Los Angeles County
Science & Engineering Fair
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TEACHER/STUDENT HANDBOOK

Los Angeles County Science & Engineering Fair

Recognizing the achievements of talented students in science, mathematics, engineering and technology

For online registration and a full set of resources for teachers and students, visit:
www.lascifair.org

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Los Angeles County Science & Engineering Fair
Teacher/Student Handbook

Our Purpose

- Provide traditional motivation for young people to apply creativity and critical thought to the solution of science, engineering, and 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 Los Angeles County area; and
- Foster school-community cooperation in developing the scientific potential and communication skills of tomorrow's leaders.

Over 1,000 student projects are exhibited at the fair, each year, from public, parochial, and private schools. Some 250 awards –1st, 2nd, 3rd place winners and Honorable Mention are presented. Special Awards are also given in addition to Sweepstakes Finalists in both Junior and Senior Divisions.

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 through 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.

Benefits to the Curriculum

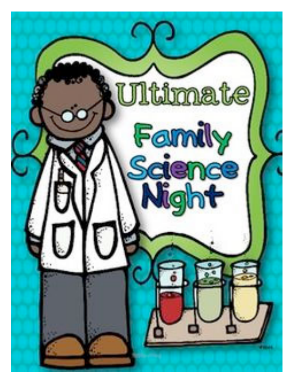
- Incorporates and deepens **all 8 Science & Engineering Practices** in the Next Generation Science Standards
- Aligns with the **Common Core ELA Reading and Writing Standards for Science & Technology**
- Integrates science with other curriculum areas including mathematics, computers, and language arts.
- 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.



Integrating Project Based Learning, Science Fair Projects and the Next Generation Science Standards

Science Fair projects are a natural end result of Problem-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 Science and Engineering Practices found in the new ***Next Generation Science Standards***. These projects should not be looked at as something "extra" to do but are an essential process to address both the NGSS and the ***Common Core*** reading and writing practices for science.

Project Based Learning (PBL) is a key instructional approach to implement the **NGSS** and prepare 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).

> "If we are serious about reaching 21st Century educational goals, PBL must be at the center of 21st Century instruction. The project contains and frames the curriculum, which differs from the short "project" or activity added onto traditional instruction. PBL is *The Main Course*, not Dessert."
>
> *Problem Based Learning for the 21st Century,*
> *2012 Buck Institute for Education*

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 o*pen-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 or 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
- *LACOE Common Core workshops*
  http://www.lacoe.edu/CurriculumInstruction/CommonCore.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 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:

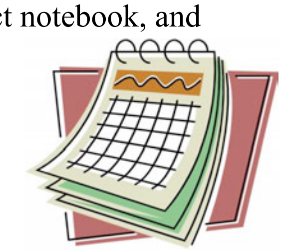
- How much class time do you wish to devote to science projects? Should class time be concentrated in one unit or used intermittently to check projects?

- 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 a secretary available to assist with typing? 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? Will organizations provide funding?

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. Many local, regional, state and national science fairs have web sites.
- If possible, form a committee of interested teachers, parents, principals, and community members to assist in the organization of the fair.

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. The following are various methods to open a discussion of science fair projects:

- Show slides or CD of projects from previous years. (Refer to www.lascifair.org)
- Request a presentation from students who have participated in previous science fairs.
- Display magazines and books with ideas of experiments and special topics that might be explored.
- 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.

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.

Suggested Timeline

Sept: Submit student project proposals **(fall submission)** involving human subjects, tissues, vertebrate animals, and hazardous chemicals **for pre-approval** to the Los Angeles County Science Fair Science Review Committee (SRC).

Oct: Schedule the date of your school science fair (prior to the LA County Science Fair).

Reserve exhibit space for your local school Science Fair.

Check rules for County Science Fair so that teachers are well informed on regulations, requirements and timelines.

Nov: Work with students to understand the components of a science fair project.

Assist students in selecting a suitable topic.

Dec: 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.)

Submit student project proposals **(winter submission)** involving human subjects, tissues, vertebrate animals, and hazardous chemicals **for pre-approval** to the Los Angeles County Science Fair Science Review Committee (SRC).

Jan: Advise students regarding contacting professionals who can help guide their project and supply necessary background (optional for teacher).

Help students develop a list of materials needed for projects (optional for teacher).

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. (Special forms may have to be completed.)

Check to ensure that all projects conform to safety rules and proper care of human subjects, animals, tissue, etc. (Any experiment where an animal or human being might be injured or experience pain should not be allowed.)

Late Jan: Final opportunity to register online for school participation in the Los Angeles County Science Fair.

Early Feb:

Develop a judging sheet that incorporates your expectations.

Determine the number of projects and categories expected.

Arrange for judges (provide judges with criteria).

Help students develop conclusions and organize and assemble the final report.

Mid Feb:

Arrange for a review of student's journal (possibly by language arts teachers.)

Publicize your fair to the community, including parents, city officials, Board of Education members, administrators, faculty and the local newspaper.

Plan physical layout of the space for the science fair.

Design printed program to include a list of judges, projects, where each student's project is located and a map.

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.

Arrange for volunteers to work during the fair.

Late Feb:

SCIENCE FAIR DAY

Set up tables with project numbers attached.

Secure public address system (if needed).

Prepare judging sheets and make necessary copies.

Prepare nametags for judges.

Arrange coffee and refreshments for judges.

Review judging criteria for judges.

Don't forget to thank judges and volunteers.

Late Mar:

Deadline for payment of school registration fee to participate in the LA County Science Fair.

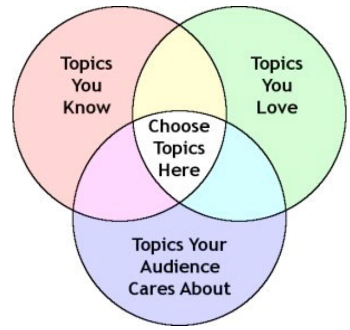
Early April:

California State Science Fair

Early May:

Intel International Science and Engineering Fair

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*

While the teacher may set limits for costs incurred, parents should be the judges of appropriate expenses. Parents should approve all plans prior to submission to the teacher. Any submitted plans must 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.lascifair.org/wp-content/uploads/2012/02/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.

KEEP IT SIMPLE. It is NOT necessary to use elaborate equipment or technology. Remember that the wealth of scientific information was built by many men and women discovering small and simple facts over a long period of time.

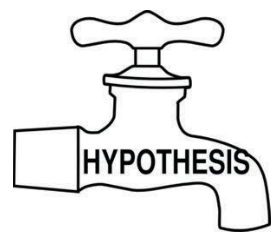
Literature Search

Find out what has been written about the selected topic. Search the library, Internet, Public Library of Science, and our website (www.lascifair.org) for at least five 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 summarizes 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 persons assigned to judge your project. The abstract represents the first exposure the judges will have to your project research. 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.
(Click here for examples)

Materials and Methods:
Indicate the materials, methods, and experimental design used in your project. Briefly describe your experiment or engineering methods. (Click here for examples)

Results:
Summarize the results of your experiment and indicate how these results pertain to your objective.
(Click here for examples)

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. (Click here for examples)

Examples For Each Section of the Abstract

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.
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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.
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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.
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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.
Top of the Document

The Display

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. The backboard may be made of pegboard, Masonite, or plywood no larger than 76-cm (2.5 ft.) deep, a maximum of 122-cm (4 ft.) wide, and a maximum of 198 cm. (6.5 ft.) high (if placed on table) or 274 cm. (9 ft.) high (if placed on floor). (Of course, the display does not need to be this large). An easy-to-handle folding design is made from pegboard held together by three notebook rings between each section. Scrap wood can be covered with fabric for an attractive display. Try requesting scraps at lumberyards, construction sites, hardware stores, or yardage stores before spending money. Foam core or folding backboards may also be purchased from science or office supply stores.

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 section titles.

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.

PLAN AHEAD—A GOOD DISPLAY TAKES TIME TO CREATE!

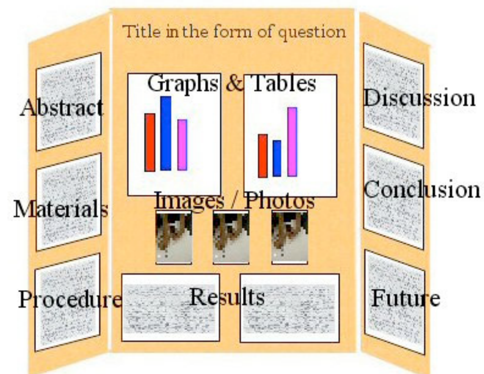
Rules for Exhibit Displays

Maximum Size

- Table displays: 76 cm (2.5 ft.) deep x 122 cm (4 ft.) wide x 198 cm (6.5 ft.) high
- Floor displays: 76 cm (2.5 ft.) deep x 122 cm (4 ft.) wide x 274 cm (9 ft.) high

Note: Projects exceeding these dimensions will not be admitted to the fair.

Construction



- Projects must be durable with all parts firmly attached. Provide back support for your exhibit.
- No attachment to walls.
- 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!

Gas or Water

- No gas or water outlets will be provided.

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 Executive Committee of the Los Angeles 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 Los Angeles County Science and Engineering Fair Committee, its Board of Directors, the Los Angeles County Office of Education, the Board of Supervisors for Los Angeles County, 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 Los Angeles County Science Fair.

Safety Guidelines for the Display

1. Fire regulations prohibit use of highly flammable materials or decorations in project displays. Background panels must be of Masonite, pegboard, hardboard, wood or foam core 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 2m long and equipped with a standard grounded plug.
   - Devices (vacuum tubes, lasers, etc.) that 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: LASER RADIATION; DO NOT STARE INTO BEAM. (See *Science Safety Handbook*)
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. <u>Sealed</u> 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.*

Judging and Criteria for Awards

The initial reward for participating in the Los Angeles County Science Fair is the opportunity to display a science project, meet with other exhibitors, and share information and views. A certificate of merit is given to each student exhibitor in recognition of his or her efforts.

First, second, third place and honorable mention awards, consisting of medals and ribbons, are awarded for exhibits in each category in both Senior and Junior Divisions. In addition to awards for place winners, 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 Los Angeles County Science Fair Judge's Worksheets that follow in the Appendix.

Form 601-076 – Individual and Team   Form 601-077 – Mathematics and Computers

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?

The Interview

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

INTERVIEW Tips:

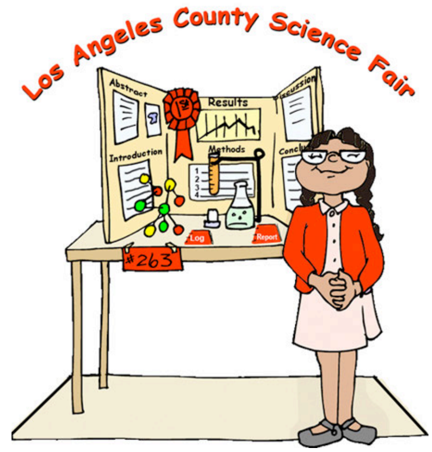
- **DON'T MISS THE INTERVIEW** – arrive EARLY to the Convention Center
- **Clothing**: clothes should be neat, preferably business style– this shows your respect for yourself and the judges.
- **Courtesy:** Introduce yourself to each judge and shake hands. Look at them directly when answering a question or listening to a comment
- Attend the 20-minute "**Nine Quick Tips Workshop**" session on Registration Day.

    1. *Think of yourself as belonging to the science community.* ***You are sharing your ideas among colleagues***
    2. *Find a way to get physically comfortable with yourself just before you begin.* ***Breathe easily!***
    3. *Draw from what you know by heart– so that it doesn't sound overly "memorized."* ***Speak from your place of confidence!***
    4. *Communicate in a natural manner, not rushed, perhaps just a bit slower than usual.* ***Give each idea its moment in the sun.***
    5. *Let your opening start with a BIG IDEA, and then connect it to your research topic.* ***Place your project into context!***
    6. *Provide a brief overview of highlights, like an abstract or a movie trailer.* ***Excite your audience about your project!***
    7. *Allow questions and comments to guide the direction of your presentation.* ***Pause from time to time to allow for dialogue!***
    8. *If you don't know, use the moment to think out loud with your colleagues.* ***Show the quality of your thinking process!***
    9. *Used sparingly, humor, charm, and eye contact may help you connect with your colleagues.* ***Stay focused on the science story!***

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?

Los Angeles County Science & Engineering Fair Info



The Los Angeles County Science 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 in the Fair is thirteen (13). Three (3) of the thirteen projects may be Team Projects (**only 2-3 participants per team *from the same school*, MAXIMUM**).

Medals will be awarded to 1st, 2nd, 3rd Place and Honorable Mention winners in each of the 38 categories for both the Junior and Senior Divisions. Special awards from business and industry are also granted each year.

Application forms for student projects must be **completely** filled out and submitted **online** by the deadline date. The Site Science Fair Coordinator is responsible for final online verification and approval of all student applicants and for submitting all necessary paperwork**.** ***Late project entries will not be accepted at the fair.*** Problems with mail delivery are not an acceptable excuse for late paperwork. The Site Science Fair Coordinator is responsible for submitting all required paperwork as ***PDF's or as online interactive submissions*** to:

Certforms@lascifair.org

Note: *2015 Summer Pre-Approval Certification forms may be mailed as paperwork to:*

Los Angeles County Science and Engineering Fair
Attn: Jennifer Moses, President
8504 Firestone Blvd. #247
Downey, CA 90241

All registration fee payments and donations must be remitted to:

Attn: Jennifer Moses, President
Los Angeles County Science Fair
8504 Firestone Blvd. #247
Downey, CA 90241

- ***On the online application, students are required to submit an abstract (not to exceed 250 words) of their project. The judges will review this abstract at least three weeks prior to the scheduled date of the Science Fair.***

- ***All projects involving tissues/cell lines, vertebrate animals, human subjects, hazardous materials or microbes must have approval prior to the initiation of student research. Projects without prior approval and proper signatures on Certification Form 601-068 (Junior Division only) or ISEF Certification Forms (Senior Division only) will not be accepted at the fair.***

The section in this guide titled *Category Interpretations* will help students determine the category in which their project should be entered.

ELIGIBILITY & PROJECT CATEGORIES

The Los Angeles County Science Fair is open to all students, grades 6-12, who have been selected as winners from a local school or district Science Fair. Each school may send a total of 13 entries, three of which may be Team Projects *that come from the same school*. A Site Coordinator must oversee the work his or her students do - this is not possible if a student attends another school. The following list of category descriptions is prepared to help students and teachers properly select the exhibit category.

Jr.	***Sr.***	***PROJECT CATEGORY DESCRIPTIONS***
X	**X**	**1. ANIMAL BIOLOGY:** Studies of evolutionary origins, genetics, growth, morphology, studies of animals in their natural habitat (or reproductions of it).
X	**X**	**2. ANIMAL PHYSIOLOGY:** Studies of major animal organ system functions involving genetics, immunology, neurobiology, pathology, reproduction, or sensory biology in mammals.
	X	**3. BEHAVIORAL/SOCIAL SCIENCES:** Studies of behavior, conditioned responses, learned responses, learning, psychiatry, or psychology in humans and other animals, including the effects of chemical or physical stress on mental processes, anthropology and archaeology; studies or surveys of attitudes, behaviors, or values of a society or groups within a society (e.g., anthropology, archaeology, or sociology)
X		**4. BEHAVIORAL SCIENCES- NON-HUMAN:** Studies of behavior, conditioned responses, learned responses, learning, psychiatry, or psychology in non-humans, including the effects of chemical or physical stress on mental processes.
X		**5. BEHAVIORAL/SOCIAL SCIENCES- HUMAN:** Studies of behavior, conditioned responses, learned responses, learning, psychiatry, or psychology in humans, including studies or surveys of attitudes, behaviors, or values of a society or groups within a society (e.g., anthropology, archaeology, or sociology), and the effects of chemical or physical stress on mental processes.
X	**X**	**6. BIOCHEMISTRY & MOLECULAR BIOLOGY:** Molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry, food chemistry, hormones.
	X	**7. CHEMISTRY:** Physical chemistry, organic chemistry (other than biochemistry), inorganic chemistry, materials, plastics, fuels, pesticides, metallurgy, soil chemistry.
X		**8. CHEMISTRY-APPLIED:** Measures and comparisons of materials durability, flammability, effectiveness for intended use, and product testing for real world applications.
X		**9. CHEMISTRY-GENERAL:** Physical chemistry, organic chemistry (other than biochemistry), inorganic chemistry, materials, plastics, fuels, pesticides, metallurgy, soil chemistry. This implies knowledge of the chemical structure of the materials being tested.
X	**X**	**10. EARTH/SPACE SCIENCES:** Geology, geophysics, physical oceanography, meteorology, atmospheric physics, seismology, petroleum geology, geography, speleology, mineralogy, topography, solar physics, astrophysics, orbital mechanics, observational astronomy and astronomical surveys.
X	**X**	**11. ECOLOGY:** Interaction of abiotic and biotic elements within any environmental investigation (habitats, food webs, oxygen, carbon & nitrogen cycles, biogeography, biomes), pollution sources (air, land, water), impact studies, resource access, environmental alteration (caused by heat, light, irrigation, erosion, etc.).

Jr.	***Sr.***	***PROJECT CATEGORY DESCRIPTIONS (continued)***
X	**X**	**12. ENGINEERING APPLICATIONS:** Project in which a potentially useful product is created (e.g., strengthening concrete, satellite reception improvement, solution to traffic jams, bionic heart/respiration monitors).
X	**X**	**13. ENGINEERING RESEARCH:** Engineering analysis, tests of devices and their operations, other than product comparisons.
X	**X**	**14. ENVIRONMENTAL MANAGEMENT:** Conservation of natural resources and usage modalities (crop rotation, use of renewable energy sources, terrace farming, recycling, clear cutting, etc.), environmental protections (emissions control, sewage and solid waste disposal, etc.)
X		**15. MATERIALS SCIENCE:** Studies of materials characteristics and their static physical properties. Includes measurements and comparisons of materials durability, flammability, and insulation properties (thermal, electrical, acoustic, optical, electromagnetic, etc.).
X	**X**	**16. MATHEMATICS & COMPUTER SCIENCES:** Calculus, geometry, abstract algebra, number theory, statistics, complex analysis, probability, topology, logic, operations research, and other topics in pure and applied mathematics, computer programs, languages, new developments in software or hardware, information systems, computer systems organization, computer methodologies, and data (including structures, encryption, coding, and information theory).
X	**X**	**17. MICROBIOLOGY:** Studies of prokaryotes, protists (excluding algae), and fungi (mycology), including genetics, growth and reproduction, and response to chemical, and physical stress. Includes bacteriology.
X	**X**	**18. PHARMACOLOGY:** Effect of any drug or chemical on any living animal, especially though not exclusively, humans. Studies should be at the cellular or organism level.
	X	**19. PHYSICS:** Experimental or theoretical studies of the physical properties of matter in all forms, Computer simulations of physical systems are appropriate in this category.
X		**20. PHYSICS- AERODYNAMICS/HYDRODYNAMICS:** Studies of aerodynamics and propulsion of air, land, water, and space vehicles; aero/hydrodynamics of structures and natural objects. Studies of the basic physics of fluid flow.
X		**21. PHYSICS- ELECTRICITY & MAGNETISM:** Experimental or theoretical studies with electrical circuits, electro-optics, electromagnetic applications, antennas and propagation, and power production.
X		**22. PHYSICS- GENERAL:** Experimental or theoretical studies of the physical properties of matter and energy in all forms (with the exception of fluids, electricity, and magnetism); computer simulations of physical systems are appropriate in this category.
X	**X**	**23. PLANT BIOLOGY:** Agriculture, agronomy, horticulture, forestry, plant taxonomy, plant genetics, hydroponics, and phycology (algae).
X	**X**	**24. PLANT PHYSIOLOGY:** Studies of major plant organ system functions involving genetics, immunology, pathology, and reproduction.
X		**25. PRODUCT SCIENCE:** Comparison and testing of natural and man-made products regarding effectiveness for their intended use in consumer-oriented applications.

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) or Animal Biology (fruit flies).

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 Physiology (growth of algae), Environmental Management (water purification systems), Microbiology (effects on microorganisms), Animal Biology (fish populations), and Ecology (organisms and pollution).

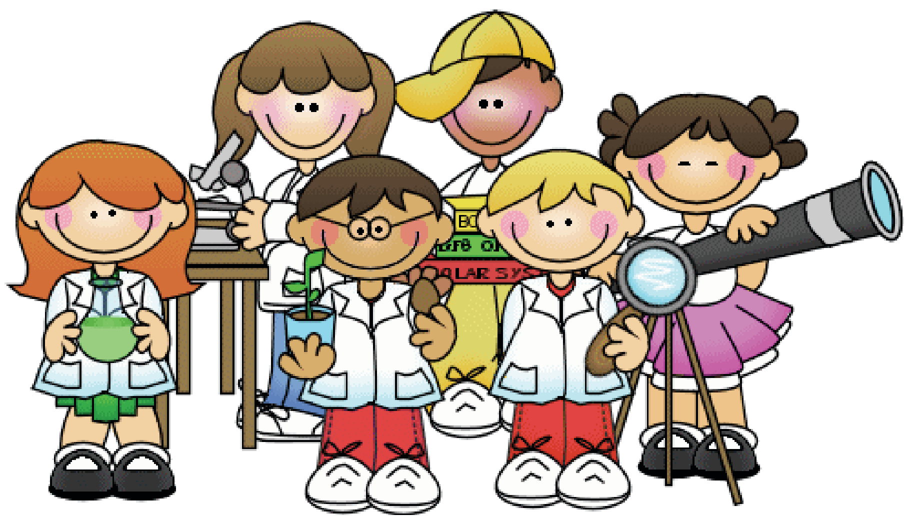
Pesticides: Biochemistry & Molecular Biology (mechanisms of toxic effects), Plant Physiology (plant intake and concentration), Chemistry (composition of pesticides), Earth/Space Sciences (mechanisms of runoff), Pharmacology (effects on human beings and animals), and Ecology (effects of pesticides on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



Possible Projects for Each Category

(It is best for students to choose their own projects based on their interests.
All things being equal, originality will always receive a higher judgment.)

Animal Biology

- Analysis of owl pellets for determining owl diet and mammal distribution
- Feeding behavior of flies
- Regeneration experiments with Planaria
- Mimicry- a study of look-alikes
- How do microwaves affect the genes of *Drosophila*?
- What happens if both juvenile and molting hormones are artificially introduced into an insect larva?
- How are stem cells induced to turn into specific tissues?
- Given a choice, which dog food do toy poodles prefer?
- Are Channel Island foxes really separate SPECIES or sub-species?
- Are coyote densities in Southern California increasing?

Animal Physiology

- What type of weight lifting increases muscle mass the quickest?
- Can *Drosophila* become immune to pesticides?
- Do video games increase hand-eye coordination?
- Do neuroinhibitors affect metamorphosis in insects?
- In which group will stretching exercises show the greatest increase in flexibility: non-athletes, runners or ballet dancers?
- Can breathing exercises improve a singer's ability to hold a note?
- What is the most cost-effective food to feed baitfish to gain the greatest and fastest growth?
- Which abdominal exercise machine decreases waist size the fastest?

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 Los Angeles or San Gabriel 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 track the data from current meters in the Southern California Bight and show seasonal patterns
- Create a modeling program to show yearly fluctuations in the wolf and moose population on Isle Royal
- Create a program to compare exponential growth in mice, cockroach, sparrow and human populations
- Create a 3-D model of the Southern California Bight to show temperature fluctuations in an El Nino event
- 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 Los Angeles County ground water?
- Did mastodons really roam near Los Angeles 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

Ecology

- 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 Palos Verdes 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?

Environmental Management

- Can water hyacinths remove nitrates from wastewater?
- Can variations in the growth rings of tree rings be correlated with specific environmental effects?
- Which is the most efficient and cost-effective method for cleaning up small oil spills?
- What is the effect of microwaves on the growth of grass?
- Does low electromagnetic radiation affect bacterial growth?
- How long does it take to restore normal coliform counts to beach waters after heavy rains?
- A study of zebra and Quagga mussel invasion and control in Southern California waterways

Microbiology

- What level of bacterial growth is found in various sources of Los Angeles 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?
- Do fat-blockers really work?
- 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?

Plant Physiology

- 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

www.usc.edu/CSSF/

Projects placing, first, second, or third in the Los Angeles County Science and Engineering Fair are eligible to enter the California State Science Fair. This fair is usually held at the California Science Center approximately two weeks after the Los Angeles County Science and Engineering Fair.

Intel International Science and Engineering Fair

https://student.societyforscience.org/intel-isef

The Judging Committee will select two to six student projects that demonstrate high levels of excellence to represent Los Angeles County at the Intel International Science and Engineering Fair.

References and Resources

Refer to the following websites for references and resources:

Los Angeles County Science & Engineering Fair: www.lascifair.org

JPL Video Series: How to Do a Science Fair Project
Need help getting started on your science fair project? In this video series, a JPL scientist, engineer and educator team up to help you learn how to craft your very own idea for a great science fair project and see it through to completion.

Discovery Education: Science Fair Central *In-depth multimedia support on all aspects of science fair project preparation and presentation: awesome resource!*

SCIENCE BUDDIES: *Free Help from Scientists and Engineers for 6th-12th Grade Science Students!*

PBS DragonflyTV: *Jr Project ideas with videos from real students*

National Science Digital Library
*Put **"science fair"** in the search box and explore the finest websites available for project development and research. HUGE amount of resources as well as images and videos available.*

Listed below are the names and emails of members of the Los Angeles County Science Fair Committee who are veteran science fair site coordinators available to answer teacher questions related to implementing a local science fair, preparing for the LA County Science Fair, monitoring student research, filling out required certification forms, etc.

Emily Hoffman	***ehoffman@fc.spusd.net***
Anne Maben	***afmaben@lascifair.org***
Jennifer Moses	***jmoses@lascifair.org***
Margery Weitkamp	***microbiot@earthlink.net***

APPENDIX

GENERAL PROJECT GUIDELINES

The following guidelines will help keep the projects uniform and within the laws of the Education Code of the State of California. Please read the **Safety Regulations** on "The Display" webpage as well as the Research Rules & Regulations webpage for *detailed information*. Science Fair sponsors want all students to have the best opportunity to compete for the annual awards. During the time that the Science 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 at the Los Angeles County Science & Engineering Fair must abide by the following:

1. **Present an experimentally-based scientific or engineering research design**.

2. **Be carefully pre-screened by the individual school's Science Fair Site Coordinator** and the teacher whose student is submitting the project. The Los Angeles County Science Fair Judges Worksheet lists the criteria used to evaluate the projects.

3. **Clearly distinguished 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 then their school must show only the student's research in their project display. Students may mention the relationship to the research of others in notebooks only if they clearly specify the assistance received and the role and contributions of others in research related to the project. It is highly recommended that projects of this kind be accompanied by a letter from the principal research director indicating the relationship of the student project.

4. **Be original and distinct.** Identical project/data may not be submitted by a school under separate judging divisions. Likewise, the same unmodified project cannot be submitted multiple years.

5. **Be within the total quota for each school.** Quotas will be announced in advance of the Science Fair. If additional applications are submitted, schools will be contacted and each school will determine which projects are the official entries. If excess entries are initially overlooked, only a number corresponding to the quota will be judged. Those to be judged will then be selected at the discretion of the Science Fair Committee.

6. **Be officially registered for the Fair** after the School's application is sent. Schools should avoid sending applications for projects until it is certain that the projects will be completed in time and will physically arrive at the Science Fair. Projects, for which we receive a registration, but are not actually entered, create errors in the program, a waste of time for judges and leave unsightly open spaces in the exhibit area. The Fair Committee will reduce the project quota for any school that fails to produce the project for which we have received a registration.

7. **Be submitted by students only in grades 6-12** or with an age equivalent to those in grades 6-12. Younger students may submit only if they are in an accelerated program with certified enrollment in grade 6 or higher-level subjects.

8. **Bring a completed Display, report and logbook to the Science Fair and pick up the display only within the designated hours.** Early entries will not be accepted. Entries will be accepted and project removal will be permitted only when a member of the Los Angeles County Science Fair Committee is present. Facility staff members are not authorized to receive or permitted to pick up projects.

9. **Use *illustrations or photos* of microorganisms, animals and plants.** The display of bacterial cultures and live or preserved animals and plants *will not be permitted*.

10. **Remain at the Fair during the days scheduled for public viewing.** The only exception to this rule is for students who must take projects to the International Fair, if their departure day/time overlaps the time that the Los Angeles County Science Fair is open. To ensure security during project removal, the authorized time for pick up will be strictly followed. The Science Fair is not responsible for projects left after the designated time.

11. **Use a title that 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.

12. **The Display must fit within the prescribed space limitations** – no larger than 76 cm (30 inches deep (front to back), 122 cm (48 inches) wide (side to side) and 284 cm (108 inches) high (floor to top including height of table). *Oversized projects will be screened at the door and refused entry.*

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

14. **Be careful to display photographs that do not show procedures detrimental to the health and well being of vertebrate animals**. *(For instance, the performance or results of surgical procedures may not be shown.)* Those not in compliance will be removed from the display areas and will not be judged.

15. **Have notebooks and small equipment items removed no later than the viewing period following the end of the awards ceremony.** The Science Fair will not be responsible if these items are missing from projects. Do not display items you cannot afford to lose.

16. **Do not have computers with projects except for Judging Day.** A computer may be brought by the student for the judging interview on the second day if the student assumes full responsibility for the computer. Judges are instructed to have students return for interviews if the computer demonstration is essential.

17. **Give attention to all considerations of safety (see Safety Regulations on the Display Page.)** Projects that use 120-volt electrical current must have all wires and connections well shielded. Those not in compliance will be screened at the door and refused entry.

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

19. Be submitted with the understanding that **the decisions of the Los Angeles County Science Fair Committee is final.**

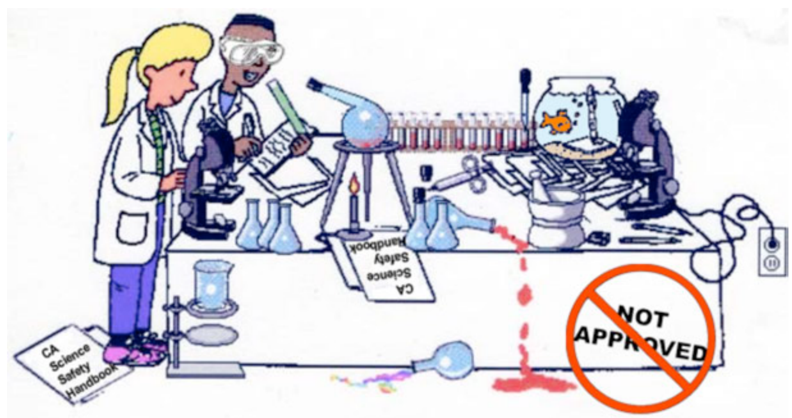
RESEARCH RULES & REGULATIONS

The Los Angeles County Science Review Committee **(SRC)** is responsible for approval of any student project involving **tissue/cell lines, human subjects, vertebrate animals, hazardous materials and/or microbes** that may be entered in the Los Angeles County Science Fair.

A minimum of three persons will pre-screen project Research Plans involving the above categories. (Additional members may be appointed to the SRC to avoid conflict of interest.) The Los Angeles County Science Review Committee includes:

1. A Biomedical Scientist (Ph.D., M.D., D.V.M., D.D, S., etc.)
2. A Science Teacher/Advisor that is not sponsoring a project at the Los Angeles County Science & Engineering Fair.
3. A Science Fair Committee member that is not involved as a Teacher/Advisor or Animal Care Supervisor

The Los Angeles County **Science Review Committee** will examine the completed Research Plan (Jr. Division Certification Form No. 601-068 or Sr. Division ISEF Certification Forms for the following, using downloadable **SRC Checklists**:



- Evidence of literature search.
- Evidence of required and proper supervision.
- Use of accepted research techniques.
- Complete signatures on Certification Forms.
- Evidence of search for alternatives to animal use.
- Humane treatment of animals.
- Compliance with Los Angeles County Science & Engineering Fair guidelines, state and federal laws governing human subject, tissue/cell line, vertebrate animal, hazardous materials and microbe research, and adherence to the California Education Code.
- Compliance with Los Angeles County Science & Engineering Fair guidelines and state and federal laws governing the use of recombinant DNA, pathogenic organisms, controlled substances, tissues and hazardous substances and devices.
- Appropriate documents and substantial expansion for continuation projects.

All students please note the following: if your project involves working with *tissue/cell lines*, *human subjects*, *live vertebrate animals*, *hazardous materials and/or microbes* you must be familiar with the safety regulations that follow.

NOTE: If a project is a **continuation of a project** that was previously entered into the Los Angeles County Science and Engineering Fair, the student must document, in the Research Plan, how the current year's project is new and must contain at least 2/3 new information. Repetitions of previous experimentation or increasing sample size are examples of unacceptable continuations. Display boards must reflect the current year's work. Supporting documentation, log books from previous related research, may be exhibited, if they are properly identified. Student must submit either the Jr. Division Continuation Project (Multi-year) form or the Continuation form included in the Sr. Division ISEF Certification Forms.

Scientific fraud and misconduct are not condoned at any level of research or competition. Plagiarism, use or presentation of other researcher's work as one's own, forgery of approval signatures and fabrication or falsification of data or approval dates will not be tolerated. ***Fraudulent projects will fail to qualify for competition in affiliated Science Fairs.***

SUPERVISOR QUALIFICATIONS

Projects may require <u>different levels of supervision</u>, *based on their topic*. All student research projects involving ***tissues/cell lines, human subjects, live vertebrate animals, hazardous materials and activities and microbes*** need supervision and must comply with guidelines from the International Science and Engineering Fair (ISEF) as modified by the Los Angeles County Science & Engineering Fair Executive Committee. **Descriptions and qualifications are below:**

<u>Teacher/Advisor (Adult Sponsor)</u> is the person in whose <u>school or lab</u> the student is working. This individual must have a solid background in science and should have close contact with the student during the course of the project. The Teacher/Advisor must be familiar with the regulations that govern potentially dangerous research as it applies to a specific student project. Some experiments involve procedures or materials that are regulated by State and Federal laws. If not thoroughly familiar with these regulations, the Teacher/Advisor should help the student enlist the aid of a qualified <u>Biomedical Scientist</u>.

The Teacher/Advisor is ultimately responsible, not only for the health and safety of the student conducting the research, but also, for the tissue, human subjects and/or animals used in the experiment. ***The Teacher/Advisor must review the student's Research Plan to make certain of the following:***

(a) Experimentation is done within local, state and federal laws and the Los Angeles County Science & Engineering Fair Project Screening Guidelines.

(b) Required online pre-approval is completed by the student involved in the project and other supervising adults and ***approved by the SRC*** <u>prior</u> to the start of research; and

(c) The qualifications of any **Biomedical Scientist** adhere to listed criteria below.

The <u>Teacher/Advisor</u> is responsible for ensuring that the student's research is eligible for entry in the Los Angeles County Science and Engineering Fair.

<u>Biomedical Scientist:</u> A qualified Biomedical Scientist should possess an earned doctoral/professional degree in the biological or medical sciences as it relates to the student's area of research. However, a master's degree with equivalent experience and/or expertise in the student's area of research is acceptable when approved by the Teacher/Advisor. The Biomedical Scientist must be thoroughly familiar with local, state and federal regulations that govern the student's area of research.

The **Biomedical Scientist** and the Teacher/Advisor *<u>may</u> be the same person*, if that person is qualified as outlined above. A student may work with a Biomedical Scientist in another city or state. In this case, the student must also work locally with a Designated Adult Supervisor who has been trained in the techniques the student will use.

<u>Designated Adult Supervisor</u> is an adult who is directly responsible for overseeing student experimentation. The Designated Adult Supervisor need not have an advanced degree, but should be thoroughly familiar with the student's project and *must be trained in the student's necessary research techniques*. The Teacher/Advisor ***or the parent*** may act as the Designated Adult Supervisor.

If a student is experimenting with <u>live</u> vertebrates and the animals are in a situation where humans influence their behavior or habitat, the Designated Adult Supervisor must be knowledgeable about the humane care and handling of the animals. If the Designated Adult Supervisor is *not knowledgeable*, the Teacher/Advisor must ensure that the student *enlists the help of an Animal Care Supervisor*.

<u>Animal Care Supervisor</u> is the person required for all non-human vertebrate animal projects. This person must be familiar with the proper care and handling of research animals used in the project. The Biomedical Scientist, Designated Adult Supervisor or animal care professional *can usually serve as the Animal Care Supervisor*. Animal Care Supervisor *may also be the Site Science Fair Coordinator*.

Los Angeles County Science Fair

Does your project require Pre-Approval? Find out fast!

Some research projects require Pre-Approval from the Science Review Committee (SRC). If you answer **YES** to any of the questions below, ***review the General Information Section 1 of the 2016 Rules & Regulations in the section noted below.***

If ALL are No: | **If ANY are Yes:**

- **Human or Vertebrate Animal Tissue, Fluid Sources** Anything coming from a human or animal body? Cells, teeth, bone, blood, saliva, or urine? RNA or DNA from one organism inserted into the RNA or DNA of another organism? — NO / YES → **Section 2**
- **Human Subjects:** Asking your friends or other people questions? Experiments on yourself? Experiments with people in any way? — NO / YES → **Section 3**
- **Non-Human Vertebrate Subjects:** Your pet? Any other animals that have bones (except people)? — NO / YES → **Section 4**
- **Hazardous Chemicals, Activities, Devices:** Includes DEA-controlled substances, prescription drugs, alcohol & tobacco, firearms, explosives, radiation, lasers, etc. Hazardous activities involve risk **above and beyond** that encountered in the student's everyday life. — NO / YES → **Section 5**
- **Potentially Pathogenic Microbes:** Working with **bacteria or molds**? With **viruses**? With disease-causing **Protozoans**? — NO / YES → **Section 6**

Project does NOT need SRC Pre-Approval!

SRC Pre-Approval Required

YOU MUST SUBMIT ONLINE:

Jr. or Sr. Division Research Plan with electronic verification

Sr. Division - ISEF Certification Forms with signatures need to be brought to the fair, for judging

For additional information on 2016 Rules & Regulations and the online pre-approval process, please see the website http://www.lascifair.org/eligibility-categories/ or contact: Jennifer Moses, 323-496-6797 or jmoses@lascifair.org

Regulations for Experiments with Tissue/Cell Lines

ALL projects involving research with tissue/cell lines must be pre-approved by the LA County Science Review Committee (SRC) before experimentation is begun.

Definition: Human or non-human tissue samples are defined as fresh tissue, organs, human or animal parts, blood, blood products (including *Blood Agar*), teeth, cell(s) and established cell lines and tissue cultures, DNA source material and body fluids (i.e., saliva, tears, urine.)

Research that DOES NOT need pre-approval
Plant tissue, cut hair samples, tissue samples, etc. obtained from commercial businesses, food stores, restaurants, or packinghouses ***DO NOT need pre-approval.***

Prohibited Research
Students may not collect blood or tissue from living human or vertebrate animals. *California law only allows medical doctors, registered nurses or licensed phlebotomists (lab technicians) to collect blood from a vein or artery.* Animals may not be sacrificed **solely** to obtain tissue samples.

Safety Precautions

1. **All projects** must conform to the *CA Education Code Title 2, Division 2, Part 28, Chapter 4, Article 5, 51540*.
2. Students may conduct research on human blood, blood products or other body fluids only if tissues are handled in accordance with standards and guidelines set forth in *OSHA 29CFR, Subpart z, 1810.1930* – *Blood Borne Pathogens* under the supervision of a qualified scientist.
3. All bodily fluids shall be treated in the same manner as pathogenic or potentially pathogenic agents as defined in *Biosafety in Microbiological and Biomedical Laboratories (BMBL)*, published by CDC-NIH.
4. Any project involving human or non-human tissue samples shall have a **Research Plan** that includes the objectives and goals for the project and a list of the tissues, organs or parts involved in the experiment. The Research Plan shall describe fully the methods and techniques involved in the project including the procurement and disposition of all proposed tissue samples. The Research Plan shall also include the source for the tissue samples, genus, species and common name. The Research Plan shall indicate the date of sample acquisition and be certified by the person providing the tissue sample that *the student was not involved in the direct acquisition of the samples from living human or vertebrate animals.*
5. Human blood and blood products *(including Student Researcher's own blood)* must be documented by a research institution or certified blood test as free of *Acquired Immune Deficiency Syndrome (AIDS)* and *Hepatitis antibodies and antigens* prior to the student receiving the tissue. **Teeth** shall be sterilized and certified free of blood and blood products.
6. When live or preserved tissue samples or parts of human or vertebrate animals are obtained by the student from an institution or Biomedical Scientist, *a statement signed by the adult providing the tissues is required.* Student researchers who collect specimens of body fluids from human subjects are also required to fill out a Written Consent Form (see JR and SR forms below.)

Supervision Regulations

- The student and Designated Adult Supervisor may consult with the Biomedical Scientist (if required) for detailed guidance in the techniques to be used by the student under the direct continuous supervision of the Designated Adult Supervisor.
- The Biomedical Scientist or Designated Adult Supervisor must be in the same locality as the student for the length of the experimental work. A project started in one city may not be continued in another unless an alternate Designated Adult Supervisor, approved by the Biomedical Scientist prior to the continuation of the experimental work, agrees to supervise the project.

Any proposed changes in the Research Plan and Attachments by the student after initial Los Angeles County Science Review Committee approval must have subsequent SRC approval before such changes are made and before experimentation resumes.

Regulations for Experiments with Human Subjects

ALL projects involving research with human subjects must be pre-approved by the LA County Science Review Committee (SRC) before experimentation is begun.

DEFINITION: Human subjects research includes projects involving: human subjects participating in physical activities (physical exertion, eating/drinking any substance, any medical procedure), psychological and opinion studies (survey, questionnaire, test of any kind), behavioral observations, studies in which the researcher is the subject of the research.

PROHIBITED RESEARCH AND DISCLOSURE

1. Student researchers may **NOT** publish or display information in a report that identifies the human subject directly or through identifiers linked to the subjects (including photographs), without written consent.
2. Students are **prohibited** from administering medications and performing medical procedures on human subjects.
3. Students under the age of 21 are prohibited by federal and state law from using controlled substances in their research projects. These substances include *all forms of alcohol, explosive materials, tobacco and firearms.*

REGULATIONS AND SUPERVISION

There are **federal regulations** that must protect the rights and welfare of human subjects. Therefore, students must plan carefully before starting research that involves the use of human subjects in either behavioral or biomedical studies. This will protect subjects from unnecessary contact to physical or psychological complications.

1. All Research Plans/Questionnaires involving human subjects must be received **ONLINE** at our **Pre-approval Site** and certified by the Los Angeles County Science Fair Science Review Committee (SRC) ***before research begins***.
2. A **Written Consent Form** *(see downloadable forms below)* is required for all projects. Children/Minors (under 18 years old) participating in research will require consent of the parent/guardian.

3. The **Research Plan** must list objectives of the project and describe fully the methods and techniques involved (including planned use of anesthetics, drugs, thermal procedures, physical stress, and organisms causing diseases to humans or other vertebrates, radiation, carcinogens or surgical procedures).
4. When the use of electrical current, laser beams, strong sounds or other artificial stimuli are a basic part of the project, it must not exceed what humans or their tissues can tolerate. One place to look is the CA Ed Code or our **Hazardous Materials pre-approval page** if you are unsure.
5. The **use of the Internet** to obtain data for human subjects research is permitted. The Student Researcher and the Adult Sponsor must take additional care to ensure that survey responses remain confidential and informed consent *(the subject's written permission)* is documented.
6. When research activities involve **collection of personal information**, fingerprints) or health related data (genetic material, blood, tissue), the student must consider risks related to the violation of privacy.
7. A student may observe and collect data for analysis of **medical procedures and medication administration** *only under the direct supervision of a qualified professional.* The qualified professional must be named in the Research Plan.

Any proposed changes in the Research Plan and Written Consent by the student after the initial SRC approval must have a second SRC approval before such changes are made and before experimentation resumes.

RISK ASSESSMENT

Risk Groups: Naturally at-risk groups include *pregnant women, with diseases such as cancer, asthma, diabetes, AIDS, cardiac disorders, psychiatric disorders, etc.* Special vulnerable at-risk groups include: *children/minors, prisoners or mentally disabled persons.*

Once a study population is chosen, the student researcher must consider any potential physical and/or psychological risks when developing the **Research Plan**. The federal definition of minimal risk is as follows: *No more than minimal risk exists when the probability and magnitude of harm or discomfort anticipated in the research are not greater (in and of themselves) than those ordinarily encountered in DAILY LIFE or during performance of routine physical or psychological examinations or tests.* Student researchers must be aware of the following:

Risk Activities – PHYSICAL:

1. **Exercise** other than ordinarily encountered in daily life by that subject.
2. **Eating or drinking of any substance or exposure** to any potentially hazardous materials, including environmental, drug and/or food allergies. Allergy symptoms including hives, rashes, swelling and or constricted breathing usually develop within a few minutes to two hours after eating the offending food and must be considered in the Human Consent Form.

Risk Activities – PSYCHOLOGICAL:

Any activity (survey, questionnaire, viewing of stimuli) or experimental condition that could potentially result in **emotional stress**

Regulations for Experiments with Live Vertebrate Animals

ALL projects involving research with vertebrate animals must be pre-approved by the Los Angeles County Science Review Committee (SRC) before experimentation is begun. Any student research involving animals must comply with the requirements of the State of California Education Code Title 2, Division 2, Part 28, Chapter 4, Article 5, 51540.

DEFINITION: Vertebrate animals, as covered by these rules, includes all live, non-human vertebrate, non-human mammalian embryos or fetuses, bird and reptile eggs within three days (72 hours) of hatching and all other non-human vertebrates at hatching or birth. Any project involving vertebrate animals must have clearly defined objectives requiring the use of animals to demonstrate a biological principle or answer a specific scientific proposition.

RESEARCH THAT NEEDS NO PRE-APPROVAL

The use of Protista and other invertebrates is encouraged for most research involving animal and NEEDS NO PRE-APPROVAL.
Alternatives to the use of vertebrate animals for research must be explored and discussed in the Research Plan.

PROHIBITED RESEARCH:

In the public elementary and high schools or in public elementary and high school sponsored activities and classes held elsewhere than on school premises, live vertebrate animals **shall not, as part of a scientific experiment or any purpose whatever:**

- *Be experimentally medicated or drugged in a manner to cause painful reaction or induce painful or lethal pathological conditions.*
- *Be injured through any other treatments, including, but not limited to, anesthetization or electric shock.*
- Be involved in induced toxicity studies such as those using alcohol, acid rain, insecticide, herbicide, heavy metals, cosmetics, cleaning products, etc.
- *Be exposed to behavioral experiments involving operant conditioning with aversive stimuli mother/infant separation or induced helplessness.*
- *Predator/prey experiments where one animal is deliberately being encouraged to hunt and eat another animal, with the exception of behavioral observations in the wild.*

Students will **NOT** be involved in the sacrifice or euthanasia of a living vertebrate or cause pain, *for whatever reason*, to a vertebrate animal.

HUMANE TREATMENT OF ANIMALS

Live animals on the premises of a public elementary or high school shall be housed and cared for in a humane and safe manner.
All projects involving vertebrate animals shall be conducted in compliance with the CA Education Code (above) AND Senior Projects must also follow the International Science and Engineering Fair (ISEF) Rules and Regulations regarding procurement, housing, husbandry, and experimental conditions available at following website: https://student.societyforscience.org/vertebrate-animals

1. **COMFORT: ALL Animals (vertebrate or invertebrate) must be treated kindly and cared for properly.** Animals must be housed in a clean, ventilated, comfortable environment compatible with the standards and requirements appropriate for the species. Animals must be given a continuous, clean (uncontaminated) water and food supply. Cages, pens and fish tanks must be cleaned regularly and appropriately. Proper care must be provided at all times including weekends, holidays and vacation periods. Animals must be observed daily to assess their health and well-being. A Designated Animal Care Supervisor is required to oversee the daily husbandry of the animals.
2. **STRESS:** Experiments involving stress will follow the guidelines for CA Ed Code "Humane Treatment of Animals" above, stay within normal stress limits for the species and NOT produce pathological lesions (diseased patches or cancers). Because weight loss is one significant sign of stress, the maximum permissible weight loss or growth retardation (compared to controls) of any experimental or control animal is 15%.

3. **DIETARY RESTRICTIONS:** If an experimental design requires food or water restriction, it must be appropriate to the species, but may not exceed 18 hours.
4. **UNEXPECTED DEATHS:** If there are unexpected deaths in either the experimental or control groups, the cause of the death must be investigated. If the experimental procedure is responsible for the deaths, the experiment must be immediately terminated.
5. **RESEARCH PLANS** for vertebrate animal studies must include the following:
   - **Justify** why animals must be used, including the reasons for choice of species and the number of animals. Describe any alternatives to animal use that were considered and why those alternatives were unacceptable or contribution this research may have on the broad fields of biology or medicine.
   - **Describe in detail** how the animals will be utilized in the experiment. Include methods and procedures, such as experimental design and data analysis. Describe any experimental procedures in detail. Identify the species, strain, sex, age, weight, source and number of animals proposed for the project.
   - **Proposed methods of animal care** need to be described and demonstrate this compliance with California Education Code and ISEF Rules and Regulations regarding procurement, housing, husbandry, experimental conditions, and disposition of all animals expected to be used in the project.

Regulations for Experiments with Hazardous Materials, Activities or Devices

ALL projects involving research with hazardous materials must be pre-approved by the LA County Science Review Committee (SRC) before experimentation is begun, **with the following exceptions:**

- Model rocket experimentation using *a fully assembled rocket motor, reload kit or propellant modules,*
- Commonly used laboratory devices, assuming that the student researcher has experience working with them, such as Bunsen burners, hot plates, scales, saws, drills, hammers, etc. with oversight by an adult.

DEFINITION: research that involves the use of hazardous materials, devices and activities (Includes DEA-controlled substances, prescription drugs, alcohol & tobacco, firearms and explosives, radiation, lasers, etc.). Rules for Hazardous Materials include substances and devices that are regulated by local, state, country, or international law, most often with restrictions of their use by minors such as DEA-controlled substances, prescription drugs, alcohol and tobacco and firearms and explosives. Hazardous activities are those that involve a level of risk *above and beyond that encountered in the student's everyday life.*

Before beginning research involving hazardous materials, activities or devices, ***be sure to check with your school or District fair as more strict rules and guidelines may be in effect.***

PROHIBITED RESEARCH

Liquid Nitrogen

Students are **prohibited from handling** liquid nitrogen (LN2). Pre-approval is needed for a project involving liquid nitrogen, which must be handled by an Adult Supervisor or scientist trained in safety requirements See Health and Safety Code section 25500-25519. Liquid Nitrogen is so cold that it can literally kill your skin when it gets on you and can cause asphyxiation and death if inhaled. It is generally around -320 degrees Fahrenheit. A full-face mask and protective cryogenic gloves and a full-length apron must be worn when handling nitrogen.

Prohibited Chemicals

The CA Science Safety Handbook lists *chemicals never to be stored or used in CA K-12 schools*, including:

- Explosive Chemicals (Table 7.2), pages 113-114
- Extremely Hazardous Chemicals (Table 7.3), pages 126-127

Prescription Drugs

Prescription drugs are drugs regulated by federal or country laws and are available only through a pharmacy to protect against inappropriate or unsafe use. Therefore, special precautions must be taken in their use for a science project.

1. Students are **prohibited** from administering prescription drugs to human subjects.
2. Students are **prohibited** from administering prescription drugs to vertebrate animals. The only exception is: *If a student is working with a veterinarian searching for a cure for his/her personal animal.* Strict veterinary supervision is required.

Alcohol and Tobacco – *Prohibited* for middle and high school students per Title IV, Part A – Safe and Drug-Free Schools and Communities

Firearms and Explosives – ***Prohibited*** for middle and high school students per California Education Code, Section 48915. "Firearm" means any device designed to be used as a weapon from which a projectile is expelled through a barrel by the force of any explosion or other form of combustion. Examples of "dangerous object" include but are not limited to: air soft guns, paintball guns, B.B. guns, pellet guns, air rifles, brass knuckles, fist packs, nunchaku, sling shots, throwing stars, darts and any object likely to cause injury to persons or property that has no reasonable use at school. *Education Code 48900(b)* Creating explosions or setting items on fire is **strictly prohibited**. **M-80's and Cherry Bombs are explosives. *Exceptions:*** *using a fully assembled rocket motor, reload kit or propellant modules; burning food with a calorimeter.*

SUPERVISION REGULATIONS

1. **The student researcher must conduct a risk assessment** *in collaboration with* a Designated Supervisor or Qualified Scientist prior to experimentation.
2. The use of hazardous materials and devices and involvement in hazardous activities require direct supervision by a Designated Supervisor, *except those involving **DEA-controlled substances**, which require supervision by a Qualified Scientist who is licensed by the DEA for use of the controlled substance.*

3. All studies using **DEA Schedule 1** substances must have the research protocol approved by DEA before research begins. **Schedule 2, 3 and 4 substances do not require protocol approval by DEA.**
4. For all chemicals, devices or activities requiring a **Federal and/or State Permit**, the student/supervisor will be expected to have the permit prior to the onset of experimentation. A copy of the permit should be available for review by adults supervising the project and/or the Scientific Review Committee in their review prior to competition.

SAFETY PRECAUTIONS

The student researcher must design experiments to minimize the impact that an experiment has on the environment, for instance using minimal quantities of chemicals that must subsequently be disposed of in an environmentally safe manner in accordance with good laboratory practices. The CA Science Safety Handbook describes general lab safety precautions (page 26-31).

- *Always handle **dry ice** with insulated gloves and wear eye protection.*
- ***Burning solid substances** (such with a calorimeter) must be performed under a fume hood or outside the classroom.*

The **2015 EPA list of chemicals** known to cause cancer or reproductive problems can be downloaded here.

DEA-CONTROLLED SUBSTANCES

The U.S. Drug Enforcement Administration (DEA) regulates a number of chemicals that can be diverted from their regular use to make illegal drugs. If a student is uncertain whether chemicals involved in a project are controlled by the DEA, he/she should consult the listing of DEA-controlled substances (Click here).

WASTE DISPOSAL

Experimentation must include **proper disposal methods** for the chemicals/materials used in an experiment. The CA Science Safety Handbook describes safe waste disposal for substances used in the lab (page 123-124).
The Flinn Scientific Catalog provides good information for the proper disposal of chemicals. If applicable, the student researcher must incorporate in the research plan disposal procedure required by federal and state guidelines. **Flinn Scientific** has an excellent FREE online School Laboratory Safety Course.

RISK ASSESSMENTS

The student researcher must conduct a risk assessment in collaboration with a Designated Supervisor or Qualified Scientist prior to experimentation. This risk assessment is documented on the 2015 SrDiv ISEF Hazard Material CertForms **or** the Hazard Materials Pre-approval template.

Hazardous Materials

A proper risk assessment of chemicals should include review of factors such as the degree of toxicity, reactivity, flammability or corrosiveness.

- **Toxicity** – the tendency of a chemical to be hazardous to health when inhaled, swallowed, injected or in contact with the skin.
- **Reactivity** – the tendency of a chemical to undergo chemical change.
- **Flammability** – the tendency of a chemical to give off vapors which readily ignite when used under normal working conditions
- **Corrosiveness** – the tendency of a chemical, upon physical contact, to harm or destroy living tissues or physical equipment.

When doing a risk assessment, the type and amount of exposure to a chemical must be considered. For example, an individual's allergies and/or family history may have an influence on the overall effect of any chemical. The student researcher must refer to Safety Data Sheets (SDS) to ensure that proper safety precautions are taken. Some SDS sheets (e.g., Flinn) rank the degree of hazard associated with a chemical. This rating may assist students and adult sponsors in determining risk associated with the use of a chemical.

Hazardous Devices

The documentation of a risk assessment (Form 3) is required when a student researcher works with potentially hazardous/dangerous equipment and/or other devices, in or outside a laboratory setting, that require a **moderate to high level of expertise to be used safely. See hazardous levels of sound production on hearing on our webpage.**

Use of other potentially dangerous devices such as high vacuum equipment, heated oil baths, NMR equipment, and high temperature ovens **must have documentation** of a risk assessment. It is recommended that all student-designed inventions also have documentation of a risk assessment.

Radiation

A risk assessment must be conducted when a student uses **non-ionizing radiation** *beyond that normally encountered in everyday life.* Non-ionizing radiation includes the spectrum of ultraviolet (UV), visible light, infrared (IR), microwave (MW), radiofrequency (RF) and extremely low frequency (ELF). Lasers usually emit visible, ultraviolet or infrared radiation. Lasers are classified into four classes based upon their safety. Manufacturers are required to label Classes II – IV lasers. This classification system changes periodically. Manufacturers have been known to make errors on labeling. Therefore, you should never look directly into a laser or a laser reflection thinking it is safe. Follow standard laser safety protocols to avoid laser exposure to bystanders.

- **Class I lasers** are those found in CD players, laser printers, geological survey equipment and some laboratory equipment. There are no known risks associated with using a Class I laser. ***THIS IS THE ONLY TYPE OF LASER THAT MAY BE DISPLAYED AT THE FAIR.***
- **Class II lasers** are found in laser pointers, aiming and range finding devices and pose a risk if the beam is directly viewed over a long period of time.
- **Class III lasers** are found in higher powered laser pointers, printers and spectrometers. They are to be considered hazardous devices, which can cause eye damage when the beam is directly viewed even for a short period of time.
- **Class IV lasers** are high-powered lasers used in surgery, research, and industrial settings. They are extremely hazardous and can cause eye and skin damage. The beam is also a fire hazard.

Projects involving radionuclides (radioisotopes) and X-rays must involve a careful examination of the risks associated with the study. Depending upon the level of exposure, radiation released from these sources can be a health hazard. Most research institutions have a **Radiation Safety Office,** which oversees the use of ionizing radiation and ensures compliance with state and federal regulations.

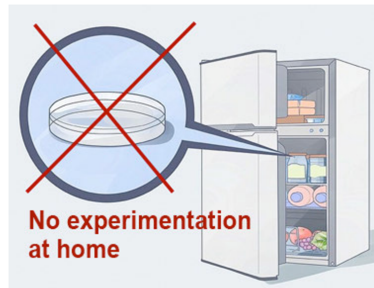
Regulations for Experiments with Microbes

(Pathogenic or potentially pathogenic bacteria, viruses, viroids, prions, Rickettsia, fungi or parasites)

ALL projects involving research with microbes must be pre-approved by the Los Angeles County Science Review Committee (SRC) before experimentation is begun.

Definition: Microbes are defined as pathogenic (disease-causing) or potentially pathogenic agents including *bacteria, viruses, viroids, prions, Rickettsia, molds and other fungi or parasites.*

PROHIBITED RESEARCH



- Studies involving pathogenic agents or potentially pathogenic agents are **prohibited from being conducted in a home environment**, except that specimens may be collected at home. Student research with potentially pathogenic agents may be performed only under the direct supervision of an experienced Biomedical Scientist or Designated Adult Supervisor in an institutional laboratory, including a school, if facilities are adequate and appropriate.
- Laboratory studies utilizing **MRSA** (Methicillin-resistant Staphylococcus aureus) and **VRE** (Vancomycin-Resistant Enterococcus) are **prohibited.** Bacteria KNOWN to be pathogenic are **not** to be cultured. *Pure cultures of non-pathogenic microorganisms should be used in experiments (e.g. pure E. coli purchased from a Scientific Supply Company, singly or in a kit.)*
- *Studies intended to produce bacteria with* ***multiple*** antibiotic resistance *are* ***prohibited****.*
- *Bacterial studies must be conducted in a properly equipped school or institutional laboratory under qualified adult supervision.* ***No experimentation using existing antibiotic-resistant microorganisms may be conducted at home or at school*** unless strains are auxotrophic as well. *Auxotrophic microbes cannot survive unless they're grown on special medium that contains essential amino acids that they are incapable of producing. They die anywhere outside the Petri dish.* District-approved Scientific Supply Houses provide auxotrophic bacterial strains in Lab Kits for use in AP and IB Science labs. ***These are approved strains.***
- *Students may NOT be directly involved in the obtaining of microbes* (**exception:** microbe collection in the environment using sterile swabs and appropriate collection techniques and supervision.

SAFETY PRECAUTIONS

These safety precautions are intended for experimental activities involving any bacteria or fungi. Even nonpathogenic microbes may cause disease if they enter the body accidentally. ***Autoclave or disinfect all waste material; disinfect work areas with 10% bleach, use gloves and goggles.***

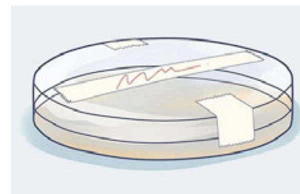
- Research involving pathogenic or potentially pathogenic agents shall be conducted following standard microbiological practices as defined in *Biosafety in Microbiological and Biomedical Laboratories (BMBL)* published by CDC-NIH.
- All projects must conform to the CA Education Code Title 2, Division 2, Part 28, Chapter 4, Article 5, 51540.
- **Collection from Human Subjects:** Student researchers who collect specimens of pathogenic or potentially pathogenic agents from **human subjects** are also required to fill out a downloadable **sample Written Consent Form** to be given to human participants in your project, to understand the project procedures, risks and confidentiality. Choose the appropriate form below.
  - Jr-Div-Human-Consent-Form
  - Sr Human Informed Consent Form
  - Human-Subject-Consent-Form-EXAMPLE
- **Environmental Sampling of unknown microorganisms** from school grounds, household surfaces and field sites off campus. These studies present a challenge because the identity, concentration, and pathogenicity of the cultured agents are unknown. Unknown microorganisms should be collected with proper safety procedures, *samples sealed immediately and grown in a school or institutional laboratory,* ***NOT*** *at home.* When soil or water is used as a source of bacteria (or molds), it is important to collect samples unlikely to be contaminated by human pathogens and never from areas suspected to be or posted as polluted. Collection of soil samples in or around old building sites, animal burrows and/or areas in which valley fever is endemic should be avoided.

SUPERVISION

The student and Designated Adult Supervisor may consult with the Biomedical Scientist (if required) for detailed guidance in the techniques to be used by the student under the direct continuous supervision of the Designated Adult Supervisor. The Biomedical Scientist or Designated Adult Supervisor must be in the same locality as the student for the length of the experimental work. A project started in one city may not be continued in another unless an alternate Designated Adult Supervisor, approved by the Biomedical Scientist prior to the continuation of the experimental work, agrees to supervise the project.

Any proposed changes in the Research Plan and Attachments by the student after initial Los Angeles County Science Review Committee approval must have subsequent SRC approval before such changes are made and before experimentation resumes.

CULTURING (GROWING) MICROBES



- **All cultures in Petri dishes** must be bound together with transparent tape, immediately after exposure/inoculation. Any Petri dish that contains fungus/mold should be ***taped shut***. Examine through lids only.
- **Inoculating loops** must be used with care. Wire loops used for transferring bacteria cultures should be flamed until the *entire* wire is *red* hot before and after each transfer is made. Petri dishes that are inoculated with materials containing unknown microorganisms (i.e., the material might not be a pure non-pathogenic culture) must not contain blood agar or Brain Heart Infusion (BHI) Broth, *(unless used in a research facility)* but rather nutrient or trypticase soy agar.
- **Experimentation with molds** and other fungi *must take place in a fume hood or open-air area* (to prevent contamination of living areas with mold spores and allergic reactions). If anyone in the area has a damaged immune system or any allergies, experiments with molds and other fungi must be conducted in a laboratory. Containers must be sealed airtight with tape around the edges during observations and disposed of as possible pathogens.

DISPOSAL TECHNIQUES

- **Glass Petri dishes:** to sterilize plates before cleaning or disposal, follow these steps: Autoclave the unopened plates in the usual manner. Usually, steaming at a pressure of 15 pounds per square inch for 15 to 20 minutes kills most microbes. However, to sterilize soil samples or large volumes of culture, continue with the procedure described below. Wait one day for any resistant spores to leave the resting stage and begin to grow, sterilize a second time. Wait one more day, sterilize a third time – discard sterilized cultures in the regular trash.
- **All cultured materials must be autoclaved** at the end of experimentation according to the recommended procedures in the Science Safety Handbook for California Public Schools (2012 edition). ***Exception:*** *Cultures of pure, non-pathogenic bacteria grown in plastic Petri dishes (usually obtained through Science Supply Company kits) can be covered with a 10% bleach solution and allowed to soak for at least 1 to 2 hours. Discard in the regular trash.*
- **Disposable plastic petri dishes**: place unopened, sealed dishes in Biohazard disposal bags (included in Science Supply kits for *E.coli* and molds) and use District pick-up of bags as hazardous waste. Calls to nearby universities and hospitals can also yield a place to dispose of microbial waste.
- **Sterilizing plates of pure, non–pathogenic bacterial cultures**: the materials can be covered with a 10% bleach solution and allowed to soak for at least 1 to 2 hours. Discard sterilized cultures in the regular trash.
- **Operation of Pressure Cooker (instead of an autoclave) for Sterilization**
  - Before using a pressure cooker, the teacher should be familiar with directions for its operation.
  - The safety valve should be examined to make sure it is in working order.
  - The gauge pressure should be kept at or below a maximum of 20 pounds per square inch.
  - The pressure should be returned to zero before the cover can be safely removed.
  - The test stopcock should be opened before the clamp can be safely released.
  - An eye-protective device should be used when working with a pressure cooker.

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JUDGES WORKSHEET

Los Angeles County Science & Engineering Fair

A. Creativity (30 points total)

1. The problem is original or is a unique approach to an old problem (considering the student's grade level)
2. Equipment and materials are used ingeniously
3. Interpretation of data is appropriate for student's grade level
4. Applications of project information shows student's creative involvement
5. Student shows evidence of understanding that unanswered questions remain
6. Creativity is evident

Creativity Total	

B. Scientific Thought or Engineering Goals

Scientific Thought (30 points total)

1. The hypothesis is clearly stated and the project is clearly designed
2. The project shows depth of study and effort
3. Project exhibits orderly recording and analysis of data
4. Sampling techniques and data collection are appropriate for the problem
5. Scientific procedures are appropriate and organized
6. Conclusions formulated are logical, based on the data collected, and are relevant to the hypothesis

Scientific Thought Total	

OR

Engineering Goals (30 points total)

1. The project has clear objective relevant to needs of potential user
2. Product or process has been tested
3. Product or process is both workable and feasible economically and ecologically
4. Project exhibits orderly recording and analysis of data
5. Testing procedures are appropriate and organized
6. Conclusions are logical and based on the data collected

Engineering Goals Total	

C. Thoroughness (15 points total)

1. The study is complete within the scope of the problem
2. Scientific literature has been searched
3. Experiments have been repeated and careful records have been kept

Thoroughness Total	

D. Skill (15 points total)

1. Special skills needed for construction or use of equipment is evident
2. Special mathematical, computational or observational skills are evident
3. Project is skillfully designed so that it yields valid, reliable, and accurate data

Skill Total	

E. Clarity (10 points total)

1. The project notebook is well organized, neat and accurate
2. The purpose, procedures and conclusions are clearly outlined and the title accurately reflects the problem

Clarity Total	
Total Points for Project	

SPECIAL COMMENTS OR CLARIFYING STATEMENTS (USE REVERSE SIDE IF NECESSARY)

SIGNATURE OF JUDGE	DATE SIGNED

Form No. 601-076 Rev. 11-13-2001

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Los Angeles County Science & Engineering Fair

JUDGES WORKSHEET

Mathematics and Computers

A. Mathematics and Computers Creativity (25 points total)

1. The mathematics or computer usage for this project is extended beyond that commonly taught at this grade level.
2. The project represents a new point of view or a more in-depth study of a standard topic.
3. The mathematical concepts or methods of computer programming are used ingeniously.
4. Interpretation of results shows student's creative involvement.
5. Student shows understanding of the mathematical or computer science context related to the project.

Mathematics and Computers Creativity Total	

B. Analytical Methods (30 points total)

1. The purpose is clearly and succinctly stated.
2. The background theory to support the project is explained.
3. All initial conditions are given.
4. The conclusions follow logically from the hypothesis or initial conditions.
5. The measure of development found in references and the amount of original work is well-defined.
6. The project shows depth of study and effort.

Analytical Methods Total	

C. Presentation (20 points total)

1. The visuals are clear, clean, neat, and easily understood.
2. The written descriptions show correct grammar and spelling.
3. Mathematical symbols or computer program readouts are standard or carefully explained.
4. Computational or programming methods are completely shown or outlined in detail.

Presentation Total	

D. Background (25 points total)

1. The study is complete within the scope of the problem.
2. The appropriate literature has been searched.
3. All original calculations or computer programs are available.
4. Special mathematical, computational, or programming skills are evident.
5. A well-organized and neat notebook clearly demonstrates the student's involvement in all aspects of the project.

Background Total	

Total Points for Project	

SPECIAL COMMENTS OR CLARIFYING STATEMENTS (USE REVERSE SIDE IF NECESSARY)

SIGNATURE OF JUDGE	DATE SIGNED

Form No. 601-077 Rev. 11-08-2002