

Rules and Guidelines
for the
49th Science Engineering Fair of Houston

In Memoriam
Norman Hackerman, PhD

March 13-15, 2008

Brown Convention Center – Hall E



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THE UNIVERSITY OF HOUSTON-DOWNTOWN
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2008
RULES AND GUIDELINES FOR THE
SCIENCE ENGINEERING FAIR OF HOUSTON

This publication serves as the official source for the Rules and Guidelines of the **49th Science Engineering Fair of Houston (SEFH)**. Sections of this document will be updated whenever necessary. Holders of this publication may make copies of any or all sections for students who are interested in participating in SEFH. In particular, this applies to the project approval and entry forms. Ignorance of these rules will not be accepted as an excuse for noncompliance. Projects not complying with these rules will be disqualified and removed from the exhibit area prior to judging.

Since 1960, SEFH has coordinated the regional science and engineering fair competition for public and private junior/middle and senior high schools in Houston and the surrounding 16-county area. The counties included in this service region are Austin, Brazoria, Chambers, Fort Bend, Galveston, Hardin, Harris, Jasper, Jefferson, Montgomery, Newton, Orange, Polk, San Jacinto, Tyler and Waller. SEFH is recognized by the Internal Revenue Service as a 501(c)(3) non-profit organization. It is supervised by a board of directors and sponsored by the University of Houston-Downtown, the Engineering, Science and Technology Council of Houston (ECH), and the Houston Museum of Natural Science. Businesses, foundations, industrial and technical organizations, and professional societies annually donate about 85% of the Fair's operating funds. From these many groups come the more than 1,200 volunteers responsible for the major fair committees and activities associated with SEFH. The Fair is a volunteer organization with no full-time employees. SEFH is affiliated with the Intel International Science and Engineering Fair (ISEF) and as a result, follows all rules and requirements specified by them for its regional science and engineering fair competition.

The Science Engineering Fair of Houston provides a unique educational experience to participating students. **We emphasize the learning of mathematics, science and engineering through doing.** Through the development and presentation of science/engineering projects, students enhance their abilities to: (1) Make observations (2) Ask questions regarding particular phenomena or situations (3) Formulate ideas regarding the solution to a problem (4) Develop and carefully follow procedures related to finding an answer or solution to a problem (5) Effectively present their works to society. Because of this, SEFH receives widespread support from many scientists and engineers, the organizations they work for, professional societies, and foundations who support meaningful educational activities. **At SEFH, we stress "understanding not memorization."**

What's New for 2008 & a few reminders from 2007 - - Please Read All of These

There are several, major new items for 2008:

1. Electricity will **not** be provided at the project display sites for the 2008 fair, as in the 2007 fair. It has just been costing us way too much money to provide access to electricity for the few students who really need it. Students should be encouraged to use photographs or portable laptops to show experimentation examples, field studies, etc. A secure site for recharging laptops or other necessary battery powered devices will be available to use at no charge.
2. Effective the 2008 SEFH we have added a new individual project category – **Energy & Transportation** to all three divisions. This new category is also a category at the Intel ISEF. It includes such topics as:
 - Aerospace, Aeronautical Engineering & Aerodynamics
 - Alternative Fuels
 - Fossil Fuel Energy
 - Green Energy Science & Technology
 - Vehicle Development
 - Renewable Energies
 - Other similar topics
3. New Project Entry Quotas for Individual Projects are listed on p. 8.
4. Effective the 2008 SEFH we have added a single **Team Category** to the **Senior Division**. Any SEFH topic project may be entered in this category. The Project Entry Quotas for this category are listed on page 8.
5. A special scholarship award of \$1,000 will be given to the First Place award winner in the Poster Design Contest in honor of the 2009, 50th SEFH. For this competition the only three colors that can be used are black (and shades of black & gray), blue and gold. White is not counted as a color for this competition. See page 55 for the rules and guidelines for this competition.

6. The only form change for 2008 is the combining of student checklist (1A) and Student Checklist (1A)-TEAM into one form, Student Checklist (1A).
7. **The following four forms are required for all projects:**
 - Adult Sponsor Form (1)
 - Student Checklist (1A)
 - Research Plan
 - Approval Form (1B)

Other forms may also be required.
8. Projects which involve “human” studies that have been reviewed and approved by a properly constituted IRB prior to any project experimentation, do **NOT** have to be reviewed by the SRC until project inspection time at SEFH. This places a lot of responsibility on local IRB’s when they complete Human Subject Form (4). After the IRB has approved the project and all committee members have signed this form, the student may begin recruiting and/or interacting with human subjects for the project. Local IRB’s should carefully review the Human Subject Rules and Guidelines before reviewing any student forms.
9. All projects involving vertebrates or potentially hazardous biological agents still require prior SRC approval before any experimentation.
10. Based on items 8 and 9 above, you will note that a lot of projects no longer require SRC approval. While we strongly disagree with this “new and improved” version of the ISEF Rules and Guidelines, we have decided to avoid having a set of SEFH rules which differ significantly from ISEF rules. **HOWEVER**, if any teacher, project supervisor, student or parent has a question or concern about a potential or actual project, they should not hesitate to contact an appropriate member of the SEFH SRC.

REMEMBER that each project will be inspected by both our SRC and Rules and Safety Committee on Thursday evening prior to judging on Friday for compliance with the ISEF/SEFH Rules and Guidelines, and if the project is not approved by both of these committees, it will (as in previous years) be disqualified for participation in the fair on Friday and Saturday.

Some districts may decide to establish their own project review protocol for all projects that may be eligible for entry to SEFH.

11. While it is not stated clearly on Approval Form (1B), if a project is done at a Regulated Research Institution which would normally require SRC approval if done elsewhere, then it should be approved by the SEFH SRC **prior** to beginning any experimentation.
12. On the student checklist (1A), the **ACTUAL** Start Date and the **ACTUAL** End Date will need to be completed by the student when the project is actually started and ended and not at the time of approval.
13. All studies involving the use of microorganisms (including bacteria, viruses, viroids, prions, rickettesia, fungi and parasites), recombinant DNA technologies, and human or animal fresh tissues, blood or body fluids require pre-approval by the SRC. A Risk Assessment is also required for these projects. And, studies in these areas of research are prohibited in a home environment.
14. **HUNSTEM** (Houston Urban Network for Science, Technology, Engineering and Mathematics) will host the SEFH website and is a valuable portal of resources for the SEFH community. HUNSTEM offers forums for discussing your ideas with other students and with professional scientists. Students can Ask a Scientist a question through the National Science Digital Library (NSDL), for instance. Plus, students can also ask a local scientist through HUNSTEM links to the many Professional Science Societies and Universities in the Houston area. HUNSTEM is also available to help directly, just e-mail us at hogeb@uhd.edu. Visit HUNSTEM at <http://hunstem.uhd.edu/PROJECTS.html>.

We will be testing on-line registration with 1-2 districts this year. We are also hoping to have a list of all entrants and status of entry updated daily on the web. If everything goes well, the on-line registration will be available to all districts for the 2009 fair.

OTHER ITEMS TO REMEMBER

1. SEFH will provide the **Jesse A. Dorrington Teacher of the Year** awards to one sponsoring teacher in each of the three divisions. These awards are determined on the number of place awards earned by students who list a particular teacher as their sponsor. Winners of this award are eligible to repeat as winners every five years.
2. **SEFH** will present about **200 Place Awards** and our many Special Awarding Agencies will present approximately **300 Special Awards**.
3. Assuming the State Science Fair maintains their same entry policies for 2008, the following SEFH students will be eligible to compete in the 22nd Texas State Science and Engineering Fair, on April 10-12 at San Antonio, Texas.

Senior Division: First & Second Place Category Winners

Ninth Grade Division: First Place Individual and Team Category Winners (students will compete in the Senior Division, grades 9-12)

Junior Division: First, Second & Third Place Individual Project Category Winners
First Place Winners in each Team Category

Entry instructions for the State Fair will be announced at the end of the SEFH Awards Ceremony.

4. The SEFH Junior Division students are eligible to enter the new national **Discovery Young Scientist Challenge (DVSC)** competition, which has the same categories as those described above for the Texas State Science and Engineering Fair. **Entry form information for this competition will be announced at the SEFH Awards Ceremony.**
5. All fair winners will be listed on our web site, <http://hunstem.uhd.edu/sefh>, within approximately ten (10) business days after the fair. Everything you may want to know about SEFH should be listed there, including project approval and entry forms and information about the **Science Writing Contest** and the **Poster Design Contest**.
6. Information on the INTEL International Science Engineering Fair (ISEF) can be found at www.sciserv.org. SEFH's four Grand Award winners or their alternates are eligible to attend this event.
7. An interactive website at www.madsci.org is available to answer questions by students, teachers and parents in many areas of science and engineering.
8. A good source for display project boards plus Science Fair Materials and Workshop Materials for Grades K-12 can be found at www.showboard.com or call Showboard at 1-800-323-9189.
9. The following page lists a variety of SEFH Internet Resources.
10. HUNSTEM at <http://hunstem.uhd.edu/PROJECTS.html> is also a valuable source for SEF-related project based learning materials and information sources.

SEFH Internet Resources

Science Fair Resources

<http://www.scifair.org> (main site for the INTEL ISEF)
<http://www.showboard.com> (good source for SEFH display boards)
<http://www.madsci.org> (good source for common questions about SEF)
<http://hunstem.uhd.edu/> (provides links to many resources)
<http://www.nsta.org/>
<http://www.ipl.org/youth/projectguide>
<http://www.madsci.org/libs/areas/reagents.html>
http://www.lib.lsu.edu/sci/chem/internet /science_fairs.html
<http://www.usc.edu/cssf/resources/>
<http://www.educationplanet.com/sciencefair.html>
<http://www.chipublib.org/008subject/009scitech/scifair.html>
<http://teams.lacoe.edu/documentation/places/science/sciencefair.html>
<http://exploratorium.edu/ls/pathfinders/scifairs/>
<http://www.us.net/mccepta/science.html>
<http://cusef.byu.edu/Science%20Fair%20Resources/resources.htm>
<http://www.saludak-12.org/scifair.htm>
<http://www.hamiltonschools.org/davies/sciencefairrefs.htm>
<http://www.saluda.lib.sc.us/science.html>
<http://sciencepage.org/scifair.htm>
<http://www.wheaton.lib.il.us/library/scifair.html>
<http://askeric.org/Projects/Newton>
<http://school.discovery.com/sciencefaircentral>

Project Ideas

<http://users.massed.net/~tedrowan/primer.html>
<http://sciencefairproject.virtualave.net/>
<http://www.cmste.uregina.ca/scifair.html>
<http://www.sciencebob.com/lab/sciencefair/resources.html>
http://www.yahooligans.com/Science_and_Nature/Experiments_and_Activities/Science_Fairs/
http://dir.yahoo.com/Science/Education/K_12/Fairs_and_Compitions/Projects_and_Ideas/

Science Fairs

<http://sciencefairproject.virtualave.net>
<http://istf.ucf.edu>
<http://www.stemnet.nf.ca/sciencefairs>
<http://www.drexel.edu/dvsf/>
<http://www4.umdj.edu/camlbweb/scifair.html>
<http://www.west.net/~vcsf/index.htm>
<http://www.gnsef.org/resources.html>

Presentation and Evaluation

<http://school.discovery.com/sciencefaircentral/scifairstudio/handbook/presandeval.html>

Others

<http://www.sciencedaily.com>
<http://www.enn.com>
<http://www.newscientist.com>
<http://www.familyeducation.com/article/0,1120,1-3600,00.html>
<http://pangloss.ca/mentors/sciencefairs.html>
<http://www.eskimo.com/~billb/amasci.html>
http://www.ontariosciencecentre.ca/kids/cool_stuff/fairlinks.asp
<http://homeworkspot.com/sciencefair/>
<http://ipl.org/youth/projectguide>
<http://youth.net/nsrc/sci/sci.index.html>
<http://www.chem4kids.com>
<http://isd77.k12.mn.us/resources/cf/steps.html>

**INFORMATION/CHECKLIST FOR STUDENTS DOING PROJECTS WHICH MAY
BE ENTERED INTO THE SCIENCE ENGINEERING FAIR OF HOUSTON**

Assignment/Activity	Date Due (if applicable)	Completed
1. Discuss doing a project with your teacher and parent/guardian, preferably at the start of the school year. Also, ask for the procedures used by your school or district to select projects for entry into the Science Engineering Fair of Houston (SEFH).		
2. If you decide to do a project, seek advice from others regarding possible topics. Your school librarian is a good person to consult when you decide on the type of project you wish to pursue.		
3. Do library research on your topic; seek advice from professionals (including your teachers) who are familiar with your area of research interest; decide on the exact title for your research; and inform your teacher.		
4. Obtain approval at your school for your SEFH Adult Sponsor/Safety Assessment Form (1), Research Plan (1A), and Approval Form (1B) prior to doing any project experimentation.		
5. If your project requires additional approval forms, they must be completed and approved by either your local Institutional Review Board (IRB) or the SEFH Scientific Review Committee (SRC) prior to any experimentation and by the SRC approval deadline date listed in the SEFH Schedule of Events.		
6. Start your project research. Use a laboratory notebook for recording research procedures and results. Follow appropriate safety procedures and SEFH rules when doing your research; use proper scientific procedures; and, where appropriate, the International System of Units (SI).		
7. Consult frequently with your project supervisor; pay attention to both positive and negative results; and be prepared for surprises and some frustration. Doing good science can be hard work!		
8. Complete your research and do a final analysis of results and conclusions with your supervisor. Inform your teacher that the project is completed.		
9. Discuss with your teacher the procedures you should now follow if you want to enter the SEFH. You may need to first enter a preliminary school and/or district fair.		
10. Consider describing your research efforts in the form of a Project Research Paper and/or a one page Project Abstract. This is not required by SEFH; however, it is beneficial to have as part of your project display. You may want to enter your paper in the SEFH Science Writing Contest. Abstracts are required for the State Fair, the Discovery Competition and the International SEF.		
11. Before preparing your project display, review the SEFH display rules. The display should be neat, visually appealing, indicate creativity/ originality, and serve as a "stand alone" description of your entire project. Since no electricity will be available, you may want to utilize photographs or a portable electronic device/laptop to illustrate certain portions of your project.		
12. Decide on the most appropriate category for your project. No category changes are allowed after project entry or at the fair site.		
13. On the SEFH entry form, do not request a floor mounted project unless you are certain that this is necessary.		
14. Submit the SEFH entry form to your school or district science fair coordinator prior to the deadline entry date. Be sure to attach copies (not originals) of your Adult Sponsor/Safety Assessment Form (1), Research Plan (1A), Research Plan Attachment and Approval Form (1B) + any other approved forms that may have been required for your project to the entry form.		

15. Obtain a copy of the SEFH Calendar of Events from your teacher or supervisor.		
16. Review the SEFH Judging Criteria and Procedures. Discuss, in detail, the project results with your supervisor. Be prepared for a broad variety of questions pertaining to your project.		
17. Develop a 3-4 minute oral presentation describing your project including: why you chose the topic, experimental procedures and results, conclusions, how your research might be expanded or improved upon, and possible applications for your research.		
18. Review the SEFH Calendar of Events with your parents/guardians for the Thursday, Friday, and Saturday activities.		
19. When you come to the Brown Convention Center on Thursday afternoon or evening to register and have your project inspected for final approval, be sure to bring copies of your Adult Sponsor/Safety Assessment Form (1), Research Plan (1A), Research Plan Attachment, and Approval Form (1B) + copies of any other approved forms that may have been required for your project. Keep them in a folder/binder. Replacement copies are \$1.00 per page.		
20. You may want to bring a comfortable folding chair (not a lounge-style chair) to have available at your project during non-judging times. They can be stored overnight under your project display table.		
21. When you setup your project display make certain that the number on your project display card (which you receive at the registration table on Thursday) matches the project number stapled to the table. If they don't match, you are in the wrong location. Ask for assistance if you cannot locate your assigned project display area.		
22. Before you leave the Convention Center Thursday evening, you MUST have your project approved by both the Scientific Review Committee AND the Rules & Safety Committee. Your project will be disqualified if you do not receive these TWO approvals Thursday evening.		
23. On Friday, " The Judging Day ," please dress and groom yourself in an appropriate manner. Many professional scientists and engineers from the greater Houston area will judge you and your project. Do not present yourself as a "slob" unless that is the image you wish the judges to have of you and your project. You may want to have a light coat/jacket/sweater available since at times the Exhibition Hall E can be cold. Do not forget your Exhibitor Badge; replacements cost \$2.00.		
24. Exhibitors must be at their project display during all judging periods. Your project will not be judged if you are not present. During judging times, only exhibitors, judges and SEFH personnel are allowed in the Exhibition Hall.		
25. Food service operations will be open on Friday and Saturday of the Fair. No commercial food deliveries are allowed. A nurse will be on duty during the Fair.		
26. The Fair is open for public viewing only on Saturday (you are encouraged to be with your project all or some of this time). No projects can be dismantled or removed from the display area until the Awards Ceremony is over.		
27. Note that in addition to the approximately 200 SEFH place awards, about 50 Special Awarding Agencies present an additional 330 special awards each year.		
28. Students requiring special accommodations should contact the Fair Office prior to the Fair.		

Additional Information:

A REVIEW OF THE SCIENTIFIC METHOD

The following is a review of the Scientific Method with some key questions/directions on how to design and conduct an experiment that will be used for a science or engineering fair project.

Problem/Purpose

- What is your goal?
- What idea are you trying to test?
- What is the scientific question you are trying to answer?

Hypothesis

- Tell how you think your project can demonstrate your purpose.
- Make a prediction regarding the outcome of your experiment.
- State the results you are predicting in measurable terms.

Procedure

- Give a detailed explanation of how the experiment will be performed to test your hypothesis.
- Be clear about the variables (elements of the experiment that change to test your hypothesis) versus your controls (elements of the experiment that do not change).
- Be very specific about how you will measure results to prove or disprove your hypothesis. You may want to develop a regular timetable for measuring results or making observations (i.e. every hour, every day, every week).
- Your procedure should be like a recipe--another person should be able to perform your experiment following your procedure. Test this with a friend or parent to be sure you have not forgotten anything. This is an important part of doing good science.

Materials:

- List all materials and equipment that were used.
- Your list of materials should include all of the ingredients of the procedure recipe.

Observations/Data/Results

- Keep a detailed journal (laboratory notebook) of observations, data and/or results. They can be data measurements and written notes about what you are sensing (hearing, seeing, or touching) about your experiment. Utilize the International System of Units where appropriate.
- Where appropriate, have both Control and Experimental groups.
- When possible, collect enough data for a statistical analysis.
- Photograph your project results or phases of the project if appropriate to help your analysis and possibly to demonstrate your experiment on your exhibit board. **Note the section pertaining to photographs and other visual depictions in the Display Rules and Safety Regulations.**
- Use charts, graphs and tables to summarize your data. You may want to use a portable electronic device to illustrate some portions of your project.

Analysis:

- Explain your observations, data and/or results. This is a summary of what your data has shown you.
- List the main points of what you've learned.
- Why did the results occur? What did your experiment prove?
- Was your hypothesis correct? Did your experiment prove or disprove your hypothesis? Should be explained thoroughly.

Conclusion:

- Answer your problem/purpose statement.
- What does it all add up to? What is the value of your project?
- What further study do you recommend given the results of your experiment? What would be the next question to ask?
- If you repeated your project, what would you change?

SELECTING A PROJECT

For many students, deciding on the objective of their research project appears to be a difficult and frustrating experience. Unfortunately, some students feel that they must have a highly complex project in order to be successful. This is simply not the case. Each year students do excellent science and engineering projects through experiments, which try to answer very basic and fundamental questions about phenomena, or situations they encounter on a daily basis. As students formulate the title and objectives for their projects, they should be strongly encouraged to use the many books, journals, magazines, and newspapers available to them in their school and local public/university libraries, in addition to their own ideas and everyday experiences. There are also many excellent web sites for science and engineering that can provide students with ideas and resources.

After students have selected their project, they should complete and obtain all approvals for the Adult Sponsor/Safety Assessment Form (1), Research Plan (1A), Research Plan Attachment, and Approval Form (1B), and then immediately determine if any additional approvals are needed before starting their project research. On completion of their research, students should review the project display rules and the SEFH judging criteria and procedures. It is also important that they enter their project in the most appropriate category. If, for example, a student enters a botany project in chemistry, judges who are professional chemists will judge it as a chemistry project. No category changes are allowed after project entry or at the fair site.

Each year many parents, guardians and teachers ask the question, "How much assistance should we give the student on his/her project?" There is no simple answer to this question. When students pursue graduate degrees in science and engineering, most of their major professors provide them with the general (and in many cases, the exact) topic for their research. The professor also serves as a close mentor while they perform the research and formulate their conclusions. To a lesser degree, this same procedure is followed in the "real world" of business and industry. In addition, very few major scientific accomplishments are truly the work of just one individual. The Fair does expect that most of the work presented in a project is based on the efforts of the student. This is a major reason why our judges spend so much time questioning the students about their project. To our knowledge, no other fair in the world devotes as much time to this portion of the judging process as SEFH. We appreciate and encourage the fact that many projects end up involving the entire family.

PROJECT ENTRY QUOTAS

	Private* & parochial schools & districts with one-two high schools	Districts with three-four high schools and/or academies	Districts** with more than four high schools and/or academies
Senior Division (gr 10-12)			
Individual Projects	39 exhibits	65 exhibits	80 exhibits
Team Projects	3 exhibits	4 exhibits	5 exhibits
Ninth Grade Division			
Individual Projects	26 exhibits	39 exhibits	52 exhibits
Team Projects	6 exhibits	8 exhibits	10 exhibits
Junior Division (gr 7&8)			
Individual Projects	39 exhibits	52 exhibits	65 exhibits
Team Projects	8 exhibits	12 exhibits	16 exhibits

*Charter Schools and Home Schools are considered to be Private Schools. All entries from these and Parochial Schools must be submitted to SEFH through the SEF coordinator for that school. All Public School entries must be submitted to SEFH through the SEF Coordinator for the School District.

**Each of the major regions for Houston ISD are considered as a district with more than four high schools and/or academies.

Note: A team must have 2 or 3 members, all from the same school, and at least 2 members must be present with the project at all judging times during the fair. Team membership may not be changed once a project research year has started. It may be changed for a continuing project. Once started as a team project it cannot be converted to an individual project and vice versa. Each team member is expected to be fully involved and familiar with all aspects of the project.

CHECKLIST FOR PROJECTS WHICH REQUIRE SPECIAL PROJECT APPROVALS

Students whose projects involve the following must secure the indicated approvals **PRIOR TO STARTING THEIR PROJECT RESEARCH** for entry into SEFH. This is also true for continuing projects and those done at a registered research institution or industrial laboratory. **ALL PROJECTS REQUIRE PRIOR APPROVAL OF THE ADULT SPONSOR/ FORM (#1), STUDENT CHECKLIST (1A), RESEARCH PLAN AND APPROVAL FORM (#1B) AT THE LOCAL SCHOOL LEVEL.** Continuing projects require **CONTINUATION PROJECTS FORM (#7).**

VERTEBRATE ANIMALS

- Adult Sponsor #1, Student Checklist #1A, Research Plan and Approval Form #1B
- SRC Approval
- Vertebrate Animal Form #5A or #5B
- Qualified Scientist Form #2
- Regulated Research Institution Form #1C (if applicable)
- Continuation Projects Form # 7 (if applicable)

HUMAN SUBJECTS (including surveys of human subjects)

- Adult Sponsor #1, Student Checklist #1A, Research Plan and Approval Form #1B
- Local or District IRB Approval*
- Human Subjects Form #4
- Regulated Research Institution Form #1C (if applicable)
- Qualified Scientist Form #2 (if applicable)
- Continuation Projects Form # 7 (if applicable)

HAZARDOUS CHEMICALS, ACTIVITIES or DEVICES

- Adult Sponsor #1, Student Checklist #1A, Research Plan and Approval Form #1B
- Qualified Scientist Form #2 (if applicable)
- Risk Assessment Form #3
- Regulated Research Institution Form #1C (if applicable)
- Continuation Projects Form # 7 (if applicable)

POTENTIALLY HAZARDOUS BIOLOGICAL AGENTS (including animal tissues)

- Adult Sponsor #1, Student Checklist #1A, Research Plan and Approval Form #1B
- SRC approval
- Qualified Scientist Form #2 (if required by SRC)
- Regulated Research Institution Form #1C (if applicable)
- Hazardous Risk Assessment Form #6A
- Human and Vertebrate Animal Tissue Form #6B (if applicable)
- Continuation Projects Form # 7 (if applicable)

Copies of all approved forms must be presented at the Science Engineering Fair of Houston when the project is inspected by the SRC and must be maintained in a binder or folder for review on request by any judge or fair official during the fair. In addition, copies (not the originals) of all approved forms must also be attached to the SEFH project entry form.

NOTE: Major deviations in any approved IRB or SRC plan may only be implemented after obtaining written approval from the IRB or SRC. Projects that are continuing ones from a previous year require approval each year of the project research. All required forms for the previous years work must be available for review at the fair. If IRB or SRC approval is required, copies of the previous approval forms must be submitted along with those for the current year.

*Each school district should have an Institutional Review Board (IRB) composed of at least one science teacher, a psychologist or M.D. or R.N. or physician's assistant, and a school administrator. No one directly involved with the project may serve on the IRB or the SRC that signs any of the project forms. A **Risk Evaluation** should be a part of each project dealing with human subjects.

Additional comments on projects involving Potentially Hazardous Biological Agents

1. The following types of studies are exempt from the rules listed on pages 25-28 and do not require SRC approval.
 - a) Studies involving baker's yeast and brewer's yeast, except when involved with rDNA studies
 - b) Studies involving most protists, archae bacteria and similar microorganisms
 - c) Research using manure for composting or other non-culturing experiments and fuel production
 - d) Water or soil sampling and testing using kits, in the field

2. The following types of tissue do not need to be treated as potentially hazardous biological agents:
 - a) Plant tissue
 - b) Established cell and tissue cultures (e.g., those obtained from the American Type Culture Collection). The source and catalog number of the cultures should be identified in the **Research Plan**
 - c) Meat or meat by-products obtained from food stores, restaurants, or packing houses
 - d) Hair
 - e) Teeth that have been sterilized to kill any blood borne pathogen that may be present. Chemical disinfection or autoclaving at 121 degrees Celsius for 20 minutes is a recommended procedure.
 - f) Fossilized tissue or archeological specimens
 - g) Prepared fixed tissue slides

The SRC Committee section was updated on 9/18/07.

WHERE TO SEND SRC APPROVAL REQUESTS	
DISTRICT/PRIVATE	SRC MEMBERS AND ADDRESSES
Aldine ISD	Xandra Williams-Earlie, 14909 Aldine Westfield Rd., Houston, 77032, (281) 985-6420; xwilliams-earlie@aldine.k12.tx.us
Alief ISD	Patty Harrison, Alief ISD P.O. Box 68, Alief, 77411, (281) 498-8110 ext. 4100; patty.harrison@aliefisd.net
Alvin ISD	Lisa Brady, 301 East House St., Alvin, TX 77511, (281) 245-2458; lbrady@alvinisd.net
Beaumont ISD & Surrounding Districts	James T. DeHart, 8750 Phelan, Beaumont, 77706 (409) 981-7300 ext 7495; jdehart@beaumont.k12.tx.us
Catholic Schools & Middle Schools in Galveston ISD	Debbie Matthews, Jr. Division, 4115 Avenue O, Galveston, 77550, (409) 766-5700; Deborah_Matthews@galveston-schools.org
Charter and Home Schools	Dr. Soner Tarim, Harmony Science Academy, 9421 W. Sam Houston Pkwy S., Houston, 77099, 713-777-8555; starim@hsatx.org
Clear Creek ISD Jr. Division,	Sally Wall, Clear Creek ISD, 2401 Meyer Rd, Seabrook, 77586; 281-284-3100; swall@ccisd.net
Clear Creek ISD Sr. Division	Terri Berry, Clear Creek ISD, 2425 East Main Street, League City, 77573, (281) 284-0089; tberry@ccisd.net
Conroe ISD/Spring ISD	Cynthia McMahan, 3200 W. Davis, Conroe, 77304, (936) 709-5731; cmcmahan@conroeisd.net
Cypress-Fairbanks ISD/Klein ISD	Gregory Zureich, 10300 Jones Road, Houston, 77065, (281) 517-6384; gregory.zureich@cfisd.net
Friendswood ISD & Pearland ISD, Sr. Div.	Theresa Lawrence, 702 Greenbriar, Friendswood, 77546, (281) 482-3413; tlawrence@fisd12.net
Friendswood ISD, Jr. Division	Suzanne Humble-Davies, 402 Larel Dr, Friendswood, 77546, (281) 482-7818; shumble-davies@fisd12.net
Fort Bend ISD	Mark Kinsey, 4200 Elkins Drive, Sugar Land, 77479; (281) 634-2150; mark.kinsey@fortbend.k12.tx.us
Galveston-Ball High School	Laura Wolfe, 4115 Avenue O, Galveston, 77550; (409) 502-0563; laura_wolfe@galveston-schools.org
Houston ISD	Janice Arceneaux, 4400 W. 18 th St., Houston, 77092 (713) 556-6823; jarcenea@houstonisd.org
Magnolia ISD	Laurel Frank, 31141 Nichols Sawmill Rd; PO Box 826, Magnolia, 77353; (281) 252-2025; lfrank@magnoliaisd.org
Pasadena ISD	Cindy Martinez-Bagwill, 1002 Fairmont Parkway, Pasadena, 77504, (713) 740-0450 ext. 07117; cbagwill@pasadenaisd.org
Private Schools, Jr. Division	Deborah Veselka, 201 Kinkaid School Drive, Houston, 77024, (713) 243-6407; deborah.veselka@kinkaid.org
Private Schools (9 th & Sr. Div.) & all other SRC Information	Melinda Mills, PO Box 89004, Houston, TX 77289-0044 (832) 498-1973; mjmills@academicplanet.com ; Ms. Mills is Chair of the SRC.

PROJECT CATEGORIES

Common subject categories are used for the individual project competition in all three divisions. For team projects, the subject categories are grouped into more general categories. The Fair is actually composed of two fairs, both occurring simultaneously - each with Junior/Middle School (grades 7&8), Ninth, and Senior divisions (grades 10-12). Listed below are the categories that are included in the two fairs.

Note: A team must have 2 or 3 members, all from the same school, and at least 2 members must be present with the project at all judging times during the fair. Team membership may not be changed once a project research year has started. Team members must be from the same school. It may be changed for a continuing project. Once started as a team project it cannot be converted to an individual project and vice versa. Each team member is expected to be fully involved and familiar with all aspects of the project.

Engineering/Physical Sciences

Chemistry
Computer Science
Earth/Space Sciences
Energy & Transportation
Engineering
Mathematics
Physics

Life Sciences

Behavioral/Social Sciences
Biochemistry/Microbiology
Botany
Environmental Science
Medicine/Health
Zoology

Team Projects/Junior Division only

Engineering/Computers/Mathematics
Physical Sciences

Team Projects/Junior Division only

Botany/Environmental/Zoology
Behavioral/Biochemistry/Medicine & Health

Team Projects/Ninth Grade only

Engineering/Physical Sciences

Team Projects/Ninth Grade only

Life Sciences

Team Projects/Senior Division only

Single category for all projects

ENTERING THE RIGHT CATEGORY

Every year, some students end up entering their projects in the wrong category. **Since SEFH judges are required to judge the content of each project based on the category in which it is entered**, these students are seriously penalized. Thus, we urge you to pay particular attention to the category that you indicate on the entry form. Once SEFH receives the completed entry form, you will be required to remain in the category that you entered. Listed below are the categories for individual project competition and a few examples of the types of projects which might be appropriate for each category.

Behavioral/Social Sciences Psychology, sociology, anthropology, archeology, ethiology, ethnology, linguistics, animal behavior (learned or instinctive), learning, perception, urban problems, gerontology, reading problems, public opinion surveys, and education testing, etc.

Biochemistry/Microbiology: Molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry, food chemistry, hormones, bacteriology, virology, protozoology, fungal and bacterial genetics, yeast, etc.

Botany: Agriculture, agronomy, horticulture, forestry, plant biorhythms, palynology, plant anatomy, plant taxonomy, plant pathology, plant genetics, hydroponics, algology, mycology, etc.

Chemistry: Physical chemistry, organic chemistry (other than biochemistry), inorganic chemistry, materials, plastics, metallurgy, soil chemistry, etc.

Computer Science: New developments in software or hardware, information systems, computer systems organization, computer methodologies, and data (including structures, encryption, coding and information theory), etc.

Earth/Space Sciences: Geology, geophysics, physical oceanography, meteorology, atmospheric physics, seismology, petroleum, geography, speleology, mineralogy, topography, optical astronomy, radio astronomy, astrophysics, etc.

Energy & Transportation: Aerospace, aeronautical engineering and aerodynamics, alternative fuels, fossil fuel energy, green energy science & technology, vehicle development, renewable energies, etc.

Engineering: Civil, mechanical, aeronautical, chemical, electrical, photographic, sound, automotive, marine, heating and refrigerating, transportation, environmental engineering, etc. Power transmission and generation, electronics, communications, architecture, bioengineering, lasers, etc.

Environmental Science: Pollution (air, water, land), pollution sources and their control, waste disposal, impact studies, environmental alteration (heat, light, irrigation, erosion, etc.), ecology.

Mathematics: Calculus, geometry, abstract algebra, number theory, statistics, complex analysis, probability, topology, logic, operations research, and other topics in pure and applied mathematics.

Medicine/Health: Medicine, dentistry, pharmacology, veterinary medicine, pathology, ophthalmology, nutrition, sanitation, pediatrics, dermatology, allergies, speech and hearing, optometry, etc.

Physics: Solid state, optics, acoustics, particle, nuclear, atomic, plasma, superconductivity, fluid and gas dynamics, thermodynamics, semiconductors, magnetism, quantum mechanics, biophysics, etc.

Zoology: Animal genetics, ornithology, ichthyology, herpetology, entomology, animal ecology, anatomy, paleontology, cellular physiology, animal biorhythms, animal husbandry, cytology, histology, animal physiology, neurophysiology, invertebrate biology, etc.

CHARACTERISTICS OF A GOOD SEFH PROJECT

- A. One of the most important factors in developing a project is deciding on the question(s) to be answered through the results of your project. Be certain of your question and determine if you have the capability, facilities, time, etc. to answer your question. At this point, you should seek the advice of your teachers, and perhaps professional scientists or engineers, before making the final decision on the topic for your project. There are a number of excellent libraries, with qualified librarians who can assist you in obtaining background information for your project.
- B. Study all the SEFH rules, requirements, and time deadlines carefully, prior to developing your Research Plan. Discuss these with your Adult Project Supervisor as he/she completes SEFH Form #1 and #1B.
- C. **Obtain all necessary project approvals. IF** your project involves vertebrate animals, human subjects (including surveys), recombinant DNA, tissues, microorganisms, cell cultures, environmental sampling, dangerous chemicals, or equipment, **YOU MUST** obtain approval for your project **BEFORE** starting your research. Ask your teacher or supervisor for the required approval forms.
- D. In most instances, if a good question(s) has been asked, the ultimate success of the project will depend on the amount of effort you put into it and the way you answer your question. You should try to start your experimentation no later than October. Many students schedule their time so that they complete their experimentation and calculations during the Christmas holidays. Some students do their research during the summer. **If you are doing a team project**, SEFH expects all team members to contribute equally to the research efforts and to also have equal knowledge of the engineering or scientific principles relevant to the project.
- E. If you do an experimental project, be sure to **maintain a properly organized Laboratory Notebook** which includes everything you do for your project on a day by day basis. Where appropriate, **use SI units**. This notebook should be included as part of your project display. The cover of the book should **not** show your name, school or teacher, just the project title and time period for the research.
- F. As you analyze your results, consult your Supervisor for additional assistance if you do not totally understand something. **If you learn a lot from your project, the chances are, so will others - and that's what good research is all about.**
- G. After you have completed your project, your next activity is to plan how you will display the results of your project. You should first go back and review with your Supervisor all SEFH rules which pertain to displays. **A good project deserves a good display.** Your display should be neat, well organized, pleasing to look at, and tell the entire story of your research: the project title, questions asked, objectives, experimental procedures, results, and conclusions. A judge should be able to read everything on your project board from a distance of 3 feet or 1 meter. Try to minimize the narrative portion and maximize the use of attractive and meaningful charts, graphs, mathematical expressions, models, photographs and tables. Your display should **"sell"** your project to the judges without you being present.
- H. While it is not required, a neatly prepared Project Abstract will be appreciated by the judges (a suggested format is included later in these guidelines). Have multiple copies available to distribute to them. An abstract will be required for the State Fair and the Discovery competition.
- I. **Enter your project in the proper subject category.** If a project, which is primarily chemistry, is entered in the engineering category, it will be judged as an engineering project. Similarly, a chemistry project which uses computers for data analysis should not be entered in the computer category. No category changes are allowed.
- J. Prior to exhibiting your project, go back to your Supervisor and review, in detail, the entire project. Make certain that you understand, and can explain to others (especially judges), all the engineering and scientific principles and variables associated with your project, the procedures followed, the results, and your conclusions. Be able to propose possible applications for your research and to suggest further studies that might also be done. **Understanding is important -- memorization is not.**
- K. You should be prepared to present an exciting 3 or 4 minute oral summation of your project to persons with varying technical backgrounds **and** to answer a broad variety of questions which relate directly, and in some instances indirectly, to your project.
- L. On the judging day, be sure to dress and groom yourself in an appropriate manner and present a positive image of yourself to the judges. Remember that most of your judges will be professional scientists and engineers from the greater Houston area. Do not try to "fool" the judges. If you don't know the answer to a question, say so, and then ask that person if they could give you the answer for future reference (another judge may ask you that same question later in the day). Do not hesitate to seek advice from your judges, as they are really there both to judge and to assist you.

THE LABORATORY NOTEBOOK

A properly maintained laboratory notebook is one of a researcher's most valuable tools. It contains the permanent written record of the scientist's or engineer's mental and physical activities from both experiment and observation, to the ultimate understanding of the question or solution they are going to obtain from their research project. The act of writing in the notebook forces the researcher to stop and think about what he/she is about to do and what is actually done. Because of this, the proper writing of a **project laboratory notebook is an essential part of doing "good" science**. The following guidelines are consistent with those of many major industrial laboratories and universities. They are not requirements, only suggestions. While SEFH does not require students to have a laboratory notebook for their project, they should understand that since most of the **fair judges** are practicing scientists and engineers, they **will expect to see a laboratory notebook as part of the project display material**. Part six of the Official Scoring Sheet for the fair refers to the laboratory notebook.

Guidelines:

1. The notebook should be bound; not a loose-leaf notebook or spiral ring composition book. A cover of stiff cardboard (pasted board), covered with a fabric or thin chemically treated paper is preferred. A size of about 8 x 10 inches is adequate for most projects.
2. The front cover of the notebook should contain a title that describes the research, and the time period covered for the data recorded in the book. If more than one notebook is used, then this should also be indicated by adding Volume I, II, etc. The first two pages of the book should be reserved for a table of contents. All remaining pages should be numbered on the top outside corner of the page. The table of content entries should be added as the project progresses. All written entries in the notebook should be done in ink; preferably using a ballpoint pen with black ink. If others do not easily read the researcher's handwriting, then entries should be printed.
3. The right-hand pages should be used for making formal entries. The left-hand pages should be used for calculations, doodling, scratch paper, etc. All right-hand pages should be dated when information is recorded on them.
4. No pages should be removed from the notebook. If information on a particular page becomes invalid for whatever reason, a single diagonal line should be drawn through the information and a brief sentence or two added explaining why the material is no longer valid. If an error is made in recording something, it should not be erased or obliterated in any way. Instead, draw one line through the incorrect entry and write the correct entry as near to it as possible. Never write a number or word over another number or word.
5. Photographs, computer printouts, recorded printouts, etc. should be properly labeled and taped or glued onto one of the right-hand pages. All numbers should be recorded in the notebook using the correct number of digits and labeled with the proper units. Students are strongly encouraged to use the International System of Units (SI). Always enter data directly in the notebook, in ink, at the time it is obtained (unless the data is being recorded automatically by an instrument).
6. If a detailed experimental procedure is being followed that is available in a readily available reference source (such as a textbook), the procedure should only be summarized in the notebook and the reference listed for the exact procedure. Any changes from the referenced procedure should be recorded and explained in the notebook.
7. Mathematical type formulas used in the project should be recorded on the right hand pages with a definition of each term in the formula along with at least one sample calculation. Again, the proper physical units should always be recorded next to the respective numerical values.
8. When chemicals are used, the name, formula, purity, and manufacturer of the chemical should be recorded.
9. When instruments are used, the name, model number, manufacturer, and operational settings for the instrument should be recorded in the notebook.
10. The purpose of each experiment in the project should be clearly stated in the notebook as it is performed, along with the corresponding procedures, data, assumptions, conclusions, etc. In summary, a project notebook is not supposed to be an attractive document; it is a working document. Yes, it may even have a few chemical stains on it and a torn page or two. However, the entries should be legible, complete, reasonably neat, and logically presented.

In summary, a project notebook is not supposed to be an attractive document; it is a working document. Yes it may even have a few chemical stains on it and a torn page or two. However, the entries should be legible, complete, reasonably neat, and logically presented.

advocates must be included on the IRB when research subjects are at a correctional facility. The institutional IRB must initially review and approve all proposed research conducted at or sponsored by that institution. The Adult Sponsor and the local IRB are responsible for ensuring that the project is appropriate for a pre-college student and adheres to the ISEF rules.

An IRB generally makes the final determination of risk. However, in reviewing projects just prior to a fair, if an SRC judges an IRB's decision as inappropriate, thereby placing human subjects in jeopardy, the SRC may override the IRB's decision and the project may fail to qualify for competition.

6) The Affiliated Fair Scientific Review Committee

A Scientific Review Committee (SRC) is a group of qualified individuals that is responsible for evaluation of student research, certifications, research plans and exhibits for compliance with the Rules and pertinent laws and regulations. Local SRCs may be formed to assist the ISEF Affiliated Fair SRC in reviewing and approving projects. The operation and composition of the local and ISEF-Affiliated Fair SRCs must fully comply with the International Rules.

Any proposed research in the following areas must be reviewed and approved BEFORE experimentation: projects involving vertebrates and potentially hazardous biological agents. (Human studies reviewed and approved by a properly constituted IRB do not have to be reviewed by the SRC until the Fair competition.)

ALL projects must be reviewed and approved by the SRC after experimentation and shortly before competition in an ISEF-affiliated Fair competition. (Projects requiring preapproval which were conducted at a regulated research institution (not home or high school, etc.) and which were reviewed and approved by the proper institutional board before experimentation must also be reviewed by the Fair SRC for rules compliance.)

An SRC must consist of a minimum of three persons. The SRC must include:

- a) a biomedical scientist (Ph.D., M.D., D.V.M., D.D.S., or D.O.)
- b) a science teacher
- c) at least one other member

Additional Expertise: Many projects will require additional expertise to properly evaluate (for instance, extended knowledge of biosafety or of human risk groups.) If animal research is involved, at least one member must be familiar with proper animal care procedures. If the SRC needs an expert as one of its members and one is not in the immediate area, then documented contact with an external expert is appropriate and encouraged.

In order to eliminate conflict of interest, the Adult Sponsor, parents, the Qualified Scientist, and the Designated Supervisor must not serve on the SRC reviewing that project. Additional members are recommended to help avoid this conflict of interest and to increase the expertise of the committee.

A Scientific Review Committee (SRC) examines projects for the following:

- a) evidence of literature search
- b) evidence of proper supervision
- c) use of accepted and appropriate research techniques
- d) completed forms, signatures and dates showing maximum of one year duration of research and appropriate preapproval dates (when needed)
- e) evidence of search for alternatives to animal use
- f) humane treatment of animals
- g) compliance with rules and laws governing human and animal research
- h) compliance with rules regarding potentially hazardous biological agents
- i) documentation of substantial expansion for continuation projects
- j) compliance with the ISEF ethics statement

7) Other Review Committees

Certain areas of research conducted in a regulated research institution require review and approval by federally mandated committees that have been established at that institution. These committees are:

- a) **Institutional Animal Use and Care Committee (IACUC)**
- b) **Institutional Biosafety Committee (IBC)**

8) The ISEF Scientific Review Committee (ISEF SRC)

A Scientific Review Committee exists at the Intel ISEF level. The ISEF SRC reviews the forms and the Research Plan for all projects to ensure that students have followed all applicable Rules.

The ISEF SRC, like an ISEF Affiliated Fair SRC, is made up of a group of adults knowledgeable about regulations concerning experimentation in restricted areas. The ISEF SRC reviews the **Checklist for Adult Sponsor (1), Abstract, Student Checklist (1A), Research Plan and Approval Form (1B)** in addition to all other required forms for students who enter the Intel ISEF. They also identify problems local fairs may be having and work with fair directors and teachers to resolve them.

If a fair director or ISEF Affiliated Fair SRC member has any questions concerning the process, feel free to contact Science Service or a member of the ISEF SRC. (see page 3)

The ISEF SRC is the final authority on projects that are qualified to compete in the Intel ISEF. In some cases, the ISEF SRC may have questions about particular projects. Usually, after students explain their procedures and research to the ISEF SRC, a simple corrective measure is prescribed (e.g., contacting the Designated Supervisor to confirm a detail, or rewriting an abstract for purposes of clarification).

It is important that students retain all original signed forms. Even though copies may have been sent with registration papers, students must bring original signed forms to the Intel ISEF in case an SRC interview is necessary. **Do not send original forms to Science Service.**

❖ Human Subjects ❖

When students conduct research with human subjects, the rights and welfare of those participating in the study must be protected. There are federal regulations protecting human subjects that require the prior review of human subjects research by an Institutional Review Board and, in most cases, the informed consent of research subjects. The following rules were developed to help student researchers adhere to the Federal regulations and to, therefore, protect the rights and welfare of both the research subjects and the student researcher.

Rules

- 1) All research projects involving human subjects, including any revisions, must be reviewed and approved by an **Institutional Review Board (IRB)** before the research begins.
- 2) The use of human subjects in science projects is allowable under the conditions and rules in the following sections. Based upon CFR (Code of Federal Regulations) 45, the definition of a **human subject** is a living individual about whom a investigator conducting research obtains (1) data or samples through intervention or interaction with individual(s), or (2) identifiable private information.
 - A) Examples of studies that are considered “human subjects research” and require IRB approval include:
 - Subjects participating in physical activities (e.g., physical exertion, ingestion of any substance, any medical procedure),
 - Psychological, educational and opinion studies (e.g., surveys, questionnaire, tests)
 - Studies in which the researcher is the subject of the research
 - Behavioral observations
 - that involve any interaction with the observed individual(s) or where the researcher has modified the environment (e.g., post a sign, place an object) in any way.)
 - that occur in a non public or restricted access settings (e.g., day care setting, doctor’s office)
 - that involve the recording of personally identifiable information
 - Data/record review projects that include identifiable data (see #3)
 - B) Examples of projects that are **NOT** considered human subjects research and do not require IRB pre-approval include:
 - Product testing of a student invention that does not pose a health hazard, personal data is not collected and feedback received is a direct reference to the product. It is recommended that Risk Assessment Form (3) be completed.
 - Data/record review studies (e.g., baseball statistics, crime statistics) in which the data are taken from pre-existing data sets that are publicly available or published (see #3-c)
- 3) Projects involving pre-existing data sets or data obtained through record review fall into one of three categories (a, b, and c below) and must adhere to the regulations detailed below. Pre-existing data set/review projects are projects that do not involve any interaction with human subjects or the collection of any data from a human subject for the purpose of the student’s research project. These projects may involve the student analyzing data given to the student researcher in paper or electronic form.
 - a) Projects in which the data are **not de-identified/anonymous** (e.g., data set that includes patient name, birth date, phone number or other identifying variables; student gathers data from patient files that include identifiers) are considered human subjects projects. These projects require prior IRB review and pre-approval and may require informed consent. Student researchers and adult mentors (Designated Supervisor or Qualified Scientist) should be familiar with and in compliance with all privacy and HIPAA laws.
 - b) Projects in which the student receives the data in a **de-identified/anonymous** format will not require IRB pre approval, but must comply with BOTH conditions below:
 - i) The professional providing the data must certify in writing that the data have been appropriately de-identified and are in compliance with all privacy and HIPAA laws.
 - ii) During the final SRC review and approval process, the SRC must ensure that the data were appropriately de-identified by review of the written documentation provided by the supervising professional.
 - c) Projects in which the records/data are **publicly available** (print, electronic or internet) do not require IRB review or approval. Examples of such projects include examination of sports teams or individual athlete statistics or crime statistics.
- 4) When developing the Research Plan, student researchers must evaluate and minimize the physical and/or psychological risks to their human subjects.
- 5) The documentation of written **Informed Consent** is required for most projects. **Children/Minors participating in most research will require special consent procedures including assent of the child/minor and consent of the parent/guardian.** Children/Minors are persons who have not attained the legal age for consent; in most jurisdictions the legal age is 18 and in some jurisdictions this may include all students still in secondary school.

- 6) Research conducted by a pre-college student at federally regulated research institutions (e.g., universities, medical centers, NIH, correctional institutions, etc.) must be reviewed and approved by that institution's IRB. A copy of the IRB approval for the entire project (which must include the research procedures/measures the student is using) or an official letter from the IRB attesting to this approval is required. A letter from the mentor is not sufficient documentation of IRB review and approval.
- 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 protocol to be specifically approved by the IRB. Students are prohibited from administering medications and performing invasive medical procedures on human subjects. The IRB must confirm that the student is not violating the medical practice act of the particular state or nation in which he/she is conducting the research.
- 8) Student researchers may NOT publish or display information in a report that identifies the human subjects directly or through identifiers linked to the subjects, (including photographs), without written consent. (Public Health Service Act, 42, USC 241 (d)).
- 9) All standardized tests that are not in the public domain must be administered, scored and interpreted by a Qualified Scientist as required by the instrument publisher. Any and all use and distribution of the test must be in accordance with the publisher's requirements including procurement of legal copies of the instrument.
- 10) Studies that collect data via use of the internet (e.g., email, web based surveys) require special consideration from the IRB which should have at least one member with professional expertise in conducting human subjects research. The use of the internet and email for data collection will pose challenges in collecting a) anonymous data, b) obtaining informed consent and c) ensuring that participants are of the appropriate age to give informed consent. The research plan and Form 4 must explicitly address how these challenges were evaluated and addressed.

It is permissible to develop a process of obtaining informed consent that is conducive to internet research. Researchers will want to provide information to potential participants about the purpose of the study and nature of their participation, potential risks, the voluntary nature of the study and the participant's right to withdrawal from the study at any time. A sample informed consent statement for adult participants is available on the web at www.sciserv.org/isef/document/index.asp.

Recruiting and utilizing participants who are under the age of 18 for a research study conducted on the internet is permissible under the two following conditions.

- a. If the IRB has determined that informed consent is required, the parent/legal guardian must give consent through a traditional Form 4 and informed consent procedures. In this situation, parents/guardians review

- and sign a Form 4 before the minor participant completes the online or email survey.
 - b. If the IRB determines that informed (parental) consent is not necessary for a study that poses very minimal risk, the student researcher can use an assent procedure similar to the sample consent form available on the web. The researcher should provide information to potential participants describing the nature of the study and what the participant will be asked to do, informing the participant of his/her right to withdrawal at any time and indicating that by typing I AGREE or checking a box on the survey and completing the survey, he/she has agreed to participate in the study.
- 11) After initial IRB/SRC approval (if required), a student with any proposed changes in the **Student Checklist (1A)** and **Research Plan** of the project must repeat the approval process before laboratory experimentation/data collection resumes.

Risk Assessment

Once a study population is chosen, the student researcher must consider any potential physical and/or psychological risks when developing the research plan. In evaluating risk, students and IRBs must use the following federal definition of minimal risk as a guide: **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.**

Risk Groups: The following risk groups require additional safeguards because they have been judged as vulnerable to coercion or undue influence:

- 1) Any member of a group that is naturally at-risk (e.g., pregnant women, mentally disabled persons, economically or educationally disadvantaged persons, individuals with diseases such as cancer, asthma, diabetes, cardiac disorders, psychiatric disorders, dyslexia, AIDS, etc.)
- 2) Special vulnerable groups that are covered by federal regulations (e.g. children/minors, prisoners, pregnant women).

Risk Activities: The following are examples of activities that contain **more than minimal risk**:

1) Physical

- a. **Exercise** other than ordinarily encountered in DAILY LIFE by that subject.
- b. **Ingestion of any substance** or exposure to any potentially hazardous materials.

2) Psychological

- a. Any activity (e.g. survey, questionnaire, viewing of stimuli) or experimental condition that could potentially result in **emotional stress**. For example, answering questions related to personal experiences such as

sexual, physical or child abuse, divorce and/or psychological well-being (e.g. depression, anxiety, suicide) must be considered more than minimal risk. Additionally, research activities that involve exposing subjects to stimuli or experimental conditions that could potentially result in emotional stress must also be considered more than minimal risk. Examples include violent or distressing video images, distressing written materials or activities that could potentially result in feelings of depression, anxiety, or low self-esteem in subjects.

- b. Any activity that could potentially result in negative consequences for the subject due to **invasion of privacy or breach of confidentiality**. Confidentiality involves taking careful measures to ensure that the research data and/or responses are not disclosed to the public or unauthorized individuals with identifiable information. When research activities involve collection of personal information (e.g. history of abuse, drug use, opinions, fingerprints) or health-related data (genetic material, blood, tissue) the researcher must consider risks related to invasion of privacy and possible breach of confidentiality. Ways to reduce these risks include collecting data anonymously or developing data collection procedures that make it impossible to link any identifying information (e.g. subject's name) with his/her responses or data. Anonymity involves collecting research data in such a way that it is impossible to connect research data (e.g. responses, questionnaires) with the individual who provided the data. That is, personal identifiers (e.g. names, birthdates, social security numbers) are not collected or linked with the data.

Informed Consent

The process of obtaining informed consent provides information to the subject (and where applicable, parents or guardians) about the risks and benefits associated with participation in the research study and allows the subject (and where applicable, parents or guardians) to make an educated decision about whether or not to participate. Informed consent is an on-going process, not a single event that ends with a signature on a page. It must incorporate procedures that do not involve coercion or deception.

Section A. Informed Consent Required

Documentation of informed consent is required for the following as long as the study does not meet any of the criteria for a waiver as described in Section B.:

- 1) When the IRB determines that a research study involves physical or psychological activities with more than minimal risk.
- 2) When the IRB determines that the project could *potentially* result in emotional stress to a research subject.
- 3) When the IRB determines that the research subjects belong to a risk group and the study does not meet any of the criteria below for a waiver.

Section B. Informed Consent May Be Waived

The IRB may waive the requirement for documentation of written informed consent if the research involves **only minimal risk and anonymous data collection and if it is one of the following**:

- a) Research involving normal educational practices
- b) Research on individual or group behavior or characteristics of individuals where the researcher does not manipulate the subjects' behavior and the study does not involve more than minimal risk.
- c) Surveys and questionnaires that are determined by the IRB to involve perception, cognition, or game theory and do NOT involve gathering personal information, invasion of privacy or potential for emotional distress. If there is any uncertainty regarding the appropriateness of waiving informed consent, it is strongly recommended that informed consent be obtained.
- d) Studies involving physical activity where the IRB determines that no more than minimal risk exists and where 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 activities.

If the documentation of informed consent is not required or obtained, all subjects must still give their consent/assent to participate in the study. Research subjects under 18 years of age or other individuals not able to give consent (e.g. mentally disabled) give their assent, whereas adults give their consent. The researcher must inform potential subjects about the purpose of the study and what they will be asked to do. The potential subjects must also be informed that their participation is voluntary and that they may withdraw from the study at any time. This information and the consent/assent can be either verbal or written. The procedure for obtaining consent/assent should be included in the research plan.

If a research subject is under 18 years of age, it is recommended that informed consent be obtained. Both the parent/legal guardian and the school age research subject must sign **Human Subjects Form (4)**. However, an IRB may decide that informed consent is not required because of the allowable exceptions listed above. **When the IRB waives informed consent of research subjects under the age of 18 for studies involving surveys or questionnaires, justification of this waiver must be stated on Human Subjects Form (4).**

Review Process

- 1) A student interested in doing a human subjects research project must first **review the rules**, choose a study group and consider the risks of their proposed research. The student must work with their Adult Sponsor who can guide them to a Qualified Scientist, if necessary, to help in the development of their research plan.

- 2) The student must complete the **Student Checklist (1A)**, **Research Plan**, and **Human Subjects Form (4)** and submit this information along with a copy of any questionnaire, survey or instrument used to collect human data to the Institutional Review Board (IRB). Submission of the appropriate forms does not give the student permission to begin the research. The IRB must **sign the Approval Form (1B) and Human Subjects Form (4)**, approving the project, before the research can begin.
- 3) To complete the IRB review process, the IRB must designate the risk-status of the project and other requirements by checking the appropriate box(es) on **Human Subjects Form (4)**. The IRB may require one or more of the following:
 - a. Documentation of written Informed Consent on the **Human Subjects Form (4)**. When the IRB waives informed consent of research subjects under the age of 18 for studies involving surveys or questionnaires, justification of this waiver must be stated on Form 4.
 - b. **Qualified Scientist Form (2)** – The IRB will require the project to be overseen by a Qualified Scientist when there is more than minimal risk involved. If the Qualified Scientist is unable to directly supervise the project, a trained **Designated Supervisor** will also be required.
 - c. Changes to the **Research Plan** – If the IRB requires changes or modifications of the Research Plan, the student must incorporate those changes into the written **Research Plan** before the IRB approves the project.
- 4) After the IRB has approved the project and **all committee members have signed the Human Subjects Form (4)**, the student may begin recruiting and/or interacting with human subjects.
- 5) After experimentation and shortly before fair competition, the SRC reviews and approves previously approved projects to make sure that students followed the approved **Research Plan** and the rules.
- 6) The following forms are required:
 - a. **Checklist for Adult Sponsor (1)**
 - b. **Student Checklist (1A)**
 - c. **Research Plan**
 - d. **Approval Form (1B)**
 - e. **Human Subjects Form (4)**
 - f. **Regulated Research Institution Form (1C)** - if applicable
 - g. **Qualified Scientist Form (2)** - if applicable

Sources of Information

- 1) *Code of Federal Regulation (CFR), Title 45 (Public Welfare), Part 46-Protection of Human Subjects (45CFR46)*
<http://ohsr.od.nih.gov/guidelines/45cfr46.html>
- 2) Dunn, C. M. and Chadwick, G. L., *Protecting Study Volunteers in Research: A Manual for Investigative Sites* (2002). Boston, MA: Thomson Centerwatch. ISBN 1-930624-36-0.
Can be purchased from:
<http://www.amazon.com>
NIH tutorial also provides similar information:
<http://www.cancer.gov/clinicaltrials/learning/page3>
- 3) Penslar, R.L., *Institutional Review Board (IRB) Guidebook*, (1993). Washington, DC: ORRP-NIH
http://www.hhs.gov/ohrp/irb/irb_guidebook.htm
- 4) *Belmont Report*, April 18, 1979
<http://ohsr.od.nih.gov/guidelines/belmont.html>
- 5) *Standards for Educational and Psychological Testing*. (1999). Washington, DC: AERA, APA, NCME.
To order call: (800) 628-4094. If outside US, call (717) 632-3535, Ext. 8087
<http://www.apa.org/science/standards.html>
- 6) American Psychological Association
750 First Street, NE
Washington, DC 20002-4242
phone: 202-336-5500; 1-800-374-2721
<http://www.apa.org>

Information for students:
<http://www.apa.org/science/infostu.html>

Information regarding publications:
<http://www.apa.org/publications/>
- 7) Educational and Psychological Testing
Testing Office for the APA Science Directorate
phone: 202-336-6000
email: testing@apa.org
<http://www.apa.org/science/testing.html>

Many of the documents above are also available by contacting:

Office for Human Research Protections
Department of Health and Human Services
The Tower Building
1101 Wootton Parkway, Suite 200
Rockville, MD 20852
phone: 240-453-6900; toll free in U.S. 866-447-4777
email: ohrp@osophs.dhhs.gov

❖ Vertebrate Animals ❖

The following rules were developed to help pre-college student researchers adhere to the federal regulations governing professional scientists and to, therefore, protect the welfare of both animal subjects and the student researcher. When students conduct research with animal subjects, the health and well-being of the animal subjects must be considered.

All projects involving vertebrate animals must adhere to the rules below AND to either Section A or Section B rules depending on the nature of the study and the research site.

Rules for ALL Studies Involving Vertebrate Animals

- 1) The use of vertebrate animals in science projects is allowable under the conditions and rules in the following sections. Vertebrate animals, as covered by these rules, are defined as live, nonhuman vertebrate mammalian embryos or fetuses, tadpoles, bird and reptile eggs within three days (72 hours) of hatching, and all other nonhuman vertebrates (including fish) at hatching or birth.
- 2) Alternatives to the use of vertebrate animals for research must be explored and discussed in the research plan. Alternatives include the following “3 R’s”:
 - Replace vertebrate animals with invertebrates, lower life forms, tissue/cell cultures or computer simulations
 - Reduce the number of animals without compromising statistical validity
 - Refine the experimental protocol to lessen pain or distress to the animals.
- 3) **Research projects which cause more than momentary pain or suffering to vertebrate animals or which are designed to kill vertebrate animals are prohibited.** (Note: Humane euthanasia is permitted under certain conditions when the research is conducted at a regulated research institution. See Section B.)
- 4) The following types of studies on vertebrate animals are **prohibited**:
 - a. All induced toxicity studies such as those using alcohol, acid rain, insecticide, herbicide, heavy metals, etc.
 - b. Behavioral experiments involving operant conditioning with aversive stimuli, mother/infant separation or induced helplessness
 - c. Studies of pain
 - d. Predator/vertebrate prey experiments
- 5) 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%.
 - 6) If an experimental design requires food or water restriction, it must be appropriate to the species, but may not exceed 18 hours.
 - 7) 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. A death rate of 30% or greater in any group or subgroup is not permitted and the project will fail to qualify for competition.
 - 8) Students performing vertebrate animal research must follow local, state, country and U.S. federal regulations.
 - 9) Except for observational studies, a Qualified Scientist or Designated Supervisor must directly supervise all research involving vertebrate animals.
 - 10) A Scientific Review Committee (SRC) and/or an Institutional Animal Care and Use Committee (IACUC) must approve all research before experimentation begins. (An IACUC is the review and approval body at a regulated research institution for all animal studies.) The research plan for vertebrate animal studies must include the following:
 - a. Justify why animals must be used, including the reasons for the choice of species and the number of animals to be used. Describe any alternatives to animal use that were considered, and the reasons these alternatives were unacceptable. Explain the potential impact or contribution this research may have on the broad fields of biology or medicine.
 - b. Describe in detail, how the animals will be used. Include methods and procedures, such as experimental design and data analysis. Describe the procedures that will minimize the potential for discomfort, distress, pain and injury to the animals during the course of experimentation. Identify the species, strain, sex, age, weight, source and number of animals proposed for use.

Research Sites

Certain types of vertebrate animal studies may be conducted at home, school or other non-regulated research sites, whereas other studies must be conducted at a regulated research institution. A regulated research institution is defined as a professional research/teaching institution that is regularly inspected by the USDA and is licensed to use animals covered by the Animal Welfare Act. Also included are all federal laboratories such as National Institutes of Health, Veteran’s Affairs Medical Centers and the Centers For Disease Control. In addition, pharmaceutical and biotechnology companies that utilize research animals that are not covered by the Animal Welfare Act but have an operational Institutional Animal Care and Use Committee and program structured in compliance with U.S. federal laws are included in this definition.

A. Non-regulated site

Vertebrate animal studies may be conducted at a **non-regulated** research site (home, school, farm, ranch, in the field, etc.). This includes:

- Studies involving animals in their natural environment
- Studies involving animals in zoological parks
- Studies involving livestock that use standard agricultural practices.

These projects must adhere to the following guidelines:

- The research involves agricultural, behavioral, observational or supplemental nutritional studies on animals.

AND

- The research involves only non-invasive and non-intrusive methods that do not negatively affect an animal's health or well-being.

All such studies must adhere to the additional rules listed in Section A to ensure the proper care and treatment of the animals in the study.

B. Regulated Research Institutions

All other studies using vertebrate animals must be conducted in a **regulated research institution** and must follow the additional rules in Section B.

A. Additional Rules for Projects Conducted in a Non-regulated Site

- 1) Animals 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 used. They must be given a continuous, clean (uncontaminated) water and food supply. Cages, pens and fish tanks must be cleaned frequently. 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 Supervisor is required to oversee the daily husbandry of the animals. The following documents offer space requirements and additional husbandry information:
 - *Federal Animal Welfare Regulation*
 - *Guide for the Care and Use of Laboratory Animals*
 - *Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (Ag-Guide)*
- 2) The Scientific Review Committee must determine when a veterinarian is required to certify that the research plan and animal husbandry are appropriate. This certification is required before experimentation and the prior SRC approval. It is highly recommended that a veterinarian be consulted in experiments that involve supplemental nutrition and/or activities that would not be ordinarily encountered in the animal's daily life.

- 3) If an unexpected illness or emergency occurs, the affected animals must have proper medical and nursing care that is directed by a veterinarian. A student researcher is expected to stop experimentation if there is significant weight loss or death in the experimental subjects. The experiment can only be resumed if the cause of illness or death is not related to the experimental procedures and if appropriate steps are taken to eliminate the causal factors.
- 4) Animals may not be captured from or released into the wild without approval of authorized wildlife or other regulatory officials. Fish may be obtained from the wild only if the researcher releases the fish unharmed, has the proper license, and adheres to state and local fishing laws and regulations.
- 5) The final disposition of the animals must be considered and explained on **Vertebrate Animal Form (5A)**. Euthanasia for tissue removal and/or pathological analysis is not permitted for a project conducted in a non-regulated site.
- 8) After initial SRC approval, a student with any proposed changes in the **Student Checklist (1A)** and **Research Plan** of the project must repeat the approval process before laboratory experimentation/data collection resumes.
- 9) **The following forms are required:**
 - a. **Checklist for Adult Sponsor (1)**
 - b. **Student Checklist (1A)**
 - c. **Research Plan**
 - d. **Approval Form (1B)**
 - e. **Vertebrate Animal Form (5A)**
 - f. **Qualified Scientist Form (2), if applicable**

B. Additional Rules for Projects Conducted in a Regulated Research Institution

Some research that is permissible for professionals in research institutions is not appropriate for pre-college students. The following are additional rules for projects conducted in a regulated research institution:

- 1) The Institutional Animal Care and Use Committee (IACUC) must approve all student research projects before experimentation begins. Such research projects must be conducted under the responsibility of a principal investigator. The local SRC must also review the project to certify that the research project complies with ISEF Rules. This SRC review should occur before experimentation begins.
- 2) Proper euthanasia at the end of experimentation for tissue removal and/or pathological analysis is permitted. Only the Qualified Scientist or an institutional representative may perform the euthanasia. All methods of euthanasia must adhere to current AVMA Guidelines.

- 3) Research projects that cause more than momentary pain or suffering to vertebrate animals are prohibited. The following table relates the USDA Pain Categories and the permissibility of studies for science fair projects.

USDA Pain Categories	Definition	ISEF Guidelines
Category A	<i>Live animals will receive non-painful manipulation. Animals may be euthanized to obtain tissues, cells, etc.</i>	Permitted
Category B	<i>Live animals will receive momentary pain or stressful stimulus without anesthesia, which results in a short-term response. Examples include but are not limited to: injections, field trapping/tagging, blood sampling and standard agricultural husbandry practices.</i>	Permitted
Category C	<i>Live animals will have significant manipulations, surgery, etc., performed while anesthetized. The animals will be euthanized at the termination of the procedure without regaining consciousness.</i>	Permitted only with proper training and certification
Category D	<i>Live animals will have manipulations performed while anesthetized and are allowed to recover and/or animals will develop discernable clinical signs indicating pain, distress, or significant physiological changes <u>spontaneously or as a result of specific experimental procedures</u>. Examples include, but are not limited to: Survival surgical procedures of any type and some studies which would include tumor development. ALL SUCH STUDIES MUST INCLUDE TREATMENT TO ALLEVIATE PAIN OR DISTRESS.</i>	Limited Category D procedures are permitted with proper training and certification. The project must adhere to all ISEF rules. Most Category D projects would be deemed inappropriate for high school students.
Category E	<i>Live animals will experience significant/severe pain or distress, without benefit of anesthetics, tranquilizers or analgesics.</i>	PROHIBITED

- 4) The following forms are required:
- a. **Checklist for Adult Sponsor (1)**
 - b. **Student Checklist (1A)**
 - c. **Research Plan**
 - d. **Approval Form (1B)**
 - e. **Regulated Research Institution Form (1C)**
 - f. **Vertebrate Animal Form (5B)**
 - g. **Qualified Scientist Form (2)**

Sources of Information for Animal Care and Use

- 1) *Guide for the Care and Use of Laboratory Animals*, Institute of Laboratory Animal Research (ILAR), Commission on Life Sciences, National Research Council
http://dels.nas.edu/ilar_n/ilarhome/reports.shtml
- 2) *Principles and Guidelines for the Use of Animals in Precollege Education* (a free pamphlet from ILAR)

Can be found online:
http://dels.nas.edu/ilar_n/ilarhome/reports.shtml

To order contact:
National Academies Press
500 Fifth Street, NW
Lockbox 285
Washington, DC 20055
phone: 888-624-8373 or 202-334-3313
fax: 202-334-2451; <http://www.nap.edu>
- 3) Federal Animal Welfare Act (AWA)
7 U.S.C. 2131-2157
Subchapter A - Animal Welfare (Parts I, II, III)
<http://www.nal.usda.gov/awic/legislat/awicregs.htm>

Above document is available from:

USDA/APHIS/AC
4700 River Road, Unit 84
Riverdale, MD 20737-1234
email: ace@aphis.usda.gov
Tel: (301) 734-7833
Fax: (301) 734-4978

<http://awic.nal.usda.gov>

- 4) *Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (Agri-Guide)*
Federation of Animal Science Societies (FASS)
1111 N. Dunlap Avenue
Savoy, IL 61874
phone: (217) 356-3182
email: fass@assoqh.org
<http://www.fass.org>

Sources of Information for Alternative Research and Animal Welfare

- 1) The National Library of Medicine provides computer searches through MEDLINE:
Reference & Customer Services
National Library of Medicine
8600 Rockville Pike
Bethesda, MD 20894
1-888-FIND-NLM or 1-888-346-3656
(301) 594-5983; email: custserv@nlm.nih.gov
<http://www.nlm.nih.gov>
<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi>

- 2) National Agriculture Library (NAL) provides reference service for materials that document a) Alternative Procedures to Animal Use and b) Animal Welfare.
- Animal Welfare Information Center
National Agriculture Library
10301 Baltimore Avenue, Room 410
Beltsville, MD 20705-2351
phone: (301) 504-6212, fax: (301) 504-7125
email: awic@nal.usda.gov
<http://www.nal.usda.gov/awic>
- 3) Institute of Laboratory Animal Resources (ILAR) provides a variety of information on animal sources, housing and handling standards, and alternatives to animal use through annotated bibliographies published quarterly in *ILAR Journal*.
- ILAR
The Keck Center of the National Academies
500 Fifth Street, NW, Keck 687
Washington, DC 20001
phone: (202) 334-2590, fax: 202-334-1687
email: ILAR@nas.edu
<http://dels.nas.edu/ilar/>

Quarterly bibliographies of Alternatives to the Use of Live Vertebrates in Biomedical Research and Testing may be obtained from:

Specialized Information Services
NLM/NIH
2 Democracy Plaza, Suite 510
6707 Democracy Blvd., MSC 5467
Bethesda, MD 20892-5467
Ph: 301-496-1131; Fax: 301-480-3537
Toll Free: 1-888-FIND NLM or 1-888-346-3656
Email: tehip@tehn.nlm.nih.gov
<http://www.sis.nlm.nih.gov>;
<http://toxnet.nlm.nih.gov/altbib.html>

- 4) Euthanasia Guidelines
2000 Report of the AVMA Panel on Euthanasia.
Journal of the American Veterinary Medical Association
(JAVMA), Vol. 218, No.52: 669-696, March 2001.
<http://www.avma.org/resources/default.asp>
- 5) John's Hopkins Center for Alternatives to Animal Testing (CAAT) has worked with scientists since 1981 to find new methods to replace the use of laboratory animals in experiments, reduce the number of animals tested, and refine necessary tests to eliminate pain and distress.
email: caat@jhsph.edu
<http://caat.jhsph.edu/>

❖ Potentially Hazardous Biological Agents ❖

(previously classified as pathogenic and potentially pathogenic agents, recombinant DNA, and human and vertebrate animal tissues)

Projects incorporating **microorganisms** (including bacteria, viruses, viroids, prions, rickettsia, fungi, and parasites), **recombinant DNA (rDNA) technologies** or **human or animal fresh tissues, blood, or body fluids** may involve working with potentially hazardous biological agents. Students are permitted to do research projects with potentially hazardous biological agents as long as every effort is made to ensure that they work safely and that the projects meet the conditions and rules described below. The following rules were developed to protect students and to help them adhere to federal and international biosafety regulations and guidelines.

When dealing with potentially hazardous biological agents it is the responsibility of the student and all of the adults involved in a research project to conduct a **risk assessment** (See page 23). A risk assessment defines the potential level of harm, injury or disease to **plants, animals** and **humans** that may occur when working with biological agents. The end result of a risk assessment is the assignment of a **final biosafety level** which then determines the laboratory facilities, equipment, training, and supervision required for the research project to proceed. A more complete discussion of the factors associated with risk assessment can be found on page 23.

All projects involving microorganisms, recombinant DNA technologies and human or animal fresh tissues, blood or body fluids must adhere to the rules below AND, depending on the study, to the additional rules in Section A, B or C.

Rules for ALL Studies Involving Potentially Hazardous Biological Agents

- 1) The use of potentially hazardous microorganisms (including bacteria, viruses, viroids, prions, rickettsia, fungi, and parasites), recombinant DNA (rDNA) technologies or human or animal fresh tissues, blood, or body fluids is allowable under the conditions and rules that follow. All of these areas of research may involve potentially hazardous biological agents and require special precautions.
- 2) An appropriate review and approval committee (SRC, IBC, IACUC) must approve all research before experimentation begins. The initial risk assessment determined by the student researcher and adults supervising the project must be confirmed by the SRC.
- 3) Experimentation with potentially hazardous biological agents, even BSL-1 organisms, **is prohibited in a home environment**. However, specimens are allowed to be collected at home as long as they are immediately transported to a laboratory with the appropriate level of biosafety containment. Naturally-occurring plant pathogens may be studied (not cultured) at home, but may not be introduced into a home/garden environment.
- 4) A risk assessment must be conducted by the student and adult supervisors prior to experimentation and a final biosafety level must be determined or confirmed by the SRC. See page 23.
- 5) Research determined to be at Biosafety Level 1 (BSL-1) may be conducted in a BSL-1 or higher laboratory. The research must be supervised by a Qualified Scientist or a trained Designated Supervisor. The student must be properly trained in standard microbiological practices.
- 6) Research determined to be a Biosafety Level 2 (BSL-2) MUST be conducted in a laboratory rated BSL-2 or above (commonly found in a regulated research institution). The research must be reviewed and approved by the Institutional Biosafety Committee (IBC) or a letter obtained from an institutional representative that the research does not require review. The research must be supervised by a Qualified Scientist. The student researcher must receive extensive training, demonstrate competency and be directly supervised while conducting microbiological procedures.
- 7) **Research determined to be biosafety levels 3 or 4 is prohibited for precollege students.**
- 8) **Studies intended to produce or genetically engineer bacteria with multiple antibiotic resistance are prohibited.** Extreme caution should be exercised when selecting out antibiotic resistant organisms. Studies using such organisms require at least BSL-2 containment.
- 9) All potentially hazardous biological agents must be properly disposed of at the end of experimentation in accordance with their biosafety level. Following are acceptable procedures for disposal of cultured materials: Autoclaving at 121 degrees Celsius for 20 minutes, use of 10% sodium hypochlorite, incineration, alkaline hydrolysis, and biosafety pick-up.
- 10) Studies involving the culturing of human or animal waste, including sewage sludge, must be treated as a BSL-2 study.
- 11) The following types of studies are exempt from prior SRC review, but must complete Risk Assessment Form 3:
 - a) Studies involving baker's yeast and brewer's yeast, except when involved with rDNA studies
 - b) Studies involving most protists, archae and similar microorganisms
 - c) Research using manure for composting or other non-culturing experiments and fuel production
 - d) Studies involving lactobacillus, bacillus thurgensis, nitrogen-fixing, oil-eating bacteria and algae-eating bacteria introduced into their natural environment. (Not exempt if cultured in a petri dish environment that could potentially be contaminated).
- 12) Any proposed changes in the **Student Checklist (1A)** and **Research Plan** by the student after initial SRC approval must have subsequent SRC or IBC review and approval before such changes are made and before experimentation resumes.
- 13) The following forms are required:
 - a. **Checklist for Adult Sponsor (1), Student Checklist (1A), Research Plan, and Approval Form (1B)**
 - b. **Regulated Research Institution Form (1C)** - if appl.
 - c. **Qualified Scientist (2)**, if applicable
 - d. **Risk Assessment (3)**, if applicable
 - e. **Hazardous Risk Assessment Form (6A)**
 - f. **Human and Vertebrate Animal Tissue Form (6B)** – for all studies involving tissues and body fluids.

A. Additional Rules for Projects Involving Unknown Microorganisms

Studies involving unknown microorganisms present a challenge because the presence, concentration and pathogenicity of possible agents are unknown. In science fair projects these studies typically involve the collection and culturing of microorganisms from the environment (e.g. soil, household surfaces, skin, etc.)

- 1) Research with unknown microorganisms can be treated as a BSL-1 study under the following conditions:
 - a) Organism **is cultured** in a plastic Petri dish (or other standard non-breakable container) **and sealed**. Other acceptable containment include petri film and doubled heavy-duty (2-ply) sealed bags.
 - b) Experiment involves only procedures in which the Petri dish remains sealed throughout the experiment (i.e. counting presence of organisms or colonies).
 - c) The sealed Petri dish is disposed of in the appropriate manner under the supervision of the Designated Supervisor.
- 2) If a culture is opened for identification, sub-culturing or isolation, it must be treated as a BSL-2 study and involve BSL-2 laboratory procedures.

B. Additional Rules for Projects Involving Recombinant DNA (rDNA) Technologies

Studies involving rDNA technologies in which microorganisms have been genetically modified require close review to assess risk level assignment. There are a few rDNA studies that can be safely conducted in a BSL-1 high school laboratory with prior review by a knowledgeable SRC.

- 1) All rDNA technology studies involving BSL-1 organisms and BSL-1 host vector systems may be conducted in a BSL-1 laboratory under the supervision of a Qualified Scientist or trained Designated Supervisor and must be approved by the SRC prior to experimentation. Examples include cloning of DNA in *E. coli* K12, *S. cerevisiae*, and *B. subtilis* host-vector systems.
- 2) All rDNA technology studies using the following DNA insert molecules may be conducted in a BSL-1 laboratory under the supervision of a Qualified Scientist or trained Designated Supervisor and must be approved by the SRC prior to experimentation: (a) DNA molecules that are not in the DNA of organisms or viruses, (b) DNA from single non-chromosomal or non-viral sources and (c) DNA that is entirely from a prokaryotic host, including its indigenous plasmids or viruses when propagated only in the host.
- 3) A rDNA technology study that involves BSL-1 agents that may convert to BSL-2 agents during the course of experimentation must be conducted entirely in a BSL-2 facility.
- 4) All rDNA technology studies involving BSL-2 organisms and/or BSL-2 host vector systems must be conducted in a regulated research institution and approved by the IBC prior to experimentation.
- 5) **Propagation of recombinants containing DNA coding for oncogenes or other human, plant or animal toxins (including viruses) are prohibited.**

C. Additional Rules for Projects Involving Tissues Including Blood and Blood Products

Studies involving fresh tissue, blood or body fluids obtained from humans and/or vertebrate may contain microorganisms and have the potential of causing disease. Therefore, a proper risk assessment is required.

- 1) If tissues are obtained from an animal that was sacrificed for a purpose other than the students' project, it may be considered a tissue study. If the animal was euthanized solely for the student's project, the study must be considered a vertebrate animal project and adhere to the vertebrate animal rules for studies conducted at a regulated research institution. (See vertebrate animal rules, pg 17.)
- 2) Biosafety level 1 studies involve the collection and examination of fresh tissue and/or body fluids, (not including blood or blood products, see rule 4) from a non-infectious source with little likelihood of microorganisms present. Biosafety level 1 studies can be conducted in a BSL-1 laboratory and must be supervised by a Qualified Scientist or trained Designated Supervisor.
- 3) Biosafety level 2 studies involve the collection and examination of fresh tissues or body fluids that may contain microorganisms belonging to BSL-1 or 2. These studies must be conducted in a regulated research institution under the supervision of a Qualified Scientist.
- 4) All studies involving human or wild animal blood or blood products should be considered a Biosafety level 2 study and must be conducted in a BSL-2 laboratory under the supervision of a Qualified Scientist. All studies involving domestic animal blood may be considered a BSL-1 level study. All blood must be handled in accordance with standards and guidelines set forth in the OSHA, 29CFR, Subpart Z. Any tissue or instruments with the potential of containing bloodborne pathogens (eg. blood, blood products, tissues that release blood when compressed, blood contaminated instruments) must be properly disposed of after experimentation.
- 5) Human breast milk of unknown origin, unless certified free of HIV and Hepatitis C, should be considered BSL-2. Domestic animal milk may be considered BSL-1.
- 6) Any study involving the collection and examination of body fluids which may contain biological agents belonging to BSL-3 or 4 is prohibited for pre-college students.
- 7) Studies of human body fluids, where the sample can be identified with a specific person, must have IRB review and informed consent. Students using their own body fluids are exempt from this requirement.
- 8) The following types of tissue do not need to be treated as potentially hazardous biological agents:
 - a. Plant tissue
 - b. Established cell and tissue cultures (e.g., those obtained from the American Type Culture Collection). The source and catalog number of the cultures should be identified in the **Research Plan**
 - c. Meat or meat by-products obtained from food stores, restaurants, or packing houses
 - d. Hair
 - e. Teeth that have been sterilized to kill any blood borne pathogen that may be present. Chemical disinfection or autoclaving at 121 degrees Celsius for 20 minutes is a recommended procedure.
 - f. Fossilized tissue or archeological specimens
 - g. Prepared fixed tissue slides

Risk Assessment

Risk assessment defines the potential level of harm, injury or disease to **plants, animals and humans** that may occur when working with biological agents. The end result of a risk assessment is the assignment of a final biosafety level which then determines the laboratory facilities, equipment, training, and supervision required for the research project to proceed.

Risk assessment involves:

- **Assignment of the biological agent to a risk group**
 - Studies involving a known microorganism should begin with an initial assignment of the microorganism to a biosafety level risk group based on information available through a literature search.
 - The study of unknown microorganisms and the use of fresh tissues should rely on the expertise of qualified adults supervising the project.
- **Determination of the level of biological containment** available to the student researcher to conduct the

experimentation. (Please see Levels of Biological Containment below for more details.)

- Assessment of the experience and **expertise of the adult(s)** supervising the student.
- **Assignment of a final biosafety level** for the study based on risk group of biological agent, level of biological containment available and the expertise of the Qualified Scientist or Designated Supervisor who will be supervising the project.

If a study is conducted at a non regulated site (e.g. school), the final biosafety level must be confirmed by the SRC. If the research is conducted at a regulated site, the final biosafety level must be assigned by an Institutional Biosafety Committee (IBC) or equivalent approval body or a letter obtained from an institutional representative that the research does not require review. If no approval body exists at the regulated site, the SRC should review the project and assign a final biosafety level.

Classification of Biological Agents Risk Groups

Biological agents, plant or animal, are classified according to biosafety level risk groups. These classifications presume ordinary circumstances in the research laboratory, or growth of agents in small volumes for diagnostic and experimental purposes.

BSL-1 risk group contains biological agents that pose low risk to personnel and the environment. These agents are highly unlikely to cause disease in healthy laboratory workers, animals or plants. The agents require Biosafety Level 1 containment. Examples of BSL-1 organisms are: *Aspergillus niger*, *Bacillus thuringiensis*, *Escherichia coli* strain K12, *Lactobacillus acidophilus*, *Micrococcus leuteus*, *Neurospora crassa*, *Pseudomonas fluorescens*, *Serratia marcescens*.

BSL-2 risk group contains biological agents that pose moderate risk to personnel and the environment. If exposure occurs in a laboratory situation, the risk of spread is limited and it rarely would cause infection that would lead to serious disease. Effective treatment and preventive measures are available in the event that an infection occurs. The agents require Biosafety Level 2 containment. Examples of BSL-2 organisms are: *Mycobacterium*, *Streptococcus pneumoniae*, *Salmonella choleraesuis*.

BSL-3 risk group contains biological agents that usually cause serious disease (human, animal or plant) or that can result in serious economic consequences. These agents are usually not spread by casual contact. The agents require Biosafety Level 3 containment. **PROHIBITED**

BSL-4 risk group contains biological agents that usually produce very serious disease (human, animal or plant) that is often untreatable. These agents are usually easily transmitted from one individual to another, from animal to human or vice-versa, either directly or indirectly, or by casual contact. The agents require Biosafety Level 4 containment. **PROHIBITED**

Levels of Biological Containment

There are four levels of biological containment (Biosafety Level 1 - 4). Each level has guidelines for laboratory facilities, safety equipment and laboratory practices and techniques.

BSL-1 containment is normally found in water-testing laboratories, in high schools, and in colleges teaching introductory microbiology classes. Work is done on an open bench or in a fume hood. Standard microbiological practices are used when working in the laboratory. Decontamination can be achieved by treating with chemical disinfectants or by steam autoclaving. Lab coats are required and gloves recommended. The laboratory work is supervised by an individual with general training in microbiology or a related science.

BSL-2 containment is designed to maximize safety when working with agents of moderate risk to humans and the environment. Access to the laboratory is restricted. Biological safety cabinets (Class 2, type A, BSC) must be available. An autoclave should be readily available for decontaminating waste materials. Lab coats, gloves and face protection are required. The laboratory work must be supervised by a competent scientist who understands the risk associated with working with the agents involved.

BSL-3 containment is required for infectious agents that may cause serious or potentially lethal diseases as a result of exposure by inhalation. The laboratory must be a separate building or isolated zone, with double-door entry, directional inward airflow. Many special procedures and protective devices are required when working with these agents. **PROHIBITED**

BSL-4 containment is required for dangerous/exotic agents that pose high risk of life-threatening disease. Numerous special facilities and precautions are required when working with these agents. **PROHIBITED**

Sources of Information

American Biological Safety Association: ABSA Risk Group
Classification – list of organisms
<http://www.absa.org>

American Type Culture Collection
(703) 365-2700; 1(800) 638-6597 (US, Canada, & PR)
<http://www.atcc.org>

Bergey's Manual of Systematic Bacteriology website –
follow the links for resources and microbial databases for a
collection of international websites of microorganisms and
cell cultures: <http://www.bergeys.org>

Biosafety in Microbiological and Biomedical Laboratories
(BMBL) - 4th Edition. Published by CDC-NIH,
To order: Office of Health and Safety
Centers for Disease Control and Prevention
1600 Clifton Road, NE, Mailstop F05
Atlanta, GA 30333

<http://www.cdc.gov/od/ohs/biosfty/biosfty.htm>

World Health Organization
Laboratory Safety Manual-3rd Edition
[http://www.who.int/csr/resources/publications/biosafety/
Biosafety7.pdf](http://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf)

Available online in English, French, Spanish, & Portuguese.
Provides practical guidance on biosafety techniques for use
in laboratories at all levels. Includes risk assessment and
safe use of recombinant DNA technology, and provides
guidelines for the commissioning and certification of
laboratories.

Canada – Agency of Public Health – list of non-pathogenic
organisms
[http://www.phac-aspc.gc.ca/ols-bsl/pathogen/
organism_e.html](http://www.phac-aspc.gc.ca/ols-bsl/pathogen/organism_e.html)

Microorganisms for Education Website – list of organisms
<http://www.science-projects.com/safemicrobes.htm>

NIH Guidelines for Research Involving Recombinant DNA
Molecules. Published by National Institutes of Health.
<http://www4.od.nih.gov/oba/>

OSHA – Occupational Health and Safety Administration
<http://www.osha.gov>

The Mad Scientist Network at Washington University
School of Medicine: <http://www.madsci.org>

❖ Hazardous Chemicals, Activities or Devices ❖

(Includes DEA-controlled substances, prescription drugs, alcohol & tobacco, firearms and explosives, radiation, lasers, etc.)

The following rules apply to research that involves the use of hazardous chemicals, devices and activities. The rules 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.

These rules are intended to protect the student researcher by ensuring that the proper supervision is provided and that all potential risks are considered so that the appropriate safety precautions are taken. Before beginning research involving hazardous chemicals, activities or devices, be sure to check with your school, local, or regional fair as more strict rules and guidelines may be in effect.

Rules for ALL Projects Involving Hazardous Chemicals, Activities and Devices

1. The use of hazardous chemicals 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.
2. 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 **Risk Assessment Form (3)**.
3. Student researchers must acquire and use regulated substances in accordance with all local, state, U.S. federal and country laws. For further information or classification for these laws and regulations, please contact the regulatory agencies listed below.
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.
5. 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.
- 6) The following forms are required:
 - a. **Checklist for Adult Sponsor (1)**
 - b. **Student Checklist (1A)**
 - c. **Research Plan**
 - d. **Approval Form (1B)**
 - e. **Regulated Research Institution Form (1C)** - if applicable
 - f. **Qualified Scientist Form (2)** - if applicable
 - g. **Risk Assessment Form (3)**

Additional Rules for Specific Regulated Substances

There are additional rules for the following regulated substances:

- A. DEA-controlled Substances
- B. Prescription Drugs
- C. Alcohol & Tobacco
- D. Firearms and Explosives

A. 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. Other countries may have similar regulatory bodies; students outside of the U.S. should consult the drug regulatory agency in their country in addition to being aware of DEA regulations. DEA controlled substances and their schedule number can be found at the DEA website listed in the Sources of Information at the end of the section. 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.

1. All studies using DEA controlled substances must be supervised by a Qualified Scientist who is licensed by the DEA (or other appropriate international regulatory body) for use of the controlled substance.
2. 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.

B. 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. (see p. 14)
2. Administering any prescription drug to vertebrate animals must be done under all appropriate vertebrate animal rules and guidelines. (see p. 17)

C. Alcohol and Tobacco

The U.S. Alcohol and Tobacco Tax and Trade Bureau (TTB) regulates the production of alcohol and distribution of alcohol and tobacco products. Many such products have an age restriction for purchase, possession and consumption. Students outside of the U.S. must additionally adhere to their local and country laws and regulations.

The Designated Supervisor is responsible for the acquisition, usage and appropriate disposal of the alcohol or tobacco used in the study.

1. Production of ethyl alcohol is allowable in the home under the supervision of the parents and must meet the TTB home production regulations.

2. Yeast fermentation studies in which minute quantities of ethyl alcohol are produced are permitted.
3. Students are allowed to conduct science fair experiments involving the distillation of alcohol for fuel production. However, to do so, the work must be conducted at school and a TTB permit must be obtained by school authorities. Details regarding this process are available from the Alcohol and Tobacco Tax and Trade Bureau (TTB) website referenced in the Sources of Information section below.

D. Firearms and Explosives

The U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF), along with state agencies, regulates the purchase and use of firearms and explosives. A firearm is defined as a small arms weapon from which a projectile is fired by gunpowder. An explosive is any chemical compound, mixture or device, the primary purpose of which is to function by explosion. Explosives include, but are not limited to, dynamite, black powder, pellet powder, detonators, and igniters.

The purchase of a firearm by a minor is generally unlawful. The use of a firearm, without proper state certification, is illegal. Students should check the training and certification requirements of individual states and countries.

1. All persons receiving explosives must obtain a license or permit from the U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) or international equivalent regulatory body.
2. A fully assembled rocket motor, reload kit or propellant modules containing more than 62.5 grams of propellant are subject to the permitting, storage and other requirements of federal explosive laws and regulations.

Note: A “potato gun” is not a firearm unless it is intended to be used as a weapon. A “potato” gun used in a science fair project should be treated as a hazardous device.

Guidance for Risk Assessment

Please find below guidance on conducting risk assessment when using the following:

- A. Hazardous Chemicals
- B. Hazardous Devices
- C. Radiation

A. Hazardous Chemicals

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 allergic and genetic disposition may have an influence on the overall effect the chemical may have. The student researcher must refer to Material Safety Data Sheets (MSDS) to ensure that proper safety precautions are taken. Some MSDS 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.

A risk assessment must include proper disposal methods for the chemicals used in an experiment. The Flinn Catalog (referenced below) 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.

Environmentally Responsible Chemistry

The mission of environmentally responsible (green) chemistry is to avoid the use or production of hazardous substances during chemical process. The principles of green chemistry are described on the EPA website in the Sources of Information section. Whenever possible the following principles should be incorporated into the research plan.

- Prevent waste
- Use safer chemicals and products
- Design less hazardous chemical syntheses
- Use renewable materials
- Use catalysts
- Use safer solvents and reaction conditions
- Increase energy efficiency
- Minimize the potential for accident

B. Hazardous Devices

A risk assessment for the use of hazardous devices must consider all potential risks for the student researcher using the device. While many household items (iron, saw, drill, etc.) can be hazardous if used improperly, the documentation of a risk assessment (Form 3) is required when a student researcher works with potentially dangerous laboratory equipment and other devices that require a moderate to high level of expertise to ensure their safe usage.

Certain laboratory equipment may present a greater risk than other equipment. For example, hot plates and Bunsen burners may not require a documented risk assessment, whereas other devices such as high vacuum equipment, heated oil baths, NMR equipment, UV lights, lasers and high-temperature ovens require documentation of a risk assessment (Form 3.)

C. 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.

- 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 1 laser.
- 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 from both direct and indirect exposure. The beam is also a fire hazard.

A risk assessment must be conducted when a student uses **ionizing radiation** beyond that normally encountered in everyday life. 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.

Sources of Information

General Lab/Chemical Safety

Safety in Academic Chemistry Laboratories, volumes 1 and 2, 2003. Washington, DC: American Chemical Society.

Order from (first copy free of charge):

American Chemical Society
Publications Support Services
1155 16th Street, NW
Washington, DC 20036

phone: (202) 872-4554 or 1-800-227-5558

email: pss@acs.org, website: <http://pubs.acs.org/>

<http://www.hhmi.org/about/labsafe/safescience.html>

Online course from Howard Hughes Medical Institute on practicing safe science. Includes sections on general lab safety, chemical safety, and safety concerns when dealing with cell cultures, human blood, radioactive materials and X-ray diffraction.

Safety in the Research Laboratory

A free DVD from Howard Hughes Medical Institute that includes sections on working with cell cultures, radioactive materials and other laboratory materials. Other free safety DVD's are also available: order from the website:

<http://catalog.hhmi.org/index.jsp>

Environmental Protection Agency (EPA) website for green chemistry: <http://www.epa.gov/greenchemistry>

Material Safety and Data Sheets (MSDS)

MSDS should be collected by your laboratory or available from the manufacturer. The internet also has a range of free resources:

<http://www.flinnsci.com> - A directory of MSDS sheets from Flinn Scientific Inc. that includes a ranking of hazard level and disposal methods

<http://www.hhmi.org/about/labsafe/lcss.html> - Laboratory chemical safety summaries from Howard Hughes Medical Institute

<http://www.ilpi.com/msds/index.html> - A listing of numerous sites that have free downloads of MSDS sheets

DEA Controlled Substances

Drug Enforcement Agency website:

<http://www.usdoj.gov/dea>

Controlled Substance Schedules – a list of controlled substances : <http://www.deadiversion.usdoj.gov/schedules/schedules.htm>

Alcohol, Tobacco Firearms and Explosives

Alcohol and Tobacco Tax and Trade Bureau

<http://www.ttb.gov/>

Bureau of Alcohol, Tobacco, Firearms and Explosives

<http://www.atf.gov>

Radiation

Radiation Manual from the Center of Disease Control (CDC): www.cdc.gov/od/ohs/manual/radman.htm

Occupational Safety and Health Administration Documents available from:

OSHA Publications

P.O. Box 37535

Washington, DC 20013-7535

phone: (202) 693-1888; fax: (202) 693-2498

<http://www.osha.gov>

PUB 8-1.7 - Guidelines for Laser Safety and Hazard Assessment

STD 1-4.1 - OSHA Coverage of Ionizing Radiation Sources Not Covered by Atomic Energy Act of 1954

U.S. Nuclear Regulatory Commission

Material Safety and Inspection Branch

One White Flint North

11555 Rockville Pike

Rockville, MD 20852-2738

phone: (301) 415-8200; (800) 368-5642

<http://www.nrc.gov>

DISPLAY RULES AND SAFETY REGULATIONS

1. A student may enter only one exhibit. The student must be a full-time student in good standing at a SEFH affiliated school.
2. Completed project entry and approval forms must be on file with the Fair Office on or prior to the deadline date for entry, including the project entry fee. Copies of these forms should also be available in a labeled folder at the display.
3. The exhibit must be set up in the category indicated on the entry form and at the assigned location.
4. The exhibit must pass inspection by both the SRC and Rules & Safety Committee on Thursday evening at the Fair. Exhibits not passing both inspections must be removed from the exhibit area on Thursday evening prior to closing time.
5. The entry exhibit must be the work of the student or team entering the Fair.
6. Repetition of a previous year's research project is not permitted. However, a student may exhibit new research on a continuing problem providing the research demonstrates significant progress over the previous year. **If the project is a continuing one**, a Roman Numeral should appear at the end of the title which indicates the years it has been entered in the Fair (e.g.-A Study of Houston Cockroaches - III) and the Continuation Projects Form (7) must be completed. Display board must indicate work for the current year.
7. Exhibit titles are limited to 6 words or less, and a maximum of 50 letters/characters.
8. The name of the student, teacher, or district must **not be a visible part of the display**.
9. Except for move-in and unpacking, the exhibitor is responsible for the set-up of his/her own exhibit.
10. No radios, TVs, tape players, or other sound transmitting devices may be played unless the sound is transmitted via headphones or the devices are used as part of the display/project presentation. Laser pointers are not allowed.
11. Students for individual and team projects must be at their project during all judging periods. At least two team members of team projects must be present during judging. All projects will be judged within the scheduled judging times.
12. Disruptive students will be disqualified from the Fair.
13. Students are encouraged to provide judges with copies of a one page abstract or summary of their project; however, the material cannot identify the student, teacher, school or district.
14. Project laboratory notebooks for all related research should be available at the display for review by judges.

Unacceptable for Display

1. living organisms
2. microbial cultures or fungi (live or dead)
3. plants cannot be displayed in water or other solutions
4. taxidermy specimens or parts
5. preserved vertebrate or invertebrate animals or their parts
6. waste, rock, sand or soil samples - unless encased in acrylic
7. chemicals
8. human/animal parts (exceptions: teeth, hair, nails, dried animal bones, histological sections, and sealed wet mount tissue)
9. human or animal food
10. sharp items (i.e., syringes, needles, pipettes).
11. poisons, drugs, controlled substances
12. dry ice or other sublimating solids.
13. flames or highly flammable display materials
14. gases of any type
15. batteries with open top cells
16. items which identify the student, teacher or school
17. offensive audio/visual displays
18. operation of a class III or IV laser
19. any equipment or devices which may be hazardous to the public including laser pointers
20. liquids (including water, mercury or alcohol thermometers)
21. previous student/project awards
22. empty tanks that once contained combustibles unless purged
23. photographs or other visual presentations depicting vertebrate animals in other-than-normal conditions
24. active Internet or e-mail connections as part of the display or demonstration of the project.

Acceptable For Display Only-(But Not Operated)

1. projects with unshielded belts, pulleys, chains, and moving parts with tension or pinch points
2. class III and IV lasers
3. devices which emit loud noises
4. devices which require more than 125V

Acceptable for Display & Operation With Restrictions

1. Photographs and/or visual depictions **if**:
 - a. Credit lines of their origins: "Photograph taken by ..." or "Image taken from ..." are attached. (If all photographs being displayed were taken by the Finalist, one credit line prominently displayed indicating that the Finalist took all photographs is sufficient.)

- b. They are from the Internet, magazines, newspapers, journals, etc., and credit lines are attached.
 - c. They are photographs of the student and/or her/his family.
 - d. They are photographs of human subjects for which signed consent forms are available at the project.
 - e. They are not deemed offensive by the Scientific Review Committee or the Rules and Safety Committee.
2. Class II lasers
 - a. must be student-operated
 - b. posted sign must read **"Laser Radiation: do not stare into beam"**
 - c. must have protective housing that prevents access to beam
 - d. must be disconnected when not operating.
 3. large vacuum tubes or dangerous ray-generating devices must be shielded properly; mechanical devices with moving parts must have adequate safeguards
 4. any apparatus producing temperatures that will cause physical burns must be adequately insulated.
 5. high-voltage (over 12V) equipment must be shielded with a grounded metal box or cage to prevent accidental contact
 6. high-voltage (over 12V) wiring, switches, and metal parts must have adequate insulation and overload safety factors, and must be inaccessible to others
 7. electric circuits for 110-volt ac must have a grounded 9-ft. (minimum) cord. The cord must have sufficient load-carrying capacity and be approved by underwriters laboratories. 220V is not allowed.
 8. electrical connections in 110-volt circuits must be soldered or made with approved connectors; connecting wires must be insulated
 9. bare wire and exposed knife switches may be used only in circuits of 12 volts or less; otherwise, standard enclosed switches are required

SIZE: Project space limitations are: 76cm (30in) deep; 122cm (48in) wide; 274cm (108in) high including table; tables are 76cm high. Heavy displays should be floor mounted when possible. Floor mounted projects are limited to the same space limitations and cannot be placed in front of a project table. No exceptions. Unless otherwise requested on the entry form, all projects will be assigned a project display table.

PROJECT ABSTRACTS

Abstracts are not required by SEFH (they are by the State and International fairs and the Discovery competition); however, they are of important assistance to judges and others who view your project. You are encouraged to have extra copies available to distribute to your judges. If you do decide to prepare a Project Abstract for use at SEFH, remember that it must not list your name, teacher, school, district or anything else that might serve to identify you. It should also be done neatly using proper grammar and punctuation. It should not contain more than 250 words. A sample abstract is shown below. Project Abstracts for the State SEF and the Intel ISEF require the use of a special form; however, they are also limited to 250 words.

A SOLUTION TO POLLUTION: ENERGY FROM WASTE MATERIALS

Sewage sludge and solid wastes are an unavoidable by product of modern society. High disposal costs for these waste materials, coupled with a projected increase in waste production over the next decade, form a serious problem. This experiment was aimed at contributing to a partial solution of the waste disposal and energy shortage enigma.

For this experiment, sewage sludge, wood and sludge/wood mixture were pyrolyzed in a batch reactor to produce oil. The production rates of oil were compared for the three materials. The average production rates of oil from all materials were excellent. The boiling range of the wood-derived oil proved to be slightly better than that of the sludge-derived oil, with the sludge/wood-derived oil being intermediate.

Sludge, waste wood and sludge/solid waste pyrolysis should be economically attractive, as the feedstocks are both renewable and inexpensive. Plant attractiveness is increased when the costs of alternate methods of waste disposal are taken into account.

In general, an abstract should include the following:

(a) purpose of the experiment

- An introductory statement of the reason for investigating the topic of the project.
- A statement of the problem and/or hypothesis being studied.

(b) procedures used

- A summarization of the key points and an overview of how the investigation was conducted.
- An abstract does not give details about the materials used unless it greatly influenced the procedure or had to be developed to do the investigation.
- An abstract should only include procedures done by the student. Work done by a mentor (such as surgical procedures) or work done prior to student involvement should not be included.

(c) data

This section should provide key results that lead directly to the conclusions you have drawn. It should not give too many details about the results nor include tables or graphs.

(d) conclusions

- Conclusions from the investigation should be described briefly.
- The summary paragraph should reflect on the process and possibly state some applications and extensions of the investigation.

The abstract **should not include:**

- a) acknowledgements (including naming the research institution and/or mentor with which you were working),
or
- b) work or procedures done by a mentor or a supervisor.

Guidelines for Citing References

In general, the author of a scientific or technical document is responsible for providing complete and accurate references so that a reader may locate the original reference material. Cited references should relate directly to statements, illustrations, data and other material included in the document. The complete listing of references should follow the body of the text and should be numbered consecutively in the order in which they are mentioned. References located in the text, tables, and legends should be annotated at the point of use by Arabic numerals contained within parentheses – multiple cited references should be separated by a comma, for example (17, 19, 23). Finally, they should be single spaced.

Here are a few examples taken from the U.S. National Library of Medicine Uniform Resource Locator website at (http://www.nlm.nih.gov/bsd/uniform_requirements.html) Find the one resembling most the source you have to cite and use the example's format to construct your reference.

Books:

Individual author(s)

Murray PR, Rosenthal KS, Kobayashi GS, Pfaller MA. Medical microbiology. 4th ed. St. Louis: Mosby; 2002.

Editor(s) as author(s)

Gilstrap LC 3rd, Cunningham FG, VanDorsten JP, editors. Operative obstetrics. 2nd ed. New York: McGraw-Hill; 2002.

Organization(s) as author

Royal Adelaide Hospital; University of Adelaide, Department of Clinical Nursing. Compendium of nursing research and practice development, 1999-2000. Adelaide (Australia): Adelaide University; 2001.

Chapter in a book

Meltzer PS, Kallioniemi A, Trent JM. Chromosome alterations in human solid tumors. In: Vogelstein B, Kinzler KW, editors. The genetic basis of human cancer. New York: McGraw-Hill; 2002. p. 93-113.

Journals/Magazines:

Standard article

Halpern SD, Ubel PA, Caplan AL. Solid-organ transplantation in HIV-infected patients. N Engl J Med. 2002 Jul 25; 347:284-7.

No author given

21st century heart solution may have a sting in the tail. British Med J. 2002;325:184.

Organization as author

Diabetes Prevention Program Research Group. Hypertension, insulin, and proinsulin in participants with impaired glucose tolerance. Hypertension. 2002;40:679-86.

Article in a Journal supplement

Glauser TA. Integrating clinical trial data into clinical practice. Neurology. 2002;58(12 Suppl 7):S6-12.

Scientific or technical report

Yen GG (Oklahoma State University, School of Electrical and Computer Engineering, Stillwater, OK). Health monitoring on vibration signatures. Final report. Arlington (VA): Air Force Office of Scientific Research (US), Air Force Research Laboratory; 2002 Feb. Report No.: AFRLSRBLTR020123. Contract No.: F496209810049.

Other Published Material:

Newspaper article

Tynan T. Medical improvements lower homicide rate: study sees drop in assault rate. The Washington Post. 2002 Aug 12; Sect. A:2 (col. 4).

Dictionary and similar references

Dorland's illustrated medical dictionary. 29th ed. Philadelphia: W.B. Saunders; 2000. Filamin; p. 675.

Computer file

Renal system [computer program]. MS-DOS version. Edwardsville, KS: Medi-Sim; 1988.

Classical material

The Winter's Tale: act 5 scene 1, lines 13-16. The complete works of William Shakespeare. London: Rex, 1973.

Electronic Material:

CD-RomUI

Anderson SC, Poulsen KB. Anderson's electronic atlas of hematology [CD-ROM]. Philadelphia: Lippincott Williams & Wilkins; 2002.

Journal article on the internet

Jacobsen JW, Mulick JA, Schwartz AA. A history of facilitate communications: Science, pseudoscience, and antiscience: Science working group on facilitated communication. *Am Psychol* 1995;. 50: 750-65. Retrieved January 25, 1996, from the World Wide Web: <http://www.apa.org/journals/jacobson.html>

Homepage/Web site

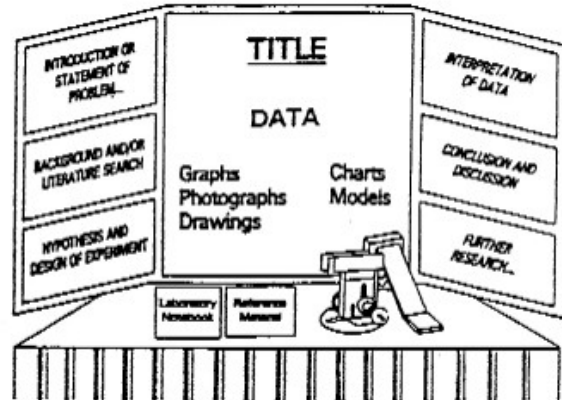
Cancer-Pain.org [homepage on the Internet]. New York: Association of Cancer Online Resources, Inc.; c2000-01 [updated 2002 May 16; cited 2002 Jul 9]. Available from: <http://www.cancer-pain.org>.

Database on the Internet

MeSH Browser [database on the Internet]. Bethesda (MD): National Library of Medicine (US); 2002- [cited 2003 June 10]. Meta-analysis; unique ID: D015201; [about 3 p.] Available from: <http://www.nlm.nih.gov/mesh/MBrowser.html> Files updated weekly

PROJECT DISPLAY

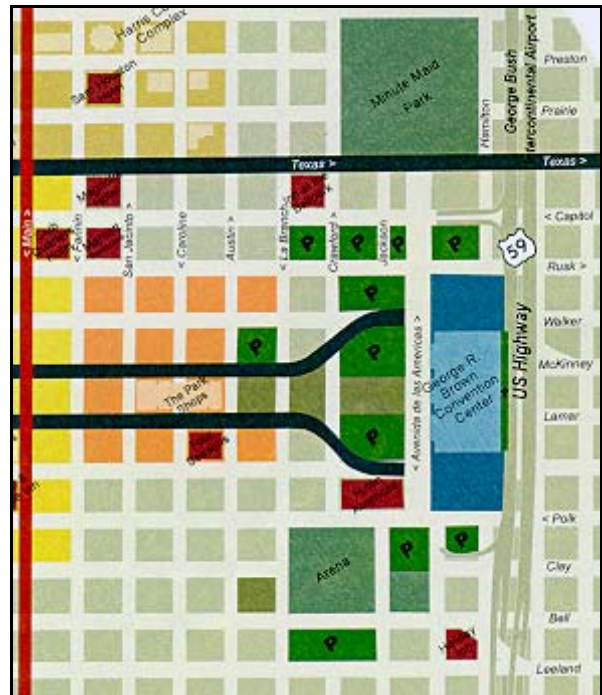
Prior to planning your display, be sure to carefully review the rules for project displays. How you display your material; the color scheme you use; your use of graphics, pictures, lettering, etc. will all be important as you try to make your display serve as a "silent" salesperson for your project. Where appropriate use the International System of Units (SI). Try to make your display a creative visual summary of your entire project. See display rule section for comments regarding photographs. **Everything** associated with your display must fit into the space allocated for your project, which is 76cm deep x 122 cm wide x 274cm high if floor mounted. Only use floor mounted projects for extra tall or extra heavy display boards and/or equipment. If table mounted, the height limit is still 274 cm, including the table which is about 76 cm high. Most display boards are constructed of plywood or foam core (gatorboard). A good source for display boards is www.showboard.com. Expensive equipment should only be displayed when it is necessary for explaining project results. If desired, videotapes or computer visualization of project action may be part of the display. An overnight check-in security room will be available at the fair.



This backboard example shows the type of information and material normally included in a project display

AT THE FAIR

Each year, in March, the SEFH is held at the George R. Brown Convention Center. Food Services, pay telephones, security guards, and a nurse are available during fair hours. **NO COMMERCIAL FOOD ORDERS** may be delivered or brought onto the fair site for consumption at the fair site. **NOTE THAT UNDER NO CIRCUMSTANCES ARE STUDENTS ALLOWED TO REMOVE THEIR PROJECTS UNTIL AFTER THE CLOSE OF THE AWARDS CEREMONY ON SATURDAY.**



DRIVING DIRECTIONS - 1001 Avenida de las Americas 77010

I-45 SOUTH	Coming from Dallas, Conroe, The Woodlands, Bush Intercontinental Airport Take I-45 South > to I-10 East > to US-59 South (exit #770A) > exit Downtown Destinations-Hamilton Street > right on Capitol Street > left on Avenida de las Americas.
I-45 NORTH	Coming from Galveston, NASA, Clear Lake, Houston Hobby Airport Take I-45 North > exit Downtown Destinations (exit #45) > exit Pease Street > right on Chartres Street > left on Polk Street > right on Avenida de las Americas.
US-59 SOUTH	Coming from Kingwood, Humble, Bush Intercontinental Airport Take US-59 South > exit Downtown Destinations-Jackson Street > left on Franklin Street > right on Hamilton Street > right on Capitol Street > left on Avenida de las Americas.
US-59 NORTH	Coming from the Galleria, Missouri City, First Colony, Sugar Land Take US-59 North > exit Downtown Destinations-Polk Street > left on Polk Street > right on Avenida de las Americas.
I-10 WEST	Coming from Baytown, Channelview, New Orleans Take I-10 West > to US-59 South (exit #770A) > exit Downtown Destinations-Hamilton Street > right on Capitol Street > left on Avenida de las Americas.
I-10 EAST	Coming from Katy, San Antonio Take I-10 East > to 59 South (exit #770A) > exit Downtown Destinations-Hamilton Street > right on Capitol Street > left on Avenida de las Americas.
SH-288 NORTH	Coming from Pearland, South Loop, Reliant Park Take SH-288 North > to US-59 North > exit Downtown Destinations-Polk Street > left on Polk Street > right on Avenida de las Americas.
SH-290 EAST	Coming from Austin, Copperfield Take SH-290 East > to Loop 610 South > to I-10 East > to US-59 South (exit #770A) > exit Downtown Destinations-Hamilton Street > right on Capitol Street > left on Avenida de las Americas.

PARKING INFO

The George R. Brown features a 1600-space parking garage located at the corner of Polk Street and Avenida de las Americas. Conveniently connected to the GRB and the Hilton by Level 2 skywalks, parking couldn't be easier.

In early September, 2006, crews started work on an 12-acre downtown park located directly across from the convention center. As a result, two of the parking lots once found in the front of the building are no more. Expected to be completed in early 2008, the multi-purpose park will include a 650-car underground parking garage.

NORTH	Parking is available in lots one block from the GRBCC on Rusk Street.
SOUTH	Parking is available in the 1600-space Hilton Americas-Houston parking garage, as well as lots near the Holiday Inn Express on Chenevert Street.
EAST	Chinatown is located just east of the GRBCC and Highway 59. There are several parking lots open to the public, in addition to street parking.
WEST	Several lots are located between the GRB and the Four Seasons Hotel/Houston Center. Houston Center has multiple parking garages available for convention center parking.

Judging Criteria & Procedures

PROCEDURES

All Exhibits will be judged in one of three divisions: the Junior/Middle School (7th and 8th grades); the Ninth (9th grade); and the Senior (10, 11, & 12th grades) Divisions. Team Projects are allowed to compete in all divisions. Each division is subdivided into subject classifications such as chemistry, engineering, zoology, botany, etc. Prior to judging, all project displays must be inspected and approved by the Rules/Safety Committee and the Scientific Review Committee on Thursday evening. Projects not approved must be removed from the Exhibition Hall prior to judging.

The judging process takes place in three phases. Phase I occurs during the morning of the judging day and involves only judges for the SEFH place awards. All exhibits are visited individually by the members of a judging team. During the judging interview judge will normally ask the exhibitor to present a 3-5 minute description of the project. This will be followed by a series of specific questions by the judges. The exhibitor may also ask questions and seek advice from the judges at this point. Each judge should obtain all the information necessary to make a professional evaluation of each criterion listed on the project scoring sheet. After completing these interviews, the judges will gather as a team to discuss their findings and arrive at their own ranking of the projects. Each judge "normalizes" his/her scores by assigning a score of 100 to the top-ranked project, 95 to the second-ranked project, etc. The team captain compiles the judges' normalized scores and delivers the collective rankings to the category coordinator. The coordinator and team captain will then decide which projects will advance to Phase II judging.

During Phase II, the SEFH place award judging for almost 200 awards continues and the Special Award judging begins. The 80-90 special awarding agencies may or may not all use the SEFH judging sheets. Some agencies will judge just projects in particular categories while others will be interested in all categories. They determine their own judging criteria, procedures and awards. SEFH place award judging continues in the same manner as Phase I; however, different judges may be involved. Place award judges meet during and after Phase II to determine the place awards for each division and category. Normally no scores are tabulated for this process; rather, the judges arrive at their rankings through in-depth discussions and by consensus.

During Phase III (held in the early evening), Special award judging continues and the SEFH category coordinators (or their deputies) meet with the judging chair to evaluate the first place award winners in each of the three divisions. These judges normally work in small teams so that a wide spectrum of expertise can be brought to bear during each interview. After the teams complete their interviews, the overall division award winners; 3 for the Junior/Middle School Division, 3 for the Ninth Grade Division and 4 for the Senior Division are determined. Also during Phase III, the special award judging for approximately 400 awards is concluded.

Throughout the judging process judges must not attempt to learn the student's name, their school, or the name of their advisor. Such information may be requested from the category coordinator after the judging is complete. Judges are free to introduce themselves and identify their affiliation (in fact, the badge worn by each judge should contain this information), but the anonymity of the exhibitors must be preserved. In addition, judges must be aware that eager ears are listening to their conversations with other judges. Thus, judges are encouraged to interact as little as possible in the exhibit area and to retire to the judging auditorium to discuss the projects. The official scoring sheets and other notes kept by judges should be concealed while in the exhibit area. After each judging phase, the scoring sheets and any notes taken by judges will be collected and destroyed.

All judging results are confidential and will be known only to the judges involved in the decision and the officials of the fair until they are publicly announced at the awards ceremony held on the day following the judging.

CRITERIA

The **Official Scoring Sheet** contains a complete summary of the criteria to be used by the judges in evaluating each project. The sheet is deliberately detailed to provide guidance for judges as well as for exhibitors and to insure that the judging process is carried out as equitably as possible.

A careful study of the official scoring sheet is critical. The salient points to be assessed by each judge have been broadly divided into five categories: objectives, design, execution, conclusions, and presentation. Note that it is not essential for a project to be completely original. It is essential; however, for the student to clearly acknowledge the

source(s) of ideas that went into his or her project. Appropriate recognition will be given to those projects that do contain clearly original ideas and that demonstrate the student's creativity - both in the genesis and the execution of the project. Judges will ascertain whether the student has applied the proper scientific and/or engineering principles in the design and execution of the experiment and carried out their data collection and analysis in a systematic manner. The project's conclusions should follow logically from the data analysis and reflect careful consideration by the student of possible errors in the experiment. Finally, judges will evaluate the quality of the student's presentation. Note that a student who fails to keep their presentation within the time limits set by the judge may be scored appropriately. Judges are prepared to hear very polished presentations from the more experienced students. Judges will go beyond the student's prepared presentation by posing questions that can determine the student's level of understanding of the principles underlying their project. Students who do not have a good understanding of the science/engineering related to their projects will be downgraded accordingly by the judges.

**SCIENCE ENGINEERING FAIR OF HOUSTON
SCORING SHEET FOR INDIVIDUAL PROJECTS**

A copy of the scoring sheet used for the SEFH place award judging of individual projects is shown below. Special Award judges may or may not use a similar scoring method since the nature and purpose of their awards varies from agency to agency.

PROJECT TITLE _____ PROJECT NO. _____

JUDGING PHASE _____ JUDGE _____ JUDGING TEAM _____

ASSIGN A MAXIMUM SCORE OF 10 POINTS IN EACH CATEGORY BELOW

PROJECT OBJECTIVES	1. Creativity and originality	
	2. Clear statement of objectives; identification of all relevant variables	
PROJECT DESIGN	3. Creativity and originality	
	4. Knowledge and understanding by each team member of the scientific or engineering principles relevant to the project	
	5. Adequacy of scientific or engineering approach used; use of relevant literature	
PROJECT EXECUTION	6. Thoroughness of experimentation or development used to reach objectives; proper recording of data in laboratory notebook	
	7. Level of skills and effort used by the student to carry out the project; amount of work done by the student; understanding of equipment or techniques used to obtain data.	
PROJECT CONCLUSIONS	8. Conclusions consistent with the data obtained and with the relevant principles of science or engineering (if not, is there an adequate explanation of the inconsistency)	
PROJECT PRESENTATION	9. Quality and coherence of the oral presentation within the time allotted (usually about 5-10 minutes)	
	10. Quality and clarity of the display, including the organization and presentation of data	
	TOTAL SCORE (maximum = 100)	
Obtain normalized score by ranking projects according to total score and assigning a normalized score of 100 to the first project, 95 to the second, etc.		
NORMALIZED SCORE		

- NOTES:**
- Projects continued from previous year(s) should be clearly identified as such with a Roman numeral at the end of the project title. For example--"Pollution in Lake Houston, II" would indicate a continuing project being entered in the fair for the second time. These projects should be judged only on what has been done since the last fair.
 - Judges should not solicit any information from an entrant that would identify the student, their sponsor, or their school. If such information is required, the judge should contact the judging chairman.

COMMENTS:

**SCIENCE ENGINEERING FAIR OF HOUSTON
SCORING SHEET FOR TEAM PROJECTS**

A copy of the scoring sheet used for the SEFH place award judging of individual projects is shown below. Special Award judges may or may not use a similar scoring method since the nature and purpose of their awards varies from agency to agency.

PROJECT TITLE _____ PROJECT NO. _____

NO. OF STUDENTS ON TEAM ____ NO. OF STUDENTS PRESENT FOR JUDGING ____

JUDGING PHASE ____ JUDGE _____ JUDGING TEAM _____

ASSIGN A MAXIMUM SCORE OF 10 POINTS IN EACH CATEGORY BELOW:

PROJECT OBJECTIVES	1. Creativity and originality	
	2. Clear statement of objectives; identification of all relevant variables	
PROJECT DESIGN	3. Creativity and originality	
PROJECT EXECUTION	4. Knowledge and understanding by each team member of the scientific or engineering principles relevant to the project.	
	5. Adequacy of scientific or engineering approach used; use of relevant literature	
	6. Thoroughness of experimentation or development used to reach objectives; proper recording of data in laboratory notebook	
PROJECT CONCLUSIONS	7. Level of skills and effort used by each team member; understanding of equipment or techniques used to obtain data on the part of each team member; appropriate division of responsibility within the team	
	8. Conclusions consistent with the data obtained and with the relevant principles of science or engineering; (if not, is there an adequate explanation of the inconsistency)	
PROJECT PRESENTATION	9. Quality and coherence of the oral presentation by the team members within the time allotted (about 3-5 minutes)	
	10. Quality and clarity of the display, including the organization and presentation of data	
	TOTAL SCORE (maximum = 100)	
Obtain normalized score by ranking projects according to raw score and assigning a normalized score of 100 to the first project, 95 to the second, etc.		
NORMALIZED SCORE		

- NOTES:**
- Projects continued from previous year(s) should be clearly identified as such with a Roman numeral at the end of the project title. For example -- "Pollution in Lake Houston, II" would indicate a continuing project being entered in the fair for the second time. These projects should be judged only on what has been done since the last fair.
 - Judges should not solicit any information from an entrant that would identify the student, their sponsor, or their school. If such information is required, the judge should contact the judging chairman.

COMMENTS:

SEFH POSTER DESIGN CONTEST
For the 50th Science Engineering Fair of Houston

(See Entry Form Below)

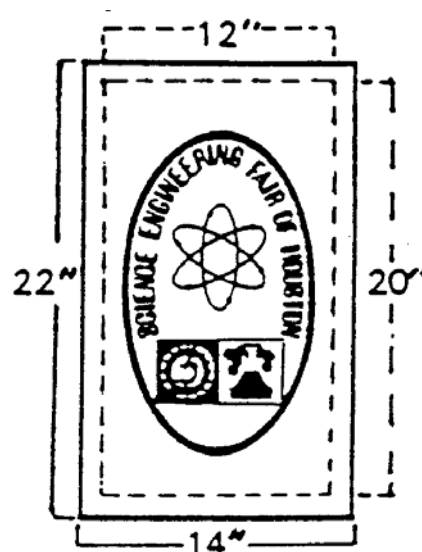
The major objective of the SEFH Poster Design Contest is to encourage students to think about science and engineering in an artistic way, and to create imaginative interpretations of the substance of science and engineering. Each year, a First Place poster will be selected in the Spring and used as the official fair cover art for publications, posters, patches, and T-shirts the following year. Three place awards and several honorable mention awards will be given. For this competition the winning poster will receive a \$1,000 scholarship. The awards will be presented at the 2008 SEFH Awards Ceremony. Entered posters will be displayed at the George R. Brown Convention Center during the fair.

ELIGIBILITY

Students in grades 7 through 12 currently enrolled in public and non-public schools as full-time students, in the 16-county fair region, are eligible to enter. Each entering student may submit one self-made poster(s) not copied from other sources. There is no limit on the number of entries that can be submitted from a particular school.

POSTER SPECIFICATIONS

Media must consist of poster board and any combination of ink or paint. Pencil or charcoal is not allowed. The design must be ready for reproduction. For this contest, three colors should be used: black, blue, and gold. Shades of black and gray count as a single color. White is not counted as a color and may also be used. Shades of any other color will count as multiple colors depending on the number of shades used. Poster size must be 14" x 22" with a 1" margin on each side. The size of the artwork will be contained within a 12" x 20" space; a vertical design is required using the 14" side as the base. The 1" margins are for printing purposes. Do NOT mat, mount or frame the poster. The title, "The 50th Science Engineering Fair of Houston," must appear on the poster. When designing the poster, students should remember that the design will be used for brochures, posters, patches, and T-shirts. Thus, designs with a lot of fine detail work should be avoided. The theme should symbolize the Fair as an aid to education and depict one or more areas of mathematics, science or engineering. Bold, simple designs are encouraged.



JUDGING CRITERIA

Posters will be judged for creativity, scientific and technical accuracy, artistic skill and visual quality. All entries submitted must be original. Copying is not acceptable. Computer generated work is permissible if it is original. Work copied from published photographs, magazines, book illustrations, or other artwork cannot be submitted.

SUBMITTING ENTRIES

A completed copy of the entry form must be taped to the backside of the poster. All posters from a school should be enclosed in a single wrapping paper package, marked with the name of the teacher & school, and either brought to the Fair Office or mailed to the SEFH Poster Contest, c/o UH-Downtown, Suite N-813, One Main St., Houston, Tx 77002. **All entries must be received by the deadline date (Thursday, February 7, 2008)** that is listed in the Calendar of Events. The Posters will be displayed in the lobby of the George R. Brown Convention Center – Hall E during the Fair. Posters (except for the First Place winning entry) may be picked up at the Information Booth at the fair, or at the Science Fair Office the week after the fair. **There is no entry fee.**

SEFH POSTER CONTEST ENTRY FORM

(Please type or print using blue or black ink)

Name _____ Grade _____ Home Phone _____
 Address _____ City _____ Zip Code _____
 School _____ Phone _____ Principal _____
 School Address _____ City _____ Zip Code _____

I hereby certify that this is my original work and that it is not copied from a published photograph, magazine, book illustration, or any other artwork. I understand that the Science Engineering Fair of Houston, Inc. is not responsible for loss, theft or damage and hereby grant the Fair permission to use my art for public display. If my poster is chosen for the First Place Award, I also give the Fair permission to make any modifications which improve the poster for reproduction and to utilize the poster, at no cost to the Fair, as cover art for publications and other materials describing the Fair. I hereby verify that to the best of my knowledge, this is an original artwork.

Student's Name _____ Parent/Guardian Signature _____
 Teacher's Name _____ Teacher's Signature _____

SCIENCE WRITING CONTEST

The Science Engineering Fair of Houston invites all participants in school or district level science fairs that are affiliated with SEFH to submit papers about their projects to the annual Science Writing Contest. Goals of the contest include the following:

- *To encourage development of analytical thinking and writing.
- *To recognize and reward excellence in technical writing.
- *To promote awareness of the importance of effective communication in science and technology.

Eligibility

If you are a participant in this year's SEFH or an SEFH affiliated school or district level science fair, you are eligible to submit a research paper and other materials you have prepared for your Science Fair project. Your project must adhere to the research and approval rules established by SEFH. Team projects are not eligible. There is no entry fee or entry quota for a school or district.

Awards

Winners will be recognized at the SEFH Awards Ceremony at the George R. Brown Convention Center. Students will be informed of their awards prior to the ceremony. First, Second, Third Place, and Honorable Mention awards, where appropriate, will be presented in each division. Winning entries in the Senior Division may be eligible for competition in the International Student Technical Writing Contest sponsored by the Society for Technical Communication. Previous SEFH winners have been very successful in this competition.

Preparation of the Entry

Discuss the format and content of the paper with your supervising teacher to satisfy particular requirements for your topic. An abstract and bibliography/reference list should be included. Credit to those who assisted you with your project, including individuals, businesses, educational or research institutions should be included in an Acknowledgments section. Reference notes are encouraged. Number all pages. In addition to the paper, you may submit any or all of the following supporting materials: graphics, illustrations, photographs, or sample programs. Be conservative in your use of color printing. Guidelines for Citing References are presented on the next page. Supporting materials enhance the communication process but should be relevant and clearly labeled. Since entries cannot be returned, you may want to make duplicate copies of the paper, as well as the supporting materials, if you intend to include them with your project display.

1. Type the paper, using double-spacing, on one side of good quality 8 1/2 inch by 11 inch paper.
2. Put the following information on a cover sheet, which will be removed prior to judging:

Name:	School Telephone Number:
Home Address and Zip Code:	Name of Principal:
Home Telephone Number:	Name of Supervising Teacher:
Grade Level:	Title of Paper:
School:	Purpose of Paper:
School Address and Zip Code:	Intended Audience:
3. Behind the cover sheet, put a title page, but do not include your name or other identifying information.
4. Staple your cover sheet, title page, abstract, paper, bibliography and supporting materials in the upper-left corner.
5. To assure impartial judging, please adhere to the following: (1) Do not put your name on any of the pages of the paper or supporting materials; (2) Do not identify your school, school district, principal, supervising teacher or parents on any of the pages, or make reference to them in the paper.

Submission of the Entry

Send the entry prior to the deadline date listed in the Calendar of Events to: **Dr. Aimee Roundtree, SEFH Science Writing Contest, c/o UH-Downtown, One Main Street, S-1063, Houston, TX 77002.**

Judging Criteria

A team composed of scientists and professional writers will review all of the entries, selecting winners for their clear statements of purpose; logical organization of writing and scientific argument; conciseness and consistency in word choice; relevance of the graphics to the text; skillful execution of the graphics; and competent use of grammar, spelling, and punctuation. See the last page for a copy of the judging sheet used by SEFH essay judges. These criteria were developed by the international contest to which the top three winners of the SEFH Senior division essay contest will be submitted.

For more information about the Science Writing Contest, contact Dr. Aimee Roundtree at (713) 221-5315 or by e-mail at kendalla@uhd.edu.

See page 47 for Citing Reference Guidelines

Paper Title: _____

Judging Sheet

Objective Tone - does not inject unsubstantiated opinion

Score: 0 -5 _____

Purpose - thesis of entry is clearly stated

Score: 0 -10 _____

Significance/Audience - explains significance of topic to audience

Score: 0 -10 _____

Organization - structure of the entry is clear; conclusions are adequately supported; pages are numbered

Score: 0 -10 _____

Focused Writing - uses active voice, doesn't ramble

Score: 0 -5 _____

Word Choice - uses appropriate, precise word choice

Score: 0 -5 _____

Standard Usage - uses proper grammar, spelling, and punctuation

Score: 0 -5 _____

References - uses references, footnotes, bibliography, and links appropriately; attributes sources

Score: 0 - 10 _____

Graphics - graphics are clear and comprehensible

Score: 0 -5 _____

Effectiveness - the whole entry is effective in its purpose for its audience

Score: 0 - 10 _____

TOTAL _____