______ | Phone: | ______________________ |
| : | | E-mail Address: | ______________________ |

School Name: ______________________

Name of Teacher(s) or Advisor(s): Please indicate name on hard copy if not on list.

Teacher/Advisor: ______________________
Teacher/Advisor: ______________________
Teacher/Advisor: ______________________

## Section II – Project Partner(s) *(If Applicable)*

| | | | |
|---|---|---|---|
| First Name: | ______________________ | Street Address: | ______________________ |
| MI: | _______ | City: | ______________________ |
| Last Name: | ______________________ | State: | _______ |
| Gender: | _______ | Zip Code: | _______ |
| Grade: | _______ | Phone: | ______________________ |
| : | _______ | E-mail Address: | ______________________ |

| | | | |
|---|---|---|---|
| First Name: | ______________________ | Street Address: | ______________________ |
| MI: | _______ | City: | ______________________ |
| Last Name: | ______________________ | State: | _______ |
| Gender: | _______ | Zip Code: | _______ |
| Grade: | _______ | Phone: | ______________________ |
| : | _______ | E-mail Address: | ______________________ |

## Section III – Project Information

Project Title: ______________________________________________________________

Category: ___________________

Does your project require a safety or humane treatment certification? Yes ☐ No☐

*(If yes, Junior Division bring the certification to the fair;* ***Senior Division*** *submit by ISEF forms for pre-approval in advance.)*

Does your display require AC electrical power? Yes ☐ No☐

*(If yes, bring your own extension cord.)*

Does your display require height or width other than the standard allotment? Yes ☐ No☐

*(If Yes, please describe your requirements below):*

_______________________________________________________

**Abstract:** *(Include objective, methods, results and conclusion):*

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

**Summary Statement** *(In one sentence, state what your project is about):*

______________________________________________________________

**Help Received in doing the project:**

*(e.g. Parent helped type report; Neighbor helped wire the board; Used lab equipment at …)*

______________________________________________________________

______________________________________________________________

______________________________________________________________

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## Section IV – Signatures

In consideration of your permitting the undersigned student to take part in the Monterey County Science and Engineering Fair, we waive all claims against MCOE and all sponsors for injury to or death of persons or loss or damage of property in any way occurring in connection with MCOE, and we agree to indemnity and hold them harmless against all such liability. We give permission to MCOE to use project descriptions, photographs, and other likeness of students for promotional purposes. We understand that only projects entered in competitive categories will be considered for awards and only projects recognized as outstanding the by the judges will receive awards, regardless of the category or number of projects in a category. We have read and understood the regulations governing the Monterey County Science and Engineering Fair and agree to abide by them.

| | |
|---|---|
| Signature of Applicant | Date Signed |
| Signature(s) of Parent(s) or Guardian(s) *See note below. | Date Signed |

*As the parent or guardian of the above-named student, I hereby give permission for the use of photographs or videos taken of my daughter/son in any newsletter, brochure, newspaper, website, electronic publication or other document that is published, distributed, or issued by the Monterey County Office of Education (MCOE) or given by MCOE to the media. I understand that any photographs or videos of my child are being produced by MCOE for educational purposes. I further agree to release MCOE, its officers, agents and employees from any and all claims, demands and actions of any kind that I may have against them in regard to the publication of the photographs or display of videos.

# Monterey County
# Science & Engineering Fair
## March 16 - 18, 2018

INTENT TO PARTICIPATE

School___________________________________

Teacher(s)________________________________

Grades Taught______________________________

Estimated Number of Projects___________________

I will submit project proposals and all pertinent ISEF forms for **all Senior Division** (grades 9-12) projects involving human subjects, tissues, vertebrate animals, and hazardous chemicals for pre-approval by the Scientific Review Committee prior to experimentation.

November 2, 2018, December 1, 2018, and January 4, 2019

**Student online application deadline: February 20, 2019**

Signature_________________________ Date________

Please email Senior Division ISEF Forms to Ginny Brown:

gbrown@montereycoe.org or fax to 831-755-6473