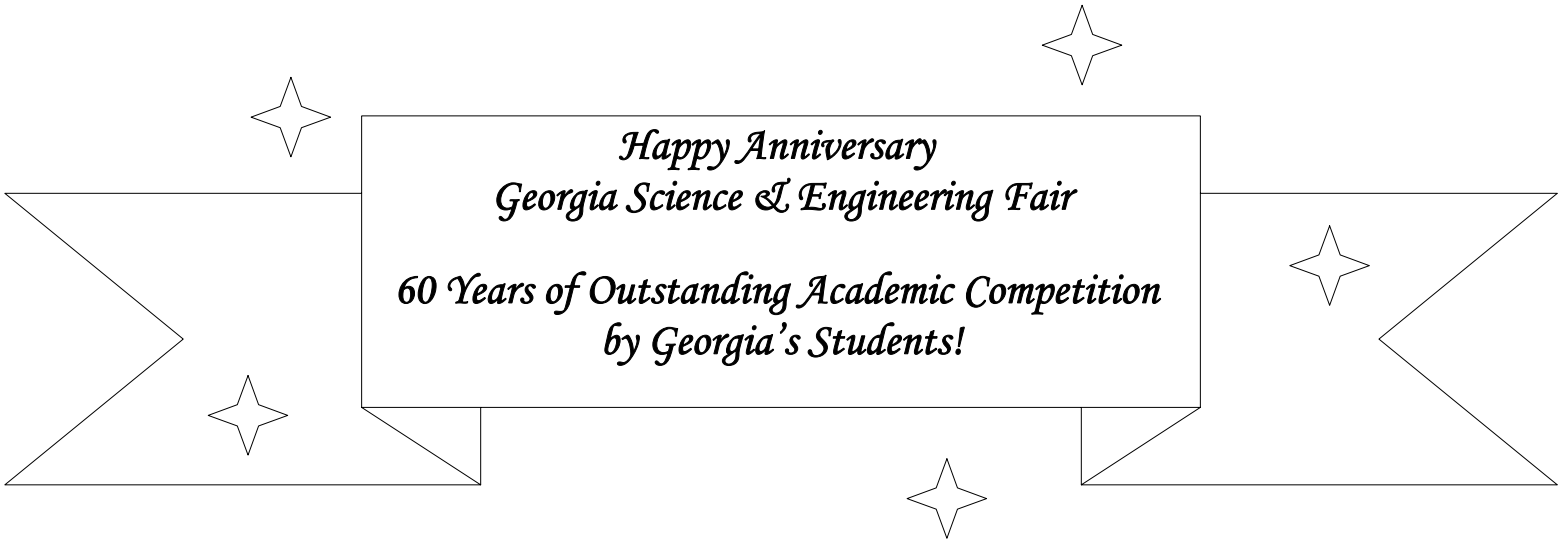
Georgia Science & Engineering Fair

INTEL International Science And Engineering Fair

2008 Rules for Precollege Science Research



Office of Academic Special Programs
Pre-Collegiate Academic Outreach and Training
The University of Georgia
Athens, GA 30602
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Section I

GSEF Rules and Regulations

Student Research Tips & Guidelines

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Table of Contents

Section I Georgia Regulations and Information

Acknowledgments

Teachers, scientists, parents, and adult volunteers inspire and encourage students to explore and investigate their world through hands-on research. Those of you who work with these young people are rarely recognized and can never be adequately thanked. Without you science projects and science fairs would not be possible.

The Georgia Science and Engineering Fair and Science Service applaud your commitment and appreciate your hard work. We sincerely hope that our efforts to enhance the Rules will serve you in working with students.

Important Dates

October 5, 2007	Deadline for GSEF Regional Fairs to return GSEF affiliation papers
November 1, 2007	Quotas and Applications will be sent to all Regional affiliated fairs if all fair affiliation papers are received on time.
March 1, 2008	**Last date a GSEF Regional Fair may be held**. If held on this date, ALL COMPLETED PAPERWORK will be due in the GSEF office by 5:00 PM on Wednesday, March 5. No exceptions can be made.
March 5, 2008	**DEADLINE FOR ALL APPLICATIONS** to be received from Regional Fair Directors for the 60th Georgia Science & Engineering Fair. REGIONAL FAIR DIRECTORS MUST MAIL ALL OF THEIR STUDENTS' APPLICATIONS TO US IN ONE PACKET. (**No exceptions will be made to this deadline due to short turn around time!)**

Future GSEF Dates

~ Dates are subject to change ~

April 2-5, 2008 Athens Classic Center, Athens, Georgia
April 1-4, 2009 Athens Classic Center, Athens, Georgia

Future ISEF Fairs

Atlanta, Georgia, May 11–17, 2008
Reno, Nevada, May 10 –16, 2009
San Jose, California, May 9 –15, 2010

What is the Science and Engineering Fair?

The Georgia Science and Engineering Fair (GSEF) is one of a number of learning experiences that help young people meet the challenges of the future. It provides a stage from which the junior high and high school students of Georgia can demonstrate their serious contributions to the advancement of society and our way of life.

By participating in the Fair, students learn how to isolate important problems and how to attack and hopefully solve problems all within the framework of organized, logical thought and study. The local science fair provides the initial opportunity for students to exhibit their research projects. If the projects show merit, they may be entered in a district fair. First and some second place winners in district fairs are then eligible to be invited to compete in the GSEF.

At all of these fairs, the student's work is judged by professional scientists who look not only for an attractive functional presentation, but more importantly for the contribution the work has made to new information and for the basic understanding the students have of their research. Please keep in mind that in any competition there is always a small degree of subjectivity and inadvertent inequities may occur in judging. Please remember the decisions of the judges are final.

We hope that you will participate in the 60th Georgia Science and Engineering Fair and that this experience will encourage you to help meet the challenges of tomorrow. Should you wish to have a copy of this book please visit our website at www.uga.edu/oasp and print a copy. **Additional print copies are not available.**

2008 Georgia Science and Engineering Fair Members

Dr. Linda Adkison
Mercer University School of Medicine
Professor, Division of Medical Sciences

Dr. Joseph Hughes
Georgia Institute of Technology
Professor & Associate Chair
Electrical & Computer Engineering

Dr. Robert Matthews
University of Georgia
College of Agriculture & Environmental Science
Professor, Entomology Department

To Be Determined
GSEF SRC/IRB Chairperson

Mary Lue Walser
Georgia Junior Academy of Science
Executive Director

Gail Sinkule
Georgia Science Teacher's Association
President

Wendy Joiner
Georgia Science Teacher's Association
President-Elect

Dr. Steve Pruitt
Georgia State Department of Education
Curriculum Director

Barbara Ferguson
Georgia Council of Teachers of Mathematics
President

OASP Contact: Rachel Ogg, Program Director
Office of Academic Special Programs
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Athens, Georgia 30602

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Visit our web site: www.uga.edu/oasp

Georgia Policy on Regional Fairs:

All GSEF affiliated fairs must admit any eligible student regardless of school organization including: public, home, private, magnet and charter schools in accordance with state and federal laws. This assures equal access for all of Georgia's students. A student can only participate in one Regional Fair. If project involves a team then they must participate in the assigned Regional Fair of the designated "Team Leader".

Public Schoools - Must attend Regional Fair where school is located.
Private Schools - Student must attend Regional Fair where school is located.
Charter Schools - Must attend Regional Fair where school is located.
Home School - Must attend Regional Fair where place of residence is located.

No exceptions are allowed.

Please visit our website at www.uga.edu/oasp to see a complete listing of all Regional Fairs to find out which Regional Fair your county/school must attend.

GSEF Schedule of Events

~ This schedule is tentative and subject to change without notice ~

Wednesday, April 2, 2008

5:00 p.m. - 8:30 p.m. **Exhibit setup / Tour sign-up**- Exhibit Hall

Thursday, April 3, 2008

7:30 a.m. - 10:00 a.m. **Exhibit setup / Tour sign-up** - Exhibit Hall

10:00 a.m. - 1:30 p.m. **Judges' Initial Inspection of Exhibits** - Exhibit Hall
ONLY JUDGES AND OASP STAFF ARE PERMITTED IN THE EXHIBIT HALL. All materials to be used by Exhibitors during judging must be in place. Electrical items that can be operated in an unattended mode must be turned on at this time. Judges will review projects before students report to formal interviews beginning at 1:30 p.m.

10:00 a.m. - 1:30 p.m. **Exhibitors free time for lunch, hotel check-in, etc.**

1:30 p.m. - 4:30 p.m. **Exhibitors at Projects for Interviews** - Exhibit Hall
Round I interviews with Exhibitors. All Exhibitors should be at their exhibit. At this time students should be prepared to answer questions, ask questions and discuss their project with the judges. Exhibitors & Judges ONLY. **** Parents/chaperones, please designate a place on the EXTERIOR of the Classic Center to meet your student(s) after 6:30 p.m.*** **NO WAITING IN THE INTERIOR OF THE BUILDING IS PERMITTED DUE TO FIRE CODES.**

1:30 p.m. - 6:30 p.m. **Parents/chaperones free to explore downtown Athens**

4:00 p.m. - 4:30 p.m. **BREAK - Students should bring money for snacks.**
NO PARENTS/CHAPERONES WILL BE PERMITTED IN THE BUILDING AT THIS TIME DUE TO THE VOLUME OF STUDENTS WHO WILL BE IN THE HALLS - THIS IS A FIRE CODE ISSUE.

4:30 p.m. - 6:30 p.m. **Exhibitors at Projects for Interviews** - Exhibit Hall
Round 2 interviews with Exhibitors. All Exhibitors should be at their exhibit. At this time students should be prepared to answer questions, ask questions and discuss their project with the judges. Exhibitors & Judges ONLY.

6:30 p.m. **FREE TIME!**
Exhibitors and their parents/chaperones are free to enjoy dinner and explore Athens. Your commitment for the day is over.

Friday, April 4, 2008

9:00 a.m. - 7:00 p.m. **Exhibit Floor Open to the General Public**

9:00 a.m. - 4:00 p.m. **Tours**
For exhibitors/parents/teachers to visit various facilities of the University

4:00 p.m. **Free Time for the Remainder of the Evening**

Saturday, April 5, 2008

7:30 a.m. - 9:30 a.m. **Exhibit Floor Open to the General Public**

10:00 a.m. - 1:30 p.m. **Awards Ceremony** - *Classic Center Theatre*
Exhibits cannot be removed until the conclusion of the Awards Program

1:30 p.m. - 3:00 p.m. **Project Teardown**
All exhibits must be removed by 3:00 p.m. Any exhibits left in the Exhibit Hall will be removed by the clean-up crew. NO EXCEPTIONS WILL BE MADE.

Awards Program
Saturday, April 5

All of those interested in the Fair, including families and friends of participants, are invited to attend the Awards Ceremony to be held at the Classic Center Theatre. Awards will be announced at this time and special awards will be presented to exhibitors of meritorious projects. All awards must be picked up at the awards ceremony. They will not be mailed to participants. **If you cannot attend, please designate someone to pick up awards you might win and to remove your display.**

Grand Awards

Exhibitors of the most outstanding projects will be awarded *Grand Awards*. Of these, one each in the Biological Sciences, Physical Sciences and Team Projects of the Senior Division will receive expense paid trips to the 59th International Science and Engineering Fair in Atlanta, GA, May 2008.

PHOTO SESSION: Photos will be taken of Top Grand Awards, Junior Division Winners, State Recognition winners and ALL of Georgia's ISEF Representatives immediately following the ceremony.

Special Awards are given each year by government, professional, educational organizations, colleges, universities and individual sponsors. They provide internships, books, equipment grants, scientific field trips, certificates, scholarships and monetary awards to selected exhibitors and teachers. These awards are tentative and are subject to change until the selection is made during the Georgia Science and Engineering Fair based on the projects exhibited at the Fair. Current years' awards will be listed in the 60th Georgia Science and Engineering Fair Awards Program. We would like to thank the following for their support in the past:

Advanced Academy of Georgia - Science/creativity Award
American Association for Clinical Chemistry South East Region
American Cancer Society
American Chemical Society (Biochemistry) North East Georgia Section
American Chemical Society (Chemistry) North East Georgia Section
American Institute of Aeronautics & Astronautics- Atlanta Section
American Meteorological Society
American Proteins Inc. Award
American Society for Microbiology Southeastern Branch Award
American Society of Agricultural Engineering, Georgia Section
American Statistics Association Award, Atlanta Chapter
American Water Works Association - Georgia Section
ASM Young Materials Engineer Award
Armed Forces Communications & Electronics Association
Association for Women GeoScientists
Atlanta Gas Light Company - Vehicle Fuel Research Award
Atlanta Section Society of Automotive Engineers
BellSouth Telephone Company Award
Discover Life In America - GSMNP ATBI Award
Discovery Young Scientist Challenge Award
Eastman Kodak Company - Photographic Award
ECE Student/Faculty Committee of GA Tech Engineering Award
Emory University Chemistry Department Award
GAMES Student of Promise Award
Gamma Sigma Delta - UGA Chapter
Georgia Academy of Family Physician's TA Sappington Scholarship
Georgia Archaeology Award
Georgia Association of Plant Pathologist
Georgia Chapter, Soil & Water Conservation Society
Georgia Council of Teachers of Mathematics
Georgia Dental Association - Excellence In Science Award
Georgia DNR Environmental Protection Division's Environmental Awards
Georgia Environmental Health Association
Georgia Engineering Foundation Award
Georgia Geological Society - Atlanta Section
Georgia Institute of Industrial Engineering - Atlanta Chapter
Georgia Junior Academy of Science - Junior Grand Prize Awards
Georgia Pharmacy Association
Georgia Power Award
GSEF Grand Prize Awards - Senior Division & State Recognition
Georgia Seagrant Frederick A Kalber Memorial Award
Georgia Society of Professional Engineers
Georgia Speech, Hearing and Language Association
Georgia Tech School of Biology Awards - Microbiology & Molecular Biology
Georgia Tech School of Electrical & Computer Engineering Award
Georgia Textile Education Foundation, Inc.
Georgia Veterinary Medical Association
Georgia Veterinary Medical Auxiliary Association
Georgia Water & Pollution Control Association
Greater Atlanta Veterinary Medical Society
H.O. Lund Entomology Club
Herbert Hoover Young Engineer Award
Inspiring Excellence Merit Awards - students & teacher
Institute of Industrial Engineers - Northeast Georgia Chapter Award
Intel Excellence in Computer Science Award
Intel Excellence in Enviornmental Health and Safety Award
Iota Sigma Pi Promethium Chapter
Jackson EMC Leadership Award
Library & Internet Research Work Award
Medical Association of Georgia
Medical College of Georgia Award
Medical College of Georgia School of Nursing - Athens Award
Mercer University Chemistry Department
Mercer University Engineering School
Mercer University Environmental Science Program Award
Mercer University School of Medicine Award
MERIAL Biotechnology Award
MERIAL ISEF 9th Grade Student of Promise

NACE International Award
National Aeronautics and Space Administration
National Association of Biology Teachers
National Council of Teachers of Mathematics
National Youth Science Camp
NOAA-Gray's Reef National Marine Sanctuary
Phi Kappa Phi - UGA Chapter
Pi Alpha Excellence in Chemistry Award-Emory University
Scientific American Subscription Award
Sigma Delta Epsilon
Sigma Xi Society, Center for Disease Control Chapter
Sigma Xi Society, University of Georgia Chapter
Society for In Vitro Biology
Society of Automotive Engineers Award - Atlanta Section
Soil and Water Conservation Award - Georgia Chapter
Target Store Focus on Family Award
Textile Education Foundation Award
UGA Artificial Intelligence Program Award
UGA Beta Beta Beta Biological Honor Society
UGA Biological & Agriculture Engineering Design Competition Award
UGA College of Agriculture & Environmental Sciences
UGA College of Family & Consumer Sciences
UGA Department of Botany
UGA Department of Cellular Biology
UGA Department of Computer Science
UGA Department of Crop and Soil Sciences - Agronomic Awards
UGA Department of Food Science & Technology
UGA Department of Food Science-Roger Wood Foods Award
UGA Department of Geology - Geosciences Award
UGA Department of Mathematics
UGA Department of Microbiology
UGA Department of Physics & Astronomy
UGA Department of Statistics
UGA Eco-Reach Environmental Achievement Award
UGA Foundation Scholarships
UGA Warnell School of Forest Resources
US Air Force - Aerospace Achievement Award
US Army Award
US Department of Energy - General Award
US Department of Health and Human Services
US Environmental Protection Agency - Georgia Section Award
US Fish and Wildlife Service Recognition
US Metric Association
US Navy/Marine Corps
Yale Science & Engineering Association Inc.

Entrants in the GSEF compete for more than $50,000 in awards and prizes honoring best achievements in specific scientific areas.

2007 Junior Division Grand Awards

Biological Science

Winner: Carmina Escalante, Burney Harris Lyons MS

Physical Science

Winner: James Mummert, Richards MS

Team Project

Winners: Sean Brown and Andrew Hickman, Vickery Creek MS

Discovery Channel Young Scientist Challenge Award

Trevor Alexander
Miranda Braun
Sean Brown & Andrew Hickman
Priyanka Chatterjee & Pranam Chatterjee
Hannah Choi
Christina Dooley & Anisha Naidu
Carmina Escalante
Natalie Galbraith
Emily Harrington
William Horton
Lizzie Howell
Mary-Ann Ionascu
Christopher Jacobs
Brandon Jenson
Hayley Johnson
Justin Jones
Rahul Joshee
Eric Lau
Vania Lee
Jacqueline Liu
James Mummert
Rebekah Mura
Emily Pace
Parth Patel
Gabriel Pippas
Jacob Schindler
Christopher Sells
Faustine Sonon
Thomas Wilkason
Hannah Woosley

2007 Senior Division Grand Awards

Merial Biological Student of Promise ISEF Trip Observer Award
Winner: Andrew Zhang, North Oconee HS

Biological Science ISEF Trip Winners
Alternate: Diana Cai, North Oconee HS
Winner: Rajasree Roy, Chamblee Charter HS

Physical Science ISEF Trip Winners
Alternate: Andrew Zhang, North Oconee HS
Winner: Jonathan Walker, Berkman HS

Team Projects ISEF Trip Winners
Alternate: David Brew, Emma Fuchs, and Tabitha Kimbrell, Chestatee HS
Winner**:** Aaron Bullock and Ryan Young, Rockdale Magnet

Teacher Awards

Junior Division Teacher of Promise

Winners:	Amy Johnson, Burney Harris Lyons MS
	Lisa Skinner, Richards MS
	Catherine Bennett, Vickery Creek MS

Senior Division Teacher of Promise - ISEF Trip Award Winner

Winner:	Michelle Robinson, Jonesboro High School
Alternate:	Gina Bright, Johnson, City Middle School

Jackson EMC State Top 10 Awards

Aaron Bullock	Rockdale Magnet
Diana Cai	North Oconee HS
Carson Dance	Chamblee Charter HS
Yihe Dong	Cedar Shoals HS
Billy Dorminy	Sola Fide Home School
Katherine Dugan	Rockdale Magnet
Rajasree Roy	Chamblee Charter HS
Joseph Stunzi	Clarke Central HS
Jonathan Walker	Berkmar HS
Ryan Young	Rockdale Magnet

Georgia Science & Engineering Fair Pinnacle Award

Winner: Joseph Stunzi - Clarke Central High School

2007 ISEF Representatives

The students below represented Georgia at the 2007 Intel ISEF in Albuquerque in May 2007.

KELCY ANDERSON	MONROE HS
AARON BULLOCK & RYAN YOUNG	ROCKDALE MAGNET SCHOOL
JOY CHOI	PEACHTREE RIDGE HS
LAUREN COBB	COBB FAMILY EDUCATION
STEFAN COBURN	FAYETTE CO HS
CARSON DANCE	CHAMBLEE CHARTER HS
SHIREEN DHIR	HOUSTON COUNTY HS
YIHE DONG	CEDAR SHOALS HS
BILLY DORMINY	SOLA FIDE HOME SCHOOL
COURTNEY GRANT & NORRISA WILLIAMS	DUTCHTOWN HS
ZARIF HASAN	WESTOVER HS
KARI JACKSON	B.E. MAYS HS
RALPH JENNINGS III	SOUTHSIDE HS
EMMA KEARNEY & WILLIAM KEARNEY	MCINTOSH HS
JIMMY LE & ANIKET SHAH	BERKMAR HS
SUMAN NAG	BROOKWOOD HS
KATIE POWELL	WESTSIDE HS
JAKE REID	LAKESIDE HS
ILYA ROGERS	BRUNSWICK HS
RAJASREE ROY	CHAMBLEE CHARTER HS
SABA STOVALL	DUTCHTOWN HS
JOSEPH STUNZI	CLARKE CENTRAL HS
JONATHAN WALKER	BERKMAR HS
COLBY WILKASON	WARNER ROBINS HS
KYLE YAWN & ANDREW HULL	WARNER ROBINS HS
ALISON YOUMANS	SPALDING HS

Judging

Experienced judging is provided with the cooperation of the following:

Abraham Baldwin Agricultural College
Agnes Scott College
AFCEA - Atlanta chapter
Albany State University
American Water Works Association
Andrew College
Armstrong Atlantic State University
Athens Technical Institute
Atlanta Gas Light Company
Atlanta Meteorological Society
Atlanta Metropolitan College
Atlanta VA Medical Center
AT&T Bell Laboratories
Augusta State University
Bainbridge College
BellSouth
Belmont Associates/USDA
Berry College
Brenau College
Carrier Transicold
Centers for Disease Control
Chattahoochee Technical Institute
Clark Atlanta University
Clayton State College
Colquit County School System
Columbus State University
Conklin Instrument Corporation
Consolidated Planning Corporation
Dalton College
Darton College
Delta Environmental Consultants
Devry Institute of Technology
Dougherty Co BOE
Earth Systems Association
East Georgia College
ECC America/Anglo American Clays Corp.
Emmanuel College
Emory University/Hospital
Fernbank Science Center
Floyd College
Fort Valley State University
Gainesville College
General Time
Georgia College & State University
Georgia Dental Association
Georgia Dept. of Education
Georgia Dept. of Natural Resources
Georgia DNR-Water Protection Branch
Georgia Environmental Protection Agency
Georgia Institute of Technology
Georgia Microscopical Society
Georgia Natural Gas Company
Georgia - Pacific Corporation
Georgia Perimeter College
Georgia Power Company
Georgia Soil & Water Conservation
Georgia Southern University
Georgia Southwestern State University
Georgia State University
Georgia Tech CEISMC
Georgia Tech Research Institute
Georgia Water & Pollution Control
Georgia Youth Science & Technology Center
Georgia Tech Research Institute
Gwinnett Area Technical School
Gwinnett Co BOE
Gwinnett Co Public Utilities
Gwinnett Hospital System
Gwinnett Medical Center
Henry Co BOE
Internet Security System Inc
Jackson EMC
Jefferson Co BOE
Kendall Company
Kennesaw State University
Kimberly-Clark Corporation

Lanier Museum of Natural History
Law Environmental Inc. Lithia Springs
School System M R Chasman & Associates P C
Macon College
McNiel Specialty Products & Co
Medical Center of Central Georgia
Medical College of Georgia
MCG School of Nursing-Athens
Mercer University
Mercer University-Atlanta
Merck & Co Inc
Middle Georgia College
Milligan Science Research Institute
Moultrie School System
Morehouse College
Morris Brown College
MVA Incorporated
N–Con Systems Company, Inc.
National Weather Service
Nitrogen Plus Inc of NC
NOAA-Grays Reef Sanctuary
Noramco Incorporated
North Georgia College & St University
Oglethorpe University
Paine College
Piedmont College
Pioneer RESA
Promina Cobb Hospital
Rhone Merieux Inc.
Rolls-Royce Inc
Roy F Weston Inc
Russell Research Center
S Ltech Inc.
Savannah State University
Society of Automotive Engineers
Soil & Water Conservation Society
South Georgia College
Southern Polytechnic State University
Spelman College
Spray Control Systems Inc.
Stiber Technical Illustrations
Technical Applications Inc.
TRW Inc.
University of Georgia
USACIL-CONUS
US Air Force
US Army
US Customs
USDA-Agriculture Research Service
USDA-Food Safety & Inspection Service
USDA-Forest Service
USDA-Soil Conservation Service
USDA-Southern Poultry Research Laboratory
USDA-Agricultural Research Service
USDA-Southern Piedmont Research
US Environmental Protection Agency
US Fish & Wildlife Service
US Marines
US National Weather Service
US Navy
USPHS Office/Surgeon General
Valdosta State University
Weather Data Plus
Weslyan College
Westinghouse/ABB
West Georgia State University
Westclox Inc.
Young Harris College

Tours

There will be organized tours of various campus buildings, departments and local companies on Friday, March 30, from 9:00 a.m. to 4:00 p.m. Visitors are welcome in buildings at other times, but these special tours will offer opportunities to visit areas not always open to the general public.

The tours may include:

Aerospace Studies
Ag & Applied Economics Tour
Army ROTC
Animal & Dairy Science Department
Artificial Intelligence Center
Avian Medicine
Astronomy Department
Biochemistry & Molecular Biology Dept
Biological & Agricultural Engineering
Botany Department - Green Houses & Herbarium
Center for Ultrastructural Research
Chemistry Department
Climatology Research Laboratory
Cognitive Primatology
College of Family & Consumer Sciences
College of Veterinary Medicine
Complex Carbohydrate Research Center
Computer Science Department
Entomology - "Insect Zoo"
Exercise Science & Aging
Food Science & Technology
Foods & Nutrition Assessment Lab
Genetics and Demography Lab
Geography Department
Geology Department
Georgia Museum of Art
Georgia Museum of Natural History
Gerontology Center
Institute of Ecology
Livestock & Poultry Department
Mathematics Department
Medical College of Georgia School of Nursing
Microbiology Department - "Bacteria Zoo"
Molecular Graphics Lab
Pharmaceutical & Biomedical Sciences
Physics & Astronomy Department
Plant Pathology
Poultry Science
Psychology Department
Ramsey Student Activities Center
Rhizotron - Crop and Soil Sciences Department
Textiles, Merchandising and Interiors Dept.
The State Botanical Gardens
University Health Center
Vision Lab
Warnell School of Forest Resources

GSEF Housing Information

Teachers, sponsors, parents, and groups of students with their chaperons **MUST MAKE THEIR OWN RESERVATIONS** at hotels in the Athens area. Reservations at commercial establishments will not be handled through any Fair personnel. The following is a list of area establishments. You should make your reservations as soon as you know you will be attending the GSEF as hotels will fill up very quickly. When making reservations mention the Georgia Science and Engineering Fair for any available reduced rates.

Local Accommodations

Comfort Inn	(706) 227-9700
Comfort Suites	(706) 995-4000
Courtyard by Marriott	(706) 369-7000
Foundry Park Inn	(706) 549-7020
Georgia Center	(706) 542-1181
Georgia Gameday Center	(706) 583-4500
Hampton Inn	(706) 548-9600
Hilton Garden Inn	(706) 353-6800
Holiday Inn	(706) 549-4433
Holiday Inn Express	(706) 546-8122
Howard Johnson	(706) 548-1111
Suburban Lodge	(706) 208-8812
Super 8 Motel	(706) 549-0251

Project Research Tips

Goals of Science Research

Research is the process by which people create new knowledge about themselves or the world in which they live in order to answer a question or solve a problem. Consider this:

Questioning is probably the most important part of scientific creativity and is often followed by an "if....then" statement. Questioning usually leads to experiments or observations.

Good scientists, both young and old, use a process to study what they see in the world. The six stages listed below will help you produce a good scientific experiment:

1) Be curious, choose a limited subject, ask a question; identify or originate/define a problem.

2) Review published materials related to your problem or question.

3) Evaluate the results of your experiment and reach conclusions based on your data.

4) Challenge and test your hypothesis through experimentation (data collection) and analysis.

5) Evaluate the results of your experiment and reach conclusions.

6) Prepare your report and exhibit.

SCIENCE = RESEARCH

Reduce to feasible test
Refute Hypothesis, if possible
Replicate to verify repeatability

Students should learn to be skeptical of all research results, especially their own. A good experiment may or may not answer the questions asked, but almost always leads to fresh questions requiring new experiments or observations. The experimental hypothesis is often developed after one has run a number of preliminary experiments, analyzed a body of results, and reached a tentative conclusion for your experiment.

Goals of Engineering

Scientists try to understand how nature works, engineers create things that never were. An engineering project should state the engineering goals, the developmental process and the evaluation of improvements. Engineering projects may include the following steps:

1) Define a need
2) Develop design criteria
3) Search literature to see what has already been done
4) Prepare preliminary designs
5) Build and test a prototype
6) Retest and redesign as necessary

ENGINEERING = DO

Determine needs and define problems
Develop alternatives and select best
Deploy solutions and evaluate

Pre-Approval for your project ?

1. SRC (Scientific Review Committee) if your project involves humans, animals, pathogens, controlled substances, recombinant DNA, or tissue.

The SRC is made up of at least 3 members:

- a science teacher
- a doctor or scientist
- an animal care specialist

2. IRB (Institutional Review Board) if your project involves **human subjects**.

The IRB can be the same committee as the SRC but must also have:

- a school administrator
- a psychologist, psychiatrist, medical doctor, or nurse

<u>Eligibility</u>

Projects will be eligible for exhibition at the Georgia Science and Engineering Fair only if they have won recognition and were selected by a GSEF affiliated fair. However, winners from regional fairs are not automatically accepted due to quota limitations. Grades 9-12 will be in the Senior Division and grades 6-8 will be in the Junior Division with only first or second place winners eligible to be invited. Each ISEF affiliated fair may send up to two finalists and one team project to the International Science and Engineering Fair. Only grades 9-12 are eligible for the International Science and Engineering Fair.

The Science Fair Timeline

This list will help you organize your time for your local fair. Detailed information is on our website.

***12 weeks before the fair* (or sooner!)**

Pick Your Topic - Ideas come from hobbies, interests, or problems needing solutions. Limit your topic to concentrate your time and resources. Many ideas are available through books and web sites.

Study Your Topic - Go to the library, talk to professionals in the field, write to companies for information, obtain or construct needed equipment, arrange where you will work (research lab, school, other) and who will supervise your work, if necessary.

Organize and Theorize - Organize everything you have learned about your topic. Narrow down your hypothesis by focusing on a particular idea.

Write out a Research Plan - This plan includes Problem, Hypothesis, Procedures, and Bibliography. It should explain how you will do your experiment before you begin and exactly what it will involve.

Obtain Your Forms - Complete necessary forms *before* experimentation. Obtain all signatures.

ALL STUDENTS need:

Checklist for Adult Sponsor (1)
Research Plan (1A) + written research plan
Approval Form (1B)
Abstract Form

Consult with your Adult Sponsor. Get all needed signatures and additional forms you may need.

***9 weeks before the fair* (or sooner!)**

Begin Experimentation - Keep detailed notes of every experiment, measurement, and observation **in ink in a bound log book**. Remember your control and experimental groups must have at least 5 test subjects in each.

4 weeks before the fair

Examine Your Results - Examine and organize your findings. Statistically analyze your data and organize your results into charts and graphs.

Draw Conclusions - Did your experimentation support your hypothesis? Discuss this, any problems you had, and future plans.

3 weeks before the fair

Write Your Abstract - Your abstract is a summary of your research using 250 words or less, on *Official Abstract Form*.

Prepare Your Report - Your written report is a *complete* discussion of your research including your problem, hypothesis, materials, procedures, results, graphs, charts, conclusions, acknowledgments, and bibliography.

Prepare Your Display - Attractive, simple, informative. Follow the Official GSEF/ISEF Rulebook for size and display safety limitations.

School Prescription for Successful Science Research Projects

1. **The School or sponsoring institution is REQUIRED to form a Scientific Review Committee (SRC) made up of a Biomedical Scientist (PhD, MD, DDS, or DO), a Science Teacher, and an Animal Care Specialist.**
   - to PRE-approve experimental procedures of projects involving human subjects, nonhuman vertebrates, pathogens, controlled substances, recombinant DNA, and human/animal tissue.
   - to POST-review procedures and safety rules for above projects.
   - to review all remaining projects to make sure students followed applicable rules.
2. **The School or sponsoring institution must provide an Institutional Review Board (IRB) made up of a science teacher, a school administrator, and one of the following: a psychologist, psychiatrist, medical doctor, physician's assistant, or registered nurse.** *This committee may be combined with the SRC to form one Review Committee for all projects just by adding one person from the list of human subjects reviewer above.*
   - to evaluate the potential physical or psychological risk of research involving human subjects.
3. **The School should encourage positive commitment by teachers involved.**
   - Decision should be made if science research projects will be mandatory.
   - Teachers must provide guidance and certify the science research for further competition. Thus, when the teacher signs the form they are giving approval to the quality, safety and appropriateness of the research. Students should be encouraged to exhibit only their very best effort.
4. **Sponsors or Teachers should provide clear communication (in writing) to students about:**
   - What a science research project is
   - What is expected of them
   - What the time lines are
   - Where they may go for help
   - How much help they can get
4. **Sponsors or Teachers should provide continuous encouragement and follow-up**:
   - Schedule 10-15 minutes at least twice a week for discussions of students' progress, ideas, etc.
5. **Sponsors or Teachers should use available resources:**
   - Teacher, librarian, a science contact person, parents, and professionals in the community.
6. **Science department or school staff should identify a science fair committee:**
   - to provide information to students and teachers
   - to plan logistics for setting up the fair exhibits
   - to arrange for judges and awards
   - to plan logistics for judging research projects
   - Involve parents and the community (i.e. open house, PTA, school newspapers, parents' newsletter, etc.)

What Do the Judges Look For?

Judges evaluate and focus on:

1) what the student did in the current year;

2) how well a student followed the scientific methodologies;

3) the detail and accuracy of research as documented in the data book;

4) whether experimental procedures were used in the best possible way.

Overall, judges look for well thought-out research. They look for the significance of your project in its field, as well as how thorough you were. Did you leave something out? Did you start with four experiments and finish only three because of lack of commitment?

The judges applaud those students who can speak freely and confidently about their research. They are not interested in memorized speeches -- they simply want to TALK with you about your research to see if you have a good grasp of your project from start to finish. Besides asking the obvious questions, judges often ask questions outside the normal scope to test your insight into your research such as "What didn't you do?" and "What would be your next step?"

What does the Scientific Review Committee (SRC) look for?

1) Evidence of library search

2) Type and amount of supervision

3) Use of and demonstrated skill in accepted research techniques

4) Completed forms and signatures

5) Humane treatment of animals

6) Compliance with rules and laws governing human and animal research

7) Appropriate use of recombinant DNA, pathogenic organisms, and controlled substances

Additional Resources

1001 Ideas for Science Projects
By Marion A. Brisk, Ph.D., Prentice Hall 1992

The Complete Handbook of Science Fair Projects
By Julianne Blair Bochinski, Wiley Science Editions, 1991

Nuts & Bolts
By Barry A. Van Deman and Ed McDonald

Science Fairs With Style
By Jerry DeBruin

Learning and Assessing Science Process Skills
By Richard J. Rezba, Constance Sprague, Ronald L. Fiel and H. James Funk

Students & Research
By Julia Cothron, Ronald Giese, Richard Rezba

Science Fair Basics - on the GSEF Web Site
www.uga.edu/oasp

2008 GEORGIA SCIENCE & ENGINEERING FAIR SCORE SHEET

Title:

Space Number: **Category:**

Name:

Teacher:

JUDGING AREAS & Comments/suggestions/constructive criticism

CREATIVE ABILITY: originality, new methods, construction/design, materials used, new conclusions
Comments:

SCIENTIFIC THOUGHT: clear purpose & objective, searched for related facts, development of hypothesis, controlled & accurate observations, sufficient data, test for accuracy of data, conclusions limited to data **or ENGINEERING GOALS:** is objective clear, useful; solution workable, acceptable and economic, improvement over existing methods, was solution tested
Comments:

THOROUGHNESS: purpose carried out, problem completely covered, conclusions based on single replication experiment, complete notes-log book, student(s) aware of other approaches/theories, familiar with related literature
Comments:

SKILLS: does student(s) have skills to do work, where was the project done, was assistance received, from whom, reasonable amount?
Comments:

CLARITY/KNOWLEDGE: was student(s) able to discuss project, does written material reflect understanding, presented in orderly manner, clear data/results, exhibit self explanatory, was all work done by student(s)?
Comments:

Note: Scores are never given out to exhibitors, teachers or parents. Team Projects are also judged on how well the group of students worked together and the complete knowledge of the projects by all members on the team**.**

Abstract Tips

Each student who completes a science fair project must write an abstract to be displayed with the project. An abstract gives the essence of the project in a brief but complete form — it should not exceed 250 words. Judges and the public should have a fairly accurate idea of the project after reading the abstract.

The abstract must focus on the current year's research and give only minimal reference to previous work. Details and discussions should not be included in the abstract, but may be put in the longer, written research paper (if required), or given on the project exhibit board.

Finalists at the Intel ISEF are required to use the on-line system for submitting their abstract. Regional and local fairs use the Official Abstract Form (not necessary for most local fairs). It is also required that the abstract not include acknowledgments (such as referencing a mentor or university laboratory).

Sample Abstract:

Effects of Marine Engine Exhaust Water on Algae

Mary E. Jones
Hometown High School, Hometown, PA

This project in its present form is the result of bioassay experimentation on the effects of two-cycle marine engine exhaust water on certain green algae. The initial idea was to determine the toxicity of outboard engine lubricant. Some success with lubricants eventually led to the formulation of "synthetic" exhaust water which, in turn, led to the use of actual two-cycle engine exhaust water as the test substance.

Toxicity was determined by means of the standard bottle or "batch" bioassay technique. Scenedesmus quadricauda and Ankistrodesmus sp. were used as the test organisms. Toxicity was measured in terms of a decrease in the maximum standing crop. The effective concentration - 50% (EC 50) for Scenedesmus quadricauda was found to be 3.75% exhaust water; for Ankistrodesmus sp. 3.1% exhaust water using the bottle technique.

Anomalies in growth curves raised the suspicion that evaporation was affecting the results; therefore, a flow-through system was improvised utilizing the characteristics of a device called a Biomonitor. Use of the Biomonitor lessened the influence of evaporation, and the EC 50 was found to be 1.4% exhaust water using Ankistrodesmus sp. as the test organism. Mixed populations of various algae gave an EC 50 of 1.28% exhaust water.

The contributions of this project are twofold. First, the toxicity of two-cycle marine engine exhaust was found to be considerably greater than reported in the literature (1.4% vs. 4.2%). Secondly, the benefits of a flow-through bioassay technique utilizing the Biomonitor was demonstrated.

Purpose of the Experiment

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

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 must not be included.

Observation/Data/Results

* 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.

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.

An abstract does not include a bibliography unless specifically required by your local fair. The Intel ISEF requires the bibliography as part of the research plan to be provided on Form 1A.

Forms Tips and Dates

The Intel ISEF forms constitute written documentation of what will occur in a research project. They are designed to provide the information that is needed to review the project to ensure compliance with the Intel ISEF rules and with laws and regulations that apply to the project. The forms should be filled out and signed before any research takes place. (Only Forms 1C, 7, and the abstract are done after the research.) The dates of the signatures reflect when the approval or consent is given.

Checklist for Adult Sponsor (1)
The checklist is provided so that the adult sponsor can review what information (and therefore which forms) must be provided. The date signed is the date that the sponsor first reviews the project plan.

Student Checklist (1A)
On this page, the student outlines what the project is about. Items that especially need to be clear are the following:

#5 Any project conducted in a similar area of research as previous projects should be considered a continuation. If the project is a continuation, explain on Form 7 as completely as possible how the project will differ from previous experimentation because ONLY a new and different research project is allowed. (If based on previous research, the current year project must demonstrate significant progress.)

#6 Explain when the actual experimental procedure (not the background literature review) will begin and end because ONLY a 12-month project that occurred within the last 18 months before this Intel ISEF is allowed.

#7 Explain where the experimental research will be done: home, university, field. Pathogens may NOT be cultured at home. Research animals must be housed in school or institutional settings only. Universities, research facilities, and industrial settings will require the additional documentation of Form 1C to explain what was done at each facility.

#9 Attach a research plan (next form).

Student Checklist (1A)
Explain clearly and in detail what will be done in the research project.

Approval Form (1B)
These statements attest that each of these people (or committees) approves or consents to this project. The dates should be signed as described below:

a) Student - Date they attest that they understand the possible risks and that they will read and follow the rules.

b) Parent/Guardian - Date they consent to their child doing this project.

c) Adult Sponsor - Date indicates when they approved this project.

d) SRC Approval <u>BEFORE</u> - Date that the committee reviews this project BEFORE the experimentation. Projects that must be pre-approved are research in these areas: human subjects, nonhuman vertebrate animals, pathogenic agents, controlled substances, recombinant DNA, and human or animal tissue.

e) SRC Approval <u>AFTER</u> - This applies only to projects that needed preapproval by the SRC but were done at a research institution and were pre-approved by that institution instead of the SRC. Date signed indicates when the affiliated SRC approved this project after it was completed. Attach all documentation from the research institution showing approval of the project.

f) Final SRC Approval - All projects must be reviewed by the SRC after the experimentation is complete and shortly BEFORE they compete in the affiliated fair. The date signed shows the date that SRC gives final approval to this project.

Regulated Research Institution (1C)
This form explains what the student researcher actually did and is signed after the project is completed. This form is only needed if the research was done at a research institution (university lab, for example) or in an industrial setting.

Qualified Scientist (2)
On this page, the scientist explains what will be done to oversee this project. The date signed indicates the date that they approve this project (before experimentation takes place).

Risk Assessment Form (3)
Required for projects using hazardous chemicals, activities or devices or regulated substances. Must be completed prior to student experimentation.

Human Subject and Informed Consent (4)
This page is filled out by the student researcher to explain to the IRB how the safety and well being of the test subjects will be ensured. The IRB reviews the project, checks the risk level and each member signs with the date they approve this project. This review and the date signed must be BEFORE any experimentation takes place.

Copies of this form are used (for informed consent) to explain very completely to the research subject and their parent(guardian) exactly what will happen to the subject in the project. Questionnaires, sample tests, and so on MUST be given to the IRB and to the parent/guardian. If they approve, they sign with the date that they approve. (Before the experiment begins). If a photo is to be displayed, the participant signs and dates it when they give permission.

Vertebrate Animal Form (5)
This form is filled out by the student researcher and describes the housing and care for the animals. The bottom of the form is filled out by the supervisor or scientist and is signed and dated when they approve this project with these housing conditions. (Before experimentation begins.)

Potentially Hazardous Biological Agents (6A)
This form is filled out by the student researcher and is required for all research involving microorganisms, rDNA and fresh tissue, blood and body fluids. SRC/IACUC/IBC/RAC approval required before experimentation. There is a section to be completed by the designated supervisor and others to be completed by the fair's SRC.

Human & Vertebrate Animal Tissue (6B)
This form is filled out by the student researcher and explains the source of the tissue. The designated supervisor must sign to show approval of the use of this tissue and the date (before experimentation) that they approve.

Continuation Projects Form (7)
Any project conducted by the student or team in a similar area of research as previous projects should be considered a continuation. Explain as completely as possible how the project is different from previous experimentation because ONLY a new and different research project is allowed. (It can be based on previous research, but must be new and different research.) Date signed is the date the student researcher is certifying that this information is correct.

Abstract
ISEF finalists must use the on-line system. Regional and local fairs use the Adobe® Acrobat® file listed above. The abstract is a summary written after experimentation that explains the project. The date signed is the date the student researcher certifies that the statements are correct.

Common Scientific Research Committee (SRC) Problems

Top Five Intel ISEF Paperwork Problems

1. Incomplete Research Plan 1A
   1. Must include proposed and actual start and end dates
   2. Must include detailed research plan
   3. Must have all work site information completed

2. Missing final SRC signature on the Approval Form 1B
   The SRC must sign the bottom of 1B to demonstrate that the paper went through SRC review prior to competition at the regional and state level.

3. Incorrect or incomplete Abstract
   1. Must be in proper format
   2. Must be without acknowledgments
   3. Must have checks properly marked and be signed
   4. Must reflect current year's work done by student

4. Missing Designated Supervisor Form 3
   1. Must be completed for projects that involve chemicals, equipment, or other potential hazards
   2. Often missing, and often incomplete without description of safety precautions taken

5. Prior year's paperwork for continuations
   1. Continuing projects, even those with clear demonstration of significant progress, must provide prior year's research (1A and Research Plan Attachment)
   2. Consider the project a continuation if prior work has been done in same general research area

Top Five Intel ISEF SRC Problems
(Guaranteed to require an interview)

1. Vertebrate animal projects without proper SRC or IACUC approval or lacking appropriate detail in the research plan

2. Human subject projects without evidence of proper prior approval or informed consents

3. Projects involving the culture of potentially-pathogenic and pathogenic agents without appropriate detail about materials cultured, methods, or location of culturing and storage

4. Continuing projects without enough detail in the research plan to demonstrate significant progress, including an abstract that is often too similar to the previous year's

5. Projects that have eligibility questions regarding either the number of students involved in the project (team to individual or too many team members), the longevity of the research involved, or the age of the participants

Top 10 SRC Problems from Regional SRC Reports

1. Incomplete paperwork - missing forms or signatures
2. Not getting paperwork in on time
3. Missing human subject forms 4a and 4b after conducting a survey or otherwise using humans in the project
4. Not differentiating between a qualified scientist and a designated supervisor
5. Inappropriate handling and safety precautions for the use of bacteria and molds (potentially-pathogenic agents)
6. Incomplete research plans, including insufficient bibliography
7. Failure to obtain prior SRC approval
8. Bad dates - paperwork not signed in the appropriate order prior to the start of experimentation
9. Not having prior paperwork for continuing projects
10. Elementary and junior projects and teachers not following the International Rules

Tips to Encourage Science Fair Participation

If you have talented students who are interested in science, here are some ways to encourage them to participate in a science fair.

In the Classroom

- Introduce science fair at the beginning of each semester and even at the end of the school year to get students interested in working on projects over the summer.
- Determine a plan for working within a school's semester or block scheduling of science classes so that everyone can be encouraged to participate.
- Stress hands-on labs with data collection in your science classes. This reinforces concepts and helps students learn the scientific method in a concrete fashion.
- Urge research experiments, rather than models or collections. To continue on to an Intel® ISEF affiliated fair, only research experiments are allowed.
- Require students to write up their lab experiments using the scientific method. Make sure they have all the parts of an experimental summary: question, hypothesis, materials, procedures, results in chart or graph form, analysis, and conclusion.

Outside of the Classroom

- Encourage students to pursue their individual interests within the scientific topic being learned and to go beyond their classroom learning.
- Start a science club to help students that are not currently enrolled in a science class and to provide extra-curricular opportunities in science exploration and discovery.
- Be familiar with the Intel ISEF & GSEF Rules and Regulations so that you may advise your students. Hold a seminar to explain them.
- Work with the community to connect students to mentors - at the local university, hospital, or veterinary practice.

Enter the 60th Georgia Science & Engineering Fair

Design a Pin and T-Shirt Contest

Win a $250 Savings Bond along with a free T-shirt and *your* official GSEF pin!
T-shirts use the same design and are sold at GSEF by the Georgia Junior Academy of Sciences as a fund raiser.

This year's theme: Georgia Uniting the World Through Science

1. Following the theme for this year, draw your design and transfer it neatly to the space provided above.
2. Put your name, address, occupation, school, school address, and school phone number on the back of this page.
3. Send entry to UGA, Office of Academic Special Programs, 209 Biological Sciences Bldg., Athens, GA 30602-2609

Entries must be received by JANURARY 1, 2008!

Design suggestions:

- ☐ Tiny details do not work well when reduced to the size of a pin (1 inch).
- ☐ Use strong outlines around colors and shapes.
- ☐ Remember the theme when coming up with your design.
- ☐ Use the state outline only when drawing your pin.
- ☐ Your pin and T-shirt will represent our state at the International Fair. Think Georgia, Science, and great design!

GSEF SPONSORS

The Georgia Science and Engineering Fair is made possible by the support of many individuals, industries and organizations.

Athens Coca Cola
Domino's Pizza
Krispy Cream
BB&T

Silver Membership

Georgia Tech
Scientific Atlanta

Gold Membership

Jackson EMC
Merial Inc.
Georgia Power
The University of Georgia

Section II

GSEF & International Rules for Precollege Science Research

Guidelines for Science and Engineering Fairs

2007-2008

A Publication of
Science Service
1719 N Street, NW
Washington, DC 20036-2888
Tel: 202/785-2255; Fax: 202/785-1243
sciedu@sciserv.org or src@sciserv.org

Georgia Science & Engineering Fair email: oasp@uga.edu
Available online: http://www.sciserv.org/isef/primer/rules.asp
Downloadable at www.uga.edu/oasp

Table of Contents

❖Acknowledgments ❖

Fair directors, teachers, scientists, parents, and adult volunteers inspire and encourage students to explore and investigate their world through hands-on research. Those of you who work with these young people are rarely recognized and never can be adequately thanked. Without you, precollege science and engineering projects and science and engineering fairs would not be possible. Science Service applauds your commitment and appreciates your hard work. We sincerely hope that our efforts to enhance these Rules will serve you in working with students.

Please address any general questions regarding the Intel ISEF to:
Science Service
Science Education Programs
1719 N Street, NW, Washington, DC 20036
office: 202/785-2255, fax: 202/785-1243, sciedu@sciserv.org

For specific rules questions, please email: src@sciserv.org or rogg@uga.edu

The ISEF SRC members listed below will be using the above email address to respond to rules inquiries.

Intel ISEF SRC

Dr. Nancy Aiello, Chairperson **(EST)**
home: 540-554-8748

Dr. James Stevens (MST)
office: 303-724-0424, home: 303-696-1504, cell: 303-921-1076, fax: 303-724-3005

Mr. Henry Disston (EST)
office: 215-895-5840, fax: 215-895-5842

Mrs. Christine Miller (PST)
home: 775-847-7129, cell: 775-722-3134

Mrs. Evelyn Montalvo (EST)
(English or Spanish inquiries)
office: 787-834-2150, home: 787-833-0287, fax: 787-265-2500

Dr. Paula Johnson (PST)
office: 520-621-3483

These Rules apply to the
Intel International Science and Engineering Fair 2008 presented by Agilent Technologies
Atlanta, Georgia, USA, May 11-17, 2008

Georgia Science and Engineering Fair
Athens, Georgia, April 2-5, 2008

❖Changes & Modifications for 2007-May 2008 ❖

Human Subjects

• There is a clarification of rules involving product testing (page 13, 2B).

Vertebrate Animals

• There is a clarification of the definition of vertebrate animal studies that may be conducted at non-regulated research sites (page 18).

Potentially Hazardous Biological Agents

• Naturally-occurring plant pathogens may be studied (not cultured) at home, but may not be introduced into a home/garden environment (page 21, 3).

• The following has been added to the list of studies exempt from prior SRC review: (page 21, 11 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).

Hazardous Chemicals, Activities or Devices

• Production of ethyl alcohol is allowable in the home under the supervision of the parents and must meet the TTB home production regulations (page 25, C1).

Form Changes

• Student Checklist (1A) and Student Checklist (1A)-TEAM have been combined into one form, Student Checklist (1A).

• An additional box has been added to Potentially Hazardous Biological Agents Form (6A) to document required letter from institutions that do not have a review process for this type of study.

In addition to providing the rules of competition, these rules and guidelines for conducting research were developed to facilitate the following:

- protect the rights and welfare of the student researcher and human subjects
- protect the health and well-being of vertebrate animal subjects
- follow federal regulations governing research
- offer guidance to affiliated fairs
- use safe laboratory practices
- address environmental concerns

❖The Rules on the Web ❖

www.sciserv.org/isef/primer/rules.asp

The International Rules and Guidelines for Science Fairs is available on the Science Service website in a number of formats to better aid all of those involved in the process: students, parents, teachers, mentors, fair directors and local, regional and state scientific review committees (SRC) and institutional review boards (IRB).

• International Rules and Guidelines - The full text of the International Rules and the forms both in html and in a downloadable format.

• The Intel ISEF Rules Wizard - This "wizard" asks a series of questions about your planned project and will provide a list of forms that you need to complete.

• Common SRC Problems - This list was generated from the SRC reviews leading up to the Intel ISEF. Read these to get pointers on what NOT to do.

Intel ISEF Categories and Subcategories

The categories have been established with the goal of better aligning judges and student projects for the judging at the Intel ISEF. Local, regional, state and country fairs may or may not choose to use these categories, dependent on the needs of their area. Please check with your affiliated fair(s) for the appropriate category listings at that level of competition.

Please visit our website at **www.sciserv.org/isef/students/research_categories.asp** for a full description and definition of the Intel ISEF categories (subcategories may adjust):

ANIMAL SCIENCES
Development
Ecology
Animal Husbandry
Pathology
Physiology
Populations Genetics
Systematics
Other

BEHAVIORAL & SOCIAL SCIENCES
Clinical & Developmental Psychology
Cognitive Psychology
Physiological Psychology
Sociology
Other

BIOCHEMISTRY
General Biochemistry
Metabolism
Structural Biochemistry
Other

CELLULAR AND MOLECULAR BIOLOGY
Cellular Biology
Cellular and Molecular Genetics
Immunology
Molecular Biology
Other

CHEMISTRY
Analytical Chemistry
General Chemistry
Inorganic Chemistry
Organic Chemistry
Physical Chemistry
Other

COMPUTER SCIENCE
Algorithms, Data Bases
Artificial Intelligence
Networking and Communications
Computational Science, Computer Graphics
Software Engineering., Programming Languages
Computer System, Operating System
Other

EARTH & PLANETARY SCIENCE
Climatology, Weather
Geochemistry, Mineralogy
Paleontology
Geophysics
Planetary Science
Tectonics
Other

ENGINEERING: Electrical & Mechanical
Electrical Eng., Computer Eng., Controls
Mechanical Engineering, Robotics
Thermodynamics, Solar
Other

ENGINEERING: Materials & Bioengineering
Bioengineering
Civil Engineering, Construction Eng.
Chemical Engineering
Industrial Engineering, Processing
Material Science
Other

ENERGY & TRANSPORTATION
Aerospace and Aeronautical Engineering, Aerodynamics
Alternative Fuels
Fossil Fuel Energy
Vehicle Development
Renewable Energies
Other

ENVIRONMENTAL MANAGEMENT
Bioremediation
Ecosystems Management
Environmental Engineering
Land Resource Management, Forestry
Recycling, Waste Management
Other

ENVIRONMENTAL SCIENCES
Air Pollution and Air Quality
Soil Contamination and Soil Quality
Water Pollution and Water Quality
Other

MATHEMATICAL SCIENCES
Algebra
Analysis
Applied Mathematics
Geometry
Probability and Statistics
Other

MEDICINE & HEALTH SCIENCES
Disease Diagnosis and Treatment
Epidemiology
Genetics
Molecular Biology of Diseases
Physiology and Pathophysiology
Other

MICROBIOLOGY
Antibiotics, Antimicrobials
Bacteriology
Microbial Genetics
Virology
Other

PHYSICS AND ASTRONOMY
Atoms, Molecules, Solids
Astronomy
Biological Physics
Instrumentation and Electronics
Magnetics and Electromagnetics
Nuclear and Particle Physics
Optics, Lasers, Masers
Theoretical Physics, Theoretical or Computational Astronomy
Other

PLANT SCIENCES
Agriculture/Agronomy
Development
Ecology
Genetics
Photosynthesis
Plant Physiology (Molecular, Cellular, Organismal)
Plant Systematics, Evolution
Other

❖Intel ISEF Display and Safety Regulations ◆

Please address any questions regarding Intel ISEF Display and Safety Regulations to:
William A. Greene, Science Service, E-mail: bgreene@sciserv.org
John O. Cole, Display and Safety Committee Chair, E-mail: dejavu60@msn.com

General Requirements

The Intel ISEF Display and Safety Committee is the final authority on display and safety issues for projects approved by the SRC to compete in the Intel ISEF. Occasionally, the Intel ISEF Display and Safety Committee may require students to make revisions in their display to conform to display and safety regulations.

Maximum Size of Project at GSEF and ISEF

30 inches (76 centimeters) **deep front to back**
48 inches (122 centimeters) **side to side**
108 inches (274 centimeters) **floor to top**

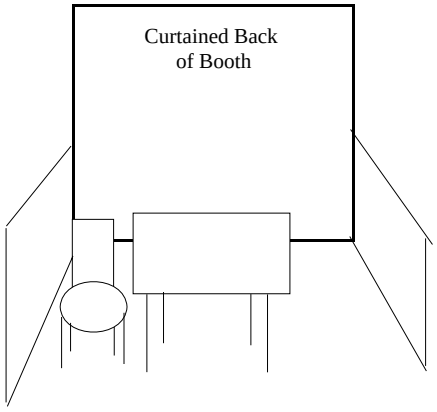
At the GSEF and Intel ISEF, fair-provided tables will not exceed a height of 36 inches (91 centimeters).

Maximum project sizes include all project materials and supports. If a table is used, it becomes part of the project and must not itself exceed the allowed dimensions nor may the table plus any part of the project exceed the allowed dimensions. No Floor Models allowed at GSEF.

At the Intel ISEF, any project with a component that will be demonstrated by the Finalist must be demonstrated only within the confines of the Finalist's booth. When not being demonstrated, the component plus the project must not exceed allowed dimensions.

Position of Project

Table or freestanding display must be parallel to, and positioned at, the back curtain of the booth.



Items Required to be in notebook at GSEF and Visible and Vertically Displayed at the Intel ISEF

- Original of official Abstract and Certification as approved and stamped/embossed by the Intel ISEF Scientific Review Committee
- Completed Intel ISEF Project Set-up Approval Form SRC/DS2 (Received on-site at the Fair)
- Regulated Research Institutional/Industrial Setting Form (1C) - if applicable
- Continuation Projects Form (7) - if applicable
- Photograph/image credits

Required to be at the Project But Not Displayed at the Intel ISEF

Forms including, but not limited to, **Checklist for Adult Sponsor (1), Student Checklist (1A), Research Plan** and **Approval Form (1B)** which are required for the project or for Scientific Review Committee approval do not have to be displayed as part of the project but must be available in the booth in case asked for by a judge or other Intel ISEF official.

Human Subjects Form (4) (or equivalent form provided by a regulated research institution) for human subjects of the research, surveys, photographs, etc. (if applicable) are confidential information, must **not** be displayed, but **must be available in the booth** in case requested by a judge or other Intel ISEF official. Human Subjects Form (4) or an equivalent photograph release signed by the human subject is required for visual images of humans (other than the Finalist) displayed as part of the project.

Handouts/Official Abstract and Certification at the Intel ISEF

The Intel ISEF Scientific Review Committee defines the"official abstract and certification" as an **UNALTERED** original abstract and certification as stamped/embossed by the Intel ISEF Scientific Review Committee. If the Scientific Review Committee requires a Finalist to make changes to the abstract and certification submitted with registration papers, the revised version will be stamped/embossed, will replace the earlier version, and will become the Finalist's official abstract and certification. The only abstract allowed anywhere at a project is the official abstract. The term "abstract" may not be used as a title or reference for any information a Finalist's display or in a Finalist's materials at the project except as part of displaying the official abstract.

An original stamped/embossed official abstract and certification must appear on the display board or in a vertical position at the project at ISEF (GSEF in notebook). Handouts to judges and to the public must be limited to **UNALTERED photocopies** of the official abstract and certification.

Not Allowed at Project or in Booth

1. Living organisms, including plants

2. Taxidermy specimens or parts

3. Preserved vertebrate or invertebrate animals

4. Human or animal food

5. Human/animal parts or body fluids (for example, blood, urine)

6. Plant materials (living, dead, or preserved) that are in their raw, unprocessed, or non-manufactured state (Exception: manufactured construction materials used in building the project or display)

7. All chemicals including water (Exceptions: water integral to an enclosed apparatus or water supplied by the Display and Safety Committee)

8. All hazardous substances or devices [for example, poisons, drugs, firearms, weapons, ammunition, reloading devices, and lasers (as indicated in item 5 in the section of these rules entitled "Allowed at Project or in Booth BUT with the Restrictions Indicated")]

9. Dry ice or other sublimating solids
10. Sharp items (for example, syringes, needles, pipettes, knives)

11. Flames or highly flammable materials
12. Batteries with open-top cells
13. **Awards, medals, business cards, flags, logos, endorsements, and/or acknowledgments** (graphic or written) unless the item(s) are an integral part of the project (Exception: Intel ISEF medal(s) may be worn at all times.)

14. Photographs or other visual presentations depicting vertebrate animals in surgical techniques, dissections, necropsies, or other lab procedures

15. Active Internet or e-mail connections as part of displaying or operating the project at the Intel ISEF

16. Prior years' written material or visual depictions on the vertical display board. [Exception: the project title displayed in the Finalist's booth may mention years or which year the project is (for example, "Year Two of an Ongoing Study")]. Continuation projects must have the Continuation Project Form (7) vertically displayed.

17. Glass or glass objects unless deemed by the Display and Safety Committee to be an integral and necessary part of the project (Exception: glass that is an integral part of a commercial product such as a computer screen)

18. Any apparatus deemed unsafe by the Scientific Review Committee, the Display and Safety Committee, or Science Service (for example, large vacuum tubes or dangerous ray-generating devices, empty tanks that previously contained combustible liquids or gases, pressurized tanks, etc.)

Allowed at Project or in Booth BUT with the Restrictions Indicated

1. Soil, sand, rock, and/or waste samples **if permanently encased in a slab of acrylic**

2. Postal addresses, World Wide Web and e-mail addresses, telephone and fax numbers **of Finalist only.**

3. Photographs and/or visual depictions **if:**

a. They are not deemed offensive or inappropriate by the Scientific Review Committee, the Display and Safety Committee, or Science Service. This includes, but is not limited to, visually offensive photographs or visual depictions of invertebrate or vertebrate animals, including humans. The decision by any one of the groups mentioned above is final.

b. They have credit lines of origin ("Photograph taken by..." or "Image taken from..."). (If all photographs being displayed were taken by the Finalist or are from the same source, one credit line prominently and vertically displayed is sufficient.)

c. They are from the Internet, magazines, newspapers, journals, etc., and credit lines are attached. (If all photographs/images are from the same source, one credit prominently and vertically displayed is sufficient.)

d. They are photographs or visual depictions of the Finalist.

e. They are photographs of human subjects for which signed consent forms are at the project or in the booth. (Human Subjects Form 4 or equivalent photograph release signed by the human subject must be included in the paperwork and must be properly checked on the Intel ISEF Official Abstract and Certification.

4. Any apparatus with unshielded belts, pulleys, chains, or moving parts with tension or pinch points **if for display only and not operated**.

5. Class II lasers **if**:

a. The output energy is <1 mW and is operated only by the Finalist

b. Operated only during the Display and Safety inspection and during judging
c. Labeled with a sign reading **"Laser Radiation: Do Not Look into Beam"**
d. Enclosed in protective housing that prevents physical and visual access to beam
e. Disconnected when not operating

Note: Class II lasers are found in laser pointers and in aiming and range-finding devices. They pose a risk if the beam is directly viewed over a long period of time.

6. Class III and IV lasers if for display only and not operated (*See the description of Class III and Class IV lasers in the Radiation section of the Hazardous Chemicals, Activities, or Devices chapter of the International Rules for Pre-college Research.)*

7. Any apparatus producing temperatures that will cause physical burns if adequately insulated.

8. The only forms that may be displayed by attaching them to the front of the provided table are the forms listed in the section of these rules entitled "Required to be Visible and Vertically Displayed at the Intel ISEF."

Electrical Regulations at the Intel ISEF

1. Finalists requiring 120 or 220 Volt A.C. electrical circuits must provide a **UL-listed 3-wire extension cord** which is appropriate for the load and equipment. Electrical must be justified at GSEF. If not, the cost is $45 per project. The GSEF office will determine whether or not electricity is justified.

2. Electrical power supplied to projects and, therefore, the maximums allowed for projects is **120** or **220 Volt, A.C., single phase, 60 cycle.** Maximum circuit amperage/wattage available is determined by the electrical circuit capacities of the exhibit hall and may be adjusted on-site by the Display and Safety Committee. For all electrical regulations, **"120 Volt A.C." or "220 Volt A.C."** is intended to encompass the corresponding range of voltage as supplied by the facility in which the Intel ISEF is being held.

3. All electrical work must conform to the National Electrical Code or exhibit hall regulations. The guidelines presented here are general ones, and other rules may apply to specific configurations. The on-site electrician may review electrical work on any project.

4. All electrical connectors, wiring, switches, extension cords, fuses, etc. must be **UL-listed** and must be appropriate for the load and equipment. Connections must be soldered or made with **UL-listed** connectors. Wiring, switches, and metal parts must have adequate insulation and over-current safety devices (such as fuses) and must be inaccessible to anyone other than the Finalist. Exposed electrical equipment or metal that possibly may be energized must be shielded with a nonconducting material or with a grounded metal box to prevent accidental contact.

5. Wiring not part of a commercially available **UL-listed** appliance or piece of equipment must have a clearly visible fuse or circuit breaker on the supply side of the power source and prior to any project equipment.

6. There must be an accessible, clearly visible on/off switch or other means of disconnect from the **120 or 220 Volt** power source.

7. Any lighting that generates considerable and excessive amounts of heat (high-intensity lamps, certain halogen lights, etc.) must be turned off when the Finalist is not present.

Other Intel ISEF Information and Requirements

1. Finalists must be present at their projects for the Display and Safety inspection (not at GSEF). The inspection is a process that takes place between the Finalist and inspector; therefore, no other persons should be present representing the Finalist except for an interpreter if necessary.

2. No changes, modifications, or additions to projects may be made after approval by the Display and Safety Committee and the Scientific Review Committee.

3. Science Service, the Scientific Review Committee, and/or the Display and Safety Committee reserve the right to remove any project for safety reasons or to protect the integrity of the Intel ISEF and its rules and regulations.

4. A project data book and research paper are required at GSEF but not at ISEF. They are highly recommended at ISEF.

5. The only acceptable informed consent form for use at the Intel ISEF is the official Human Subjects Form (4) in the International Rules for Precollege Science Research or an equivalent form provided by a regulated research institution (see Form 1C) or, in the case of display of photographs only, an equivalent photograph release signed by the human subject.

6. Finalists using audio-visual or multi-media presentations (for example, 35mm slides; videotapes; images, graphics, animations, etc., displayed on computer monitors; or other non-print presentation methods) must be prepared to show the entire presentation to the Display and Safety inspectors before the project is approved.

7. If a project fails to qualify and is not removed by the Finalist, Science Service will remove the project in the safest manner possible but is not responsible for damage to the project.

8. Any disks, CDs, printed materials, etc. (including unofficial abstracts) designed to be distributed to judges or the public will be confiscated by the Display

and Safety Committee and will be discarded immediately.

9. Project sounds, lights, odors, or any other display items must not be distracting.

10. No food or drinks, except small containers of bottled water for personal consumption, are allowed in the Exhibit Hall.

◆All Projects ◆

Ethics Statement

Scientific fraud and misconduct are not condoned at any level of research or competition. Such practices include plagiarism, forgery, use or presentation of other researcher's work as one's own and fabrication of data. Fraudulent projects will fail to qualify for competition in affiliated fairs or the Intel ISEF.

Eligibility/Limitations

1) Any student in grades 9-12 or equivalent is eligible, none of whom has reached age 21 on or before May 1 preceding the Intel ISEF. Grade 6-12 at GSEF.

2) Each student may enter only **one** project which covers research done over a maximum of 12 continuous months between January 2007 and May 2008.

3) Students may compete in only one ISEF Affiliated Fair, except when proceeding to a state/national fair affiliated with the Intel ISEF from an affiliated regional fair.

4) Team projects may have a maximum of three members.

5) Each ISEF-affiliated fair may send up to two Individual Project Finalists and one Team Project of two or three Finalists to the Intel ISEF.

6) Projects that are demonstrations, 'library' research or informational projects, 'explanation' models or kit building are not appropriate for the Intel ISEF.

7) A research project may be a part of a larger study done by professional scientists, but the project presented by the student may only be their portion of the complete study.

Requirements - General

1) All domestic and international students competing in an ISEF-affiliated fair must adhere to all of the rules as set forth in this document.

2) All projects must adhere to the Ethics Statement above.

3) Projects must adhere to local, state, country and U.S. Federal laws, regulations and permitting conditions.

4) Introduction or disposal of non-native species, pathogens, toxic chemicals or foreign substances into the environment is prohibited. See www.anstaskforce.gov/documents/isef.pdf.

5) Intel ISEF exhibits must adhere to Intel ISEF display and safety requirements.

6) **It is the responsibility of the student and adult sponsor to check with their affiliated fair for any additional restrictions or requirements.**

Approval and Documentation

7) Before experimentation begins, an Institutional Review Board (IRB) or Scientific Review Committee (SRC) must review and approve most projects involving human subjects, vertebrate animals, and potentially hazardous biological agents. See the appropriate sections of the Rules Book.

8) Every student must complete **Student Checklist (1A), a Research Plan** and **Approval Form (1B)** and review the project with the Adult Sponsor as the **Checklist for Adult Sponsor (1)** is completed.

9) A Qualified Scientist is required for all studies involving BSL-2 potentially hazardous biological agents, DEA-controlled substances, more than minimal risk in human subjects and for many vertebrate animal studies.

10) After initial IRB/SRC approval (if required), any proposed changes in the **Student Checklist (1A)** and **Research Plan** must be re-approved before laboratory experimentation/data collection resumes.

11) Projects which are continuations of previous year's work and which require IRB/SRC approval must be reapproved prior to experimentation/data collection for the current year.

12) Any continuing project must document that the additional research is new and different. (See **Continuation Projects Form (7)**)

13) If work was conducted in a regulated research institution, industrial setting or any work site other than home, school or field at any time during the current ISEF project year, **Regulated Research Institutional/Industrial Setting Form (1C)** must be completed.

14) After experimentation, each student or team must submit a (maximum) 250-word, one-page abstract which summarizes the current year's work. The abstract must

describe research conducted by the student, not by adult supervisors.

15) A project data book and research paper are required at GSEF, but not at ISEF. They are highly recommended at ISEF. (See *Student Handbook;)* Regional fairs may have different requirements.

16) All signed forms, certifications, and permits must be available for review by an SRC just before each fair a student enters.

17) It is the student's responsibility to check with their affiliated fair for any additional restrictions or requirements.

Continuation of Projects

1) As in the professional world, research projects may be done that build on previous work done in past years. Students will be judged only on the most recent year's research. The project year includes research conducted over a maximum of 12 continuous months from January 2007- May 2008.

2) Any project based on the student's prior research could be considered a continuation project. If the current year's project could not have been done without what was learned from the past year's research, then it is a continuation project for competition. These projects must document that the additional research is an expansion from prior work (e.g. testing a new variable or new line of investigation, etc.) Repetition of previous experimentation with the exact same methodology and research question or increasing sample size are examples of unacceptable continuations.

3) Display boards must reflect the current year's work only. The project title displayed in the Finalist's booth may mention years (for example, "Year Two of an Ongoing Study"). Supporting data books (not research papers) from previous related research may be exhibited on the table properly labeled as such.

4) Longitudinal studies are permitted as an acceptable continuation under the following conditions:

a. The study is a multi-year study testing or documenting the same variables in which time is a critical variable. (Examples: Effect of high rain or drought on soil in a given basin, return of flora and fauna in a burned period over time.)
b. Each consecutive year must demonstrate timebased change.
c. The display board must be based on collective past conclusionary data and its comparison to the current year data set. No raw data from previous years may be displayed.

NOTE: For competition in the Intel ISEF, documentation must include the **Continuation Project Form (7)**, the priors year's abstract and **Student Checklist (1A)** and **Research Plan** or equivalent documentation. Copies must be attached behind the current year's **Student Checklist (1A)** and **Research Plan** and forms. Each page of the previous year's forms must be clearly labeled in the upper right hand corner with the year (ex: 2006-2007). Retain all previous years' paperwork in case an SRC requests documentation of experimentation conducted in other prior years.

Team Projects

1) Team Projects compete in a separate "team" category against all other Team Projects. An ISEF Affiliated Fair has the option of sending a team project, in addition to two individual projects, to the Intel ISEF. ISEF-Affiliated Fairs are not required to have Team Projects, but are encouraged to do so.

2) Teams may have up to three members. NOTE: Teams may not have more than three members at a local fair and then eliminate members to qualify for the Intel ISEF.

3) Team membership cannot be changed during a given research year including converting from an individual project or vice versa, but may be altered in subsequent years.

4) Each team should appoint a team leader to coordinate the work and act as spokesperson. However, each member of the team should be able to serve as spokesperson, be fully involved with the project, and be familiar with all aspects of the project. The final work should reflect the coordinated efforts of all team members and will be evaluated using similar rules and judging criteria as individual projects.

5) Each team member must submit an **Approval Form (1B)**. However, team members must jointly submit the **Checklist for Adult Sponsor (1)**, one abstract, a **Student Checklist (1A), a Research Plan** and other required forms.

6) Full names of all team members must appear on the abstract and forms. All forms, including the abstract, must be in a notebook at GSEF.

◆Roles and Responsibilities of Students & Adults ◆

1) The Student Researcher(s)

The student researcher is responsible for all aspects of the research project including enlisting any needed supervisory adults (Adult Sponsor, Qualified Scientist, etc.), obtaining necessary approvals (SRC, IRB, etc.), following the Rules & Guidelines of the ISEF, and doing the experimentation, engineering, data analysis, etc. involved in the project.

The student must be in grades 9-12 (grades 6-12 at GSEF) or equivalent and must not have reached age 21 on or before May 1 preceding the Intel ISEF. Students may compete as a team of up to 3 members.

Scientific fraud and misconduct are not condoned at any level of research or competition. Such practices include plagiarism, forgery, use or presentation of other researcher's work as one's own and fabrication of data. Fraudulent projects will fail to qualify for competition in affiliated fairs or the Intel ISEF.

2) The Adult Sponsor

An Adult Sponsor may be a teacher, parent, university professor, or scientist in whose lab the student is working. This individual must have a solid background in science and should have close contact with the student during the course of the project.

The Adult Sponsor is responsible for working with the student to evaluate any possible risks involved in order to ensure the health and safety of the student conducting the research and the humans or animals involved in the study. The Adult Sponsor must review the student's **Student Checklist (1A)** and **Research Plan** to make sure that: a) experimentation is done within local, state, and federal laws and these International Rules; b) that forms are completed by other adults involved in approving or supervising any part of the experiment; and c) that criteria for the Qualified Scientist adhere to those set forth below.

The Adult Sponsor must be familiar with the regulations that govern potentially dangerous research as they apply to a specific student project. These may include chemical and equipment usage, experimental techniques, research involving human or vertebrate animals, and cell cultures, microorganisms, or animal tissues. The issues must be discussed with the student when completing the **Research Plan**. Some experiments involve procedures or materials that are regulated by state and federal laws. If not thoroughly familiar with the regulations, the Adult Sponsor should help the student enlist the aid of a Qualified Scientist.

The Adult Sponsor is responsible for ensuring the student's research is eligible for entry in the Intel ISEF.

3) The Qualified Scientist

A Qualified Scientist should possess an earned doctoral/professional degree in the biological or medical sciences as it relates to the student's area of research. However, a master's degree with equivalent experience and/or expertise in the student's area of research is acceptable when approved by a Scientific Review Committee (SRC). The Qualified Scientist must be thoroughly familiar with the local, state, and federal regulations that govern the student's area of research.

The Qualified Scientist and the Adult Sponsor may be the same person, if that person is qualified as outlined above. A student may work with a Qualified Scientist in another city or state. In this case, the student must work locally with a Designated Supervisor (see below) who has been trained in the techniques the student will use.

4) The Designated Supervisor

The Designated Supervisor is an adult who is directly responsible for overseeing student experimentation. The Designated Supervisor need not have an advanced degree, but should be thoroughly familiar with the student's project, and must be trained in the student's area of research. The Adult Sponsor may act as the Designated Supervisor.

If a student is experimenting with live vertebrates and the animals are in a situation where their behavior or habitat is influenced by humans, the Designated Supervisor must be knowledgeable about the humane care and handling of the animals.

5) The Institutional Review Board (IRB)

An Institutional Review Board (IRB) is a committee that, according to federal regulations (45-CFR-46), must evaluate the potential physical and/or psychological risk of research involving human subjects. All proposed human research must be reviewed and approved by an IRB before experimentation begins. This includes any surveys or questionnaires to be used in a project.

Federal regulations require local community involvement, therefore an IRB should be established at the school level to evaluate human research projects. An IRB at the school or ISEF Affiliated Fair level must consist of a minimum of three members. **In order to eliminate conflict of interest, the Adult Sponsor, parents, the Qualified Scientist, and the Designated Supervisor who oversee a specific project must not serve on the IRB reviewing that project.** Additional members are recommended to help avoid this conflict of interest and to increase the expertise of the committee. This IRB must include:

a) a science teacher
b) a school administrator (preferably, a principal or vice

principal),
c) and one of the following who is knowledgeable and capable of evaluating the physical and/or psychological risk involved in a given study: a medical doctor, physician's assistant, registered nurse, a psychiatrist, psychologist, or licensed social worker.

If the IRB 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. A copy of the correspondence (e.g. email, fax, etc.) should be attached to Form 4 and can be used as the signature of that expert.

IRBs exist at federally regulated institutions (e.g., universities, medical centers, NIH, correctional facilities). Prisoner 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 ISEFaffiliated 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/give original forms to Science Service, your regional fair or anyone else.**

◆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 an 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
  - o 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.)
  - o that occur in a non public or restricted access settings (e.g., day care setting, doctor's office)
  - o 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 preexisting data sets that are publicly available or published (see #3-c)
- Behavioral observations of unrestricted, public settings (e.g., shopping mall, public park) in which **all** of the following apply:

  - o The researcher has no interaction with the individuals being observed,
  - o The researcher does not manipulate the environment in any way **and**
  - o The researcher does not record any personally identifiable data.

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 preapproval 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 **deidentified/ 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 deidentified 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 breech 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 breech 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":

• **R**eplace vertebrate animals with invertebrates, lower life forms, tissue/cell cultures or computer simulations
• **R**educe the number of animals without compromising statistical validity
• **R**efine 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 nonintrusive 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	*Live animals will receive non-painful manipulation. Animals may be euthanized to obtain tissues, cells, etc.*	Permitted
Category B	*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.*	Permitted
Category C	*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.*	Permitted only with proper training and certification
Category D	*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 spontaneously or as a result of specific experimental procedures. 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.*	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	*Live animals will experience significant/severe pain or distress, without benefit of anesthetics, tranquilizers or analgesics.*	**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
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@assochq.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 ILARJournal.
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@teh.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 theconditions 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-occuring 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, nitrogenfixing, 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 matter 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. cerevesiae*, 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 nonchromosomal 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) An 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 blood borne 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 pneumonia, 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

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

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 ignitors.

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

Information on Required Abstract & Certification for ALL Projects at the Intel ISEF

**** This form may not be relevant for your regional or state fair; please refer to instructions from your affiliated fair.****

In ADDITION to the basic form requirements for ALL Projects and any other requirements due to specific areas of research, an Abstract & Certification is required at the conclusion of research. Details on this requirement follow.

Completing the Abstract

After finishing research and experimentation, you are required to write a (maximum) 250 word, one-page abstract. This should be written on the Official Abstract and Certification Form as provided by Science Service. The abstract **should include the following:**

a) purpose of the experiment
b) procedure
c) data
d) conclusions

It may also include any possible research applications. Only minimal reference to previous work may be included. An abstract **must not include the following**:

a) acknowledgments (including naming the research institution and/ or mentor with which you were working), or self-promotions and external endorsements
b) work or procedures done by the mentor

Completing the Certification

At the bottom of the Abstract & Certification form there are five questions. Please read each carefully, answer appropriately, and sign in the signature box to certify your answers. The Intel ISEF Scientific Research Committee will review and approve the abstract and answers to the questions.

Revisions or questions will be resolved via an SRC appointment on site at the Intel ISEF. Please bring a copy of your Abstract & Certification to the fair. Only after final Intel ISEF SRC approval has been obtained via a stamped/embossed copy of this Abstract & Certification may a Finalist make copies to hand out to the judges and the public.

Intel ISEF Sample Abstract & Certification

Title
Finalist's Name
School Name, City and State, Country

Category
Pick one only--mark an "X" in box at right

Start Typing the Body of Your Abstract Here Beginning at the Left Margin

- Animal Sciences ☐
- Behavioral and Social Science ☐
- Biochemistry ☐
- Cellular & Molecular Biology ☐
- Chemistry ☐
- Computer Science ☐
- Earth Science ☐
- Eng. Materials & Bioengineering ☐
- Eng.: Electrical & Mechanical ☐
- Energy & Transportation ☐
- Environmental Sciences ☐
- Environmental Management ☐
- Mathematical Sciences ☐
- Medicine and Health ☐
- Microbiology ☐
- Physics & Astronomy ☐
- Plant Sciences ☐

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply): ☐ human subjects ☐ vertebrate animals; potentially hazardous biological agents: ☐ microorganisms ☐ rDNA ☐ tissue
2. Student independently performed all procedures as outlined in this abstract. ☐ yes ☐ no
3. Student worked or used equipment in a site other than school, field or home. ☐ yes ☐ no
4. This project is a continuation of previous research . ☐ yes ☐ no
5. My display board includes non-published photographs/visual depictions of humans (other than myself): ☐ yes ☐ no

I/We hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I/We also attest that the above properly reflects my/our own work.

Finalist or Team Leader Signature _____ Date _____

FOR INTEL ISEF OFFICIAL USE ONLY

This embossed seal attests that this project is in compliance with all federal and state laws and regulations and that all appropriate reviews and approvals have been obtained including the final clearance by the Intel ISEF Scientific Review Committee.

Sample Intel ISEF Official Abstract & Certification

NOTE: Your abstract must be on the Intel International Science and Engineering Fair Abstract & Certification form and embossed/ stamped by the Intel ISEF Scientific Review Committee before it is displayed or handed out. *No pasted or taped text will be permitted.* No other format or version of your approved Abstract & Certification will be allowed for any purpose at the Intel ISEF.

2008 Georgia Science and Engineering Fair

Official Abstract Form

TITLE _____

Name _____

School Name _____

City and State, Country _____

Start typing the body of your abstract here, beginning at the left margin **- maximum 250 words.**

☐ **Team Project**

Category - Pick only one. Mark an "x" in box at left.

☐ Animal Sciences
☐ Behavioral & Social Science
☐ Biochemistry
☐ Cellular & Molecular Biology
☐ Chemistry
☐ Computer Science
☐ Earth Science
☐ Eng. Materials & Bioengineering
☐ Eng.: Electrical &Mechanical
☐ Energy & Transportation
☐ Environmental Analysis
☐ Environmental Management
☐ Mathematical Sciences
☐ Medicine and Health
☐ Microbiology
☐ Physics & Astronomy
☐ Plant Sciences

As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ Human subjects ☐ Potentially hazardous biological agents ☐ Microorganisms ☐ Tissue
☐ Vertebrate animals ☐ rDNA

☐ Yes No ☐ Student independently performed all procedures as outlined in this abstract.
☐ Yes No ☐ A Regulated Research Institution was a work site for some or al of this project
☐ Yes No ☐ This project is a continuation.
☐ Yes No ☐ My display board includes photographs/visual depictions of humans (other then my self)

I/We hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I/We also attest that the above properly reflects my/our own work.

_____

Finalist or Team Leader Signature Date

Checklist for Adult Sponsor (1)

This completed form is required for ALL projects and must be completed before experimentation

To be completed by the Adult Sponsor in collaboration with the student researcher:

Student's Name: _____

Project Title: _____

1) ☐ I have reviewed the ISEF Rules and Guidelines.

2) ☐ I have reviewed the student's completed Student Checklist (1A) and Research Plan.

3) ☐ I have worked with the student and we have discussed the possible risks involved in the project.

4) ☐ The project involves one or more of the following and requires prior approval by an SRC, IRB, IACUC or IBC:

- ☐ Humans
- ☐ Vertebrate Animals
- ☐ Potentially Hazardous Biological Agents:
  - ☐ Microorganisms
  - ☐ rDNA
  - ☐ Tissues

5) Forms to be completed for **ALL Projects:**

- ☐ Adult Sponsor Checklist (1)
- ☐ Research Plan
- ☐ Student Checklist (1A)
- ☐ Approval Form (1B)
- ☐ Regulated Research Institutional/Industrial Setting Form (1C) (when applicable)
- ☐ Continuation Form (7) (when applicable)

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6) **Additional forms required if the project includes the use of one or more of the following** (check all that apply):

☐ **Humans** (Requires prior approval by an Institutional Review Board (IRB), see pp. 13-16 for full text of the rules)

- ☐ Human Subjects Form (4)
- ☐ Qualified Scientist Form (2) (if applicable and/or required by the IRB)

☐ **Vertebrate Animals** (Requires prior approval, see pp. 17-20 for full text of the rules)

- ☐ Vertebrate Animal Form (5A) - for projects conducted in a non-regulated research site (SRC prior approval required.)
- ☐ Vertebrate Animal Form (5B) - for projects conducted at a Regulated Research Institution. (Institutional Animal Care and Use Committee (IACUC) approval required prior experimentation.)
- ☐ Qualified Scientist Form (2) (Required for all vertebrate animal projects at a regulated research site or when applicable)

☐ **Potentially Hazardous Biological Agents** (Requires prior approval by SRC, IACUC or Institutional Biosafety Committee (IBC), see pp. 21-24 for full text of the rules.)

- ☐ Potentially Hazardous Biological Agents Form (6A)
- ☐ Human and Vertebrate Animal Tissue Form (6B) - to be completed in addition to Form 6A when project involves the use of fresh tissue, primary cell cultures, blood, blood products and body fluids.
- ☐ Qualified Scientist Form (2) (when applicable)

☐ **Hazardous Chemicals, Activities and Devices** (No prior approval required, see pp.25-27 for full text of the rules.)

- ☐ Risk Assessment Form (3)
- ☐ Qualified Scientist Form (2) (required for projects involving DEA-controlled substances or when applicable)

Adult Sponsor's Printed Name	Signature	Date of Review (Must be prior to experimentation.)

Phone	Email

Student Checklist (1A)

This form is required for ALL projects.

1) a. Student/Team Leader: _____ Grade: _____

Email: _____ Phone: _____

b. Team Member: _____ c. Team Member: _____

2) Title of Project: _____

_____

3) School: _____ School Phone: _____

School Address: _____

_____

4) Adult Sponsor: _____ Phone/Email: _____

5) Is this a continuation from a previous year? ☐ Yes ☐ No

If Yes:

a) Attach the previous year's ☐ **Abstract** ☐ **Form 1A and** ☐ **Research Plan**

b) Explain how this project is new and different from previous years on ☐ **Continuation Form (7)**

6) **This year's** laboratory experiment/data collection will begin: **(must be stated (mm/dd/yy)**

Projected Start Date: _____ Projected End Date: _____
(Projected dates are required for projects that require SRC/IRB prior review)

ACTUAL Start Date: _____ ACTUAL End Date: _____

7) Where will you conduct your experimentation? (check all that apply)

☐ Research Institution ☐ School ☐ Field ☐ Home ☐ Other: _____

8) List name and address of all non-school work site(s):

Name: _____ _____

Address: _____ _____

_____ _____

Phone: _____ _____

9) **Complete a Research Plan as described on page 31 and attach to this form.**

10) **An abstract is required for all projects after experimentation (see page 28).**

Research Plan

REQUIRED for ALL Projects Before Experimentation
A complete research plan must accompany Checklist for Student (1A)

Provide a typed research plan and attach to Student Checklist (1A).

The research plan for ALL projects is to include the following:

A. Question being addressed

B. Hypothesis/Problem/Engineering Goals

C. Description in detail of method or procedures (The following are important and key items that should be included when formulating ANY AND ALL research plans.)

- **Procedures:** Detail all procedures and experimental design to be used for data collection
- **Data Analysis:** Describe the procedures you will use to analyze the data that answer research question or hypothesis

D. Bibliography: List at least five (5) major references (e.g. science journal articles, books, internet sites) from your literature review. If you plan to use vertebrate animals, one of these references must be an animal care reference.

- Choose one style and use it consistently to reference the literature used in the research plan
- Guidelines can be found in the Student Handbook.

These are guidelines and should be followed where applicable. *Refer to Items 1-4 below.

1. **Human subjects research** (See instructions on p. 13 of the International Rules):
   - Detail all procedures, include what the participants are asked to do (see p. 13)
   - Describe Risk Assessment process and how risks will be minimized
     - Strategies used to protect privacy and confidentiality
   - Describe Study Sample/Human Subjects
     - Number of human subjects and estimated demographics (may include information such as: age, male/female, cultural background breakdown, Socio-economic status)
     - Recruitment procedures (where and how subjects are recruited)
     - Procedures for obtaining informed consent must include statement about informing potential human subjects about voluntary nature of participation and right to withdraw at any time
   - Include survey or questionnaires if used, and critically evaluate the risk
     - List and describe the measures (questionnaires, surveys) used and how you measure the variable of interest (behavioral observations, time, length). Attach the questionnaire/survey
     - Consider emotional stress and potential consequences
   - Describe any physical activities or procedures, if used, and critically evaluate the risks
     - Type, duration of exercise or physical activity
     - Ingestion method, amount, intervals, etc.

2. **Vertebrate animal research** (See instructions on p.17 of the International Rules):
   - Briefly discuss **POTENTIAL ALTERNATIVES** and present a detailed justification for use of vertebrate animals
   - Explain potential impact or contribution this research may have
   - Detail all procedures to be used
     - Include methods used to minimize potential discomfort, distress, pain and injury to the animals during the course of experimentation
     - Detailed chemical concentrations and drug dosages
   - Detail animal numbers, species, strain, sex, age, etc.
     - Include justification of the numbers planned for the research
   - Describe housing and oversight of daily care
   - Discuss disposition of the animals at the termination of the study

3. **Potentially Hazardous Biological Agents** (See instructions on p.21 of the International Rules):
   - Describe Biosafety Level Assessment process and resultant BSL determination
   - Give source of agent, source of specific cell line, etc.
   - Detail safety precautions
   - Discuss methods of disposal

4. **Hazardous Chemicals, Activities & Devices** (See instructions on p.25 of the International Rules):
   - Describe Risk Assessment process and results
   - Detail chemical concentrations and drug dosages
   - Describe safety precautions and procedures to minimize risk
   - Discuss methods of disposal

Approval Form (1B)

This completed form is required for each student, including all team members.

1) To be completed by student and parent

a) Student Acknowledgment:

☐ I understand the risks and possible dangers to me of the proposed research plan. I have read the ISEF Rules and Guidelines and will adhere to all International Rules when conducting this research.

☐ I have read and will abide by the following Ethics statement:

Scientific fraud and misconduct are not condoned at any level of research or competition. Such practices include plagiarism, forgery, use or presentation of other researcher's work as one's own, and fabrication of data. Fraudulent projects will fail to qualify for competition in affiliated fairs or the ISEF.

Student's Printed Name	Signature	Date Acknowledged (Must be prior to experimentation.)

b) Parent/Guardian Approval: I have read and understand the risks and possible dangers involved in the **Research Plan**. I consent to my child participating in this research.

Parent/Guardian's Printed Name	Signature	Date of Approval (Must be prior to experimentation.)

2) To be completed by the fair SRC

(Required for projects requiring prior SRC/IRB APPROVAL. Sign 2a or 2b as appropriate.)

a) Required for projects that need prior SRC/IRB approval BEFORE experimentation
(humans, vertebrates or potentially hazardous biological agents)

The SRC/IRB has carefully studied this project's **Research Plan** and all the required forms are included. My signature indicates approval of the **Research Plan** before the student begins experimentation.

SRC/IRB Chair's Printed Name

Signature | Date of Approval (Must be prior to experimentation.)

OR

b) Required for research conducted at all Regulated Research Institutions with no prior fair SRC/IRB approval.

This project was conducted at a regulated research institution (**not home or high school, etc.**), was reviewed and approved by the proper institutional board before experimentation and complies with the ISEF Rules. **Attach (1C) and required institutional approvals (e.g. IACUC, IRB)**

SRC Chair's Printed Name

Signature | Date of Approval

NOTE: If a stamp is used, it must be initialed by the chairperson.

3) Final ISEF Affiliated Fair SRC Approval. (Required for ALL Projects)

SRC Approval After Experimentation and Shortly Before Competition at Regional/State/National Fair
I certify that this project adheres to the approved **Research Plan** and complies with all ISEF Rules.

Regional SRC Chair's Printed Name	Signature	Date of Approval
State/National SRC Chair's Printed Name *(where applicable)*	Signature	Date of Approval

Regulated Research Institutional/Industrial Setting Form (1C)

This form must be completed after experimentation by the adult supervising the student research conducted in a regulated research institution, industrial setting or any work site other than home, school or field.

This form MUST be displayed with your project.

Student's Name _____

Title of Project _____

To be completed by the Supervising Adult in the Setting (NOT the Student) after experimentation:

The student conducted research at my work site:

a) ☐ to use the equipment b) ☐ to perform experiment(s)/conduct research

1) How did the student get the idea for her/his project?
(e.g. Was the project assigned, picked from a list, an original student idea, etc.)

2) Were you made aware of the ISEF rules before experimentation? ☐ Yes ☐ No

3) Did the student work on the project as a part of a research group? ☐ Yes ☐ No
If yes, how large was the group and what kind of research group was it (students, group of adult researchers, etc.)

4) What specific procedures or equipment did the student actually use and how independently did the student work?
Please list and describe. (Do not list procedures student **only** observed.)

Student research projects dealing with human subjects, vertebrate animals or potentially hazardous biological agents require review and approval by an institutional regulatory board (IRB/IACUC/IBC). **Copy of approval(s) must be attached, if applicable.**

Supervising Adult's Printed Name _____ Signature _____ Title _____

Institution _____ Date Signed _____

Address _____ Email/ Phone _____

Qualified Scientist Form (2)

May be required for research involving human subjects, vertebrate animals, potentially hazardous biological agents, and DEA-controlled substances. Must be completed and signed before the start of student experimentation.

Student's Name _____

Title of Project _____

To be completed by the Qualified Scientist:

Scientist Name: _____

Educational Background: _____ Degree(s): _____

Experience/Training as relates to the student's area of research:

_____

Position: _____ Institution: _____

Address: _____ Email/Phone: _____

1) Have you reviewed the ISEF rules relevant to this project? ☐ yes ☐ no

2) Will any of the following be used?

a) Human subjects . . . . . ☐ yes ☐ no

b) Vertebrate animals . . . . . ☐ yes ☐ no

c) Potentially hazardous biological agents (microorganisms, rDNA and tissues, including blood and blood products) . . . . . ☐ yes ☐ no

d) DEA-classed substances. . . . . ☐ yes ☐ no

3) Will you directly supervise the student? . . . . . ☐ yes ☐ no

a. If no, who will directly supervise and serve as the Designated Supervisor? _____

b. Experience/Training of the Designated Supervisor:

4) Describe the safety precautions and training necessary for this project:

To be completed by the Qualified Scientist:

I certify that I have reviewed and approved the **Research Plan** prior to the start of the experimentation. If the student or Designated Supervisor is not trained in the necessary procedures, I will ensure her/his training. I will provide advice and supervision during the research. I have a working knowledge of the techniques to be used by the student in the **Research Plan**. I understand that a Designated Supervisor is required when the student is not conducting experimentation under my direct supervision.

_____
Qualified Scientist's Printed Name

_____ _____
Signature Date of Approval

To be completed by the Designated Supervisor when the Qualified Scientist cannot directly supervise.

I certify that I have reviewed the **Research Plan** and have been trained in the techniques to be used by this student, and I will provide direct supervision.

_____
Designated Supervisor's Printed Name

_____ _____
Signature Date of Approval

_____ _____
Phone Email

Risk Assessment Form (3)

Required for projects using hazardous chemicals, activities or devices or regulated substances and some potentially hazardous biological agents. Must be completed before experimentation.

Student's Name _____

Title of Project _____

To be completed by the Student Researcher in collaboration with Designated Supervisor/Qualified Scientist:
(All questions must be answered; additional page(s) may be attached.)

1. List/identify the hazardous chemicals, activities, or devices or microorganisms that will be used.

2. Identify and assess the risks involved.

3. Describe the safety precautions and procedures that will be used to reduce the risks.

4. Describe the disposal procedures that will be used (when applicable).

5. List the source(s) of safety information.

To be completed and signed by the Designated Supervisor (or Qualified Scientist, when applicable):
I agree with the risk assessment and safety precautions and procedures described above. I certify that I have reviewed the **Research Plan** and will provide direct supervision.

Designated Supervisor's Printed Name _____ Signature _____ Date of Review _____
(must be prior to experimentation.)

Position & Institution _____ Phone or email contact information _____

Experience/Training as relates to the student's area of research

Human Subjects Form (4)

Required for all research involving human subjects. IRB approval required before experimentation.

Student's Name _____

Title of Project _____

To be completed by Student Researcher in collaboration with the Designated Supervisor/Qualified Scientist:

(All questions must be answered; additional page may be attached.)

1) Describe the purpose of this study and list all of the research procedures in which the subject will be involved. Include the duration of the subject's involvement. Attach any survey or questionnaire.

2) Describe and assess any potential risk or discomfort, and, if any, potential benefits (physical, psychological, social, legal or other) that may be reasonably expected by participating in this research.

3) Describe the procedures that will be used to minimize risk, to obtain informed consent and/or assent, and to maintain confidentiality.

For questions or concerns regarding this research, contact: _____ at _____.
Adult Sponsor Email/phone

To be completed by Institutional Review Board (IRB) prior to experimentation: Determination of risk, including physical and psychological risks (See risk evaluation, p. 14.) MUST CHECK ONE OF THE BOXES

☐ **Minimal risk where informed consent is recommended, but not required.** Justification for waiver of informed consent for research with subjects under 18 years of age: _____

☐ **Minimal risk where informed consent is REQUIRED.**

☐ **More than minimal risk where informed consent & a Qualified Scientist are REQUIRED**

IRB SIGNATURES (All three signatures are required; Conflict of interest must be avoided (See p.11))

1) Medical Professional: ***(MUST circle one)*** (a psychologist, psychiatrist, medical doctor, licensed social worker, physician's asst., or registered nurse)

Printed Name (including title) _____ Signature _____ Date of Approval _____

2) Science Teacher:

Printed Name _____ Signature _____ Date of Approval _____

3) School Administrator:

Printed Name _____ Signature _____ Date of Approval _____

To be completed by Human Subject:

(prior to participation)

Printed Name _____

☐ yes ☐ no I have read and understand the conditions and risks above and I consent/assent to voluntarily participate in this research study.

☐ yes ☐ no I realize I am free to withdraw my consent and to withdraw from this study at any time without negative consequences.

☐ yes ☐ no I consent to the use of visual images (photos, videos, etc.) involving my participation in this research.

Signature _____ Date _____

To be completed by Parent/Guardian:

(Prior to participation and when participant is under 18 and informed consent is required)

Printed Name _____

☐ yes ☐ no I have read and understand the conditions and risks above and consent to the participation of my child.

☐ yes ☐ no I have reviewed a copy of any survey or questionnaire used in the research.

☐ yes ☐ no I consent to the use of visual images (photos, videos, etc.) involving my child in this research.

Signature _____ Date _____

Vertebrate Animal Form (5A)

Required for all research involving vertebrate animals that is conducted in a Non-Regulated Research Site. (SRC approval required before experimentation.)

Student's Name _____

Title of Project _____

To be completed by Student Researcher:

1. Common name (or Genus, species) and number of animals used.

2. Describe completely the housing and husbandry to be provided. Include the cage/pen size, number of animals per cage, environment, bedding, type of food, frequency of food and water, how often animal is observed, etc.

3. What will happen to the animals after experimentation?

To be completed by Scientific Review Committee (SRC) BEFORE experimentation:

☐ Observational study only. Veterinarian and Designated Supervisor NOT required.

☐ Agricultural, behavioral, nutritional study.

- ☐ Designated Supervisor REQUIRED. Please have applicable person sign below.
- ☐ Veterinarian and Designated Supervisor REQUIRED. Please have applicable persons sign below.
- ☐ Veterinarian, Designated Supervisor and Qualified Scientist REQUIRED. Please have supervisor sign below and complete a Qualified Scientist Form (2).

The SRC has carefully reviewed this study and finds it is an appropriate study that may be conducted in a non-regulated research site.
SRC Pre-Approval Signature:

SRC Chair Printed Name _____ Signature _____ Date of Approval _____

To be completed by Veterinarian:

☐ I certify that I have reviewed this research and animal husbandry with the student before the start of experimentation.

☐ I certify that I will provide veterinary medical and nursing care in case of illness or emergency.

Printed Name _____ Email/Phone _____

Signature _____ Date of Approval _____

To be completed by Designated Supervisor:

☐ I certify that I have reviewed this research and animal husbandry with the student before the start of experimentation and I accept primary responsibility for the care and handling of the animals in this project.

☐ I certify that I will directly supervise the experiment.

Printed Name _____ Email/Phone _____

Signature _____ Date of Approval _____

Vertebrate Animal Form (5B)

Required for all research involving vertebrate animals that is conducted at a Regulated Research Institution. (IACUC approval required before experimentation.)

Student's Name _____

Title of Project _____

Title and Protocol Number of IACUC Approved Project _____

To be completed by Qualified Scientist or Principal Investigator:

1. Was this a student-generated idea or was it a subset of your work?

2. Have you reviewed the ISEF Rules relevant to this project?
3. What laboratory training, including dates, was provided to the student?

4. Species of animals used: _____ Number of animals used: _____
5. USDA Pain Category designated for this study:
6. Describe, in detail, the role of the student in this project: procedures and equipment they were involved with, oversight provided and safety precautions employed. (Attach extra pages if necessary.)

7. **Attach a copy of the Regulated Research Institution IACUC Approval.** A letter from the Qualified Scientist or Principal Investigator is not sufficient**.**

Certification or Documentation of Student Researcher Training

_____ _____

List Certificate Number or Attach Documentation Date(s) of Training

_____ _____ _____

Qualified Scientist/Principal Investigator Printed Name Signature Date

_____ _____ _____

IACUC Chair/Coordinator Printed Name Signature Date

Potentially Hazardous Biological Agents Form (6A)

Required for all research involving microorganisms, rDNA and fresh tissue, blood and body fluids.
SRC/IACUC/IBC approval required before experimentation.

Student's Name _____

Title of Project _____

To be completed by Student Researcher in collaboration with Qualified Scientist/Designated Supervisor:

(All questions are applicable and must be answered; additional page(s) may be attached.)

1) Identify potentially hazardous biological agents to be used in this experiment. Include the source, quantity and the biosafety level risk group of each microorganism.

2) Describe the site of experimentation including the level of biological containment.

3) Describe the method of disposal of all cultured materials and other potentially hazardous biological agents.

4) Describe the procedures that will be used to minimize risk. (personal protective equip., hood type, etc.)

5) What final biosafety level do you recommend for this project given the risk assessment you conducted?

To be completed by Qualified Scientist or Designated Supervisor

1) What training will the student receive for this project?

2) Do you concur with the biosafety information and recommendation provided by the student researcher above? ☐ Yes ☐ No
If no, please explain.

QS/DS Printed Name _____ Signature _____ Date of Signature _____

Experience/training of Designated Supervisor as it relates to the student's area of research (if applicable)

To be completed by SRC prior to experimentation:

☐ The SRC has carefully studied this project's Research Plan and the risk level assessment above and approves this study as a BSL-1 study, which must be conducted at a BSL-1 or above laboratory.

☐ The SRC has carefully studied this project's Research Plan and the risk level assessment above and approves this study as a BSL-2 study, which must be conducted at a BSL-2 or above laboratory.

SRC Chair's Printed Name _____

Signature _____ Date of Approval _____

To be completed by SRC after experimentation with Institutional pre-approval:

☐ This project was reviewed and approved by the appropriate institutional board (e.g. IACUC, IBC) before experimentation at a BSL-1 or BSL-2 laboratory and complies with the ISEF rules. The required institutional forms are attached.

☐ The institution does not require approval for this type of study. The student has received proper training. Attached is a letter from an institutional representative certifying the above.

SRC Chair's Printed Name _____

Signature _____ Date of Approval _____

Human and Vertebrate Animal Tissue Form (6B)

Required for all projects using fresh tissue, primary cell cultures, blood, blood products and body fluids.
If the research involves living organisms, please ensure that the proper human or animal forms are completed.
ALL PROJECTS USING ANY TISSUE LISTED ABOVE, MUST ALSO COMPLETE FORM 6A.

Student's Name _____

Title of Project _____

To be completed by Student Researcher:

1) What tissue(s), organ(s), or part(s) will be used?

2) Where will the above tissue, organ, or part be obtained (identify each separately):

3) If the tissue is obtained from a source within a research institution, please provide information regarding the vertebrate study from which the tissue was obtained. Include the name of the research institution, the title of the study, the IACUC approval number and date of IACUC approval.

To be completed by the Qualified Scientist or Designated Supervisor:

☐ I verify that the student will work solely with organs, tissues, cultures or cells that will be supplied to him/her by myself or qualified personnel from the laboratory; and that if vertebrate animals were euthanized they were euthanized for a purpose other than the student's research.

AND/OR

☐ I certify that the blood, blood products, tissues or body fluids in this project will be handled in accordance with the standards and guidance set forth in Occupational Safety and Health Act, 29CFR, Subpart Z, 1910.1030 - Blood Borne Pathogens.

Printed Name	Signature	Date Signed (Must be prior to experimentation.)
Title	Phone/Email	
Institution		

Continuation Projects Form (7)

Required for projects that are a continuation in the same field of study as a previous project.
This form must be accompanied by the previous year's abstract, Form (1A) and Research Plan.

Student's Name _____

To be completed by Student Researcher:

List all components of the current project that make it new and different from previous research. Use an additional form for 2004 and earlier projects.

Components	Current Research Project	Previous Research Project
1. Title		2006-2007: 2005-2006:
2. Objectives		2006-2007: 2005-2006:
3. Variables studied		2006-2007: 2005-2006:
4. Line of investigation		2006-2007: 2005-2006:
5. Additional changes		2006-2007: 2005-2006:

This form must be displayed at your project to help provide the judges a better understanding of your project and what research has been done in the current year.

I hereby certify that the above information is correct and that the current year Abstract & Certification and project display board properly reflect work done only in the current year.

Student's Printed Name _____ Signature _____ Date of Signature _____

Science Research and the Process of Science

Research is a process by which people discover or create new knowledge about the world in which they live. The ISEF and Affiliated Fairs are research (data) driven. Students design research projects that provide quantitative data through experimentation followed by analysis and application of that data. Projects that are demonstrations, 'library' research or informational projects, 'explanation' models or kit building are not appropriate for research based science fairs.

Questioning is probably the most important part of a scientific investigation and is often followed by an "if…then" statement. Students are encouraged to design 'controlled' experiments, ones that allow them to set up a standard and then change only one variable at a time to see how that variable might affect the original condition tested as the standard. Thus, questioning usually leads to experiments or observations.

Good scientists, both young and old, frequently use a process to study what they see in the world. This process has been referred as the 'Scientific Method' or more recently as the 'Inquiry Cycle'. The following stages listed below will help you produce a good scientific experiment:

1) Be curious, choose a limited subject, ask a question; identify or originate/define a problem. It is important that this question be a 'testable' question – one in which data is taken and used to find the answer. A testable question can further be identified as one in which one or more variables can be identified and tested to see the impact of that variable on the original set of conditions. The question should not merely be an 'information' question where the answer is obtainable through literature research.
2) Review published materials related to your problem or question. This is called background research.
3) Evaluate possible solutions and guess why you think it will happen (hypothesis).
4) Experimental design (procedure). In designing the experiment, it is critical that only one variable – a condition that may effect the results of the experiment – is changed at a time. This makes the experiment a 'controlled' experiment.
5) Challenge and test your hypothesis through your procedure of experimentation (data collection) and analysis of your data. Use graphs to help see patterns in the data.
6) Draw conclusions based on empirical evidence from the experiment.
7) Prepare your report and exhibit.
8) Review and discuss the findings with peer group/ professional scientists
9) New question(s)may arise from your discussions.

This sets the stage for another research project as new questions are raised from others and the process repeats itself. The hypothesis often changes during the course of the experiment. Supporting or not supporting your hypothesis is secondary to what is learned and discovered during the research.

Non Inquiry Based Research

Not all areas of study are best served by scientific method based research. Because engineers, inventors, mathematicians, theoretical physicists, and computer programmers have different objectives than those of other scientists, they follow a different process in their work. The process that they use to answer a question or solve a problem is different depending on their area of study. Each one uses their own criteria to arrive at a solution.

Engineering Projects

"Scientists try to understand how nature works; engineers create things that never were." An engineering project should state the engineering goals, the development process and the evaluation of improvements. Engineering projects may include the following:

1) Define a need or "How can I make this better?"
2) Develop or establish design criteria (could be more than one)
3) Do background research and search the literature to see what has already been done or what products already exist that fill a similar need. What make them good and what makes them weak?
4) Prepare preliminary designs and a materials list. Consider costs, manufacturing and user requirements.
5) Build and test a prototype of your best design. Consider reliability, repair and servicing.
6) Retest and redesign as necessary. Product testing.
7) Present results

Computer Science Projects

These often involve creating and writing new algorithms to solve a problem or improve on an existing algorithm. Simulations, models or 'virtual reality' are other areas on which to conduct research.

Mathematics Projects

These involve proofs, solving equations, etc. Math is the language of science and is used to explain existing phenomena or prove new concepts and ideas.

Theoretical Projects

These projects may involve a thought experiment, development of new theories and explanations, concept formation or designing a mathematical model.

Getting Started

1) **Pick your topic:** This is perhaps the most difficult part. Get an idea of what you want to study or learn about. Ideas should come from things in your area of interest. A hobby might lead you to a good topic. What is going on in the world that you would like to know more about? Most importantly, pick a question or problem that is not too broad and that can be answered through scientific investigation.

2) **Research your topic:** Go to the library or internet to learn more about your topic. Always ask Why or What if…. Look for unexplained or unexpected results. Also, talk to professionals in the field.

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

4) **Make a time table:** Choose a topic that not only interests you, but can be done in the amount of time you have. Identify your 'testable question'. Develop a time line to manage your time efficiently. You will need time to fill out the necessary forms and to review the Research Plan with your sponsor. Certain projects will require more time because they need prior Scientific Review Committee (SRC) or Institutional Review Board (IRB) approval. Allow plenty of time to experiment and collect data. You will also need time to write a paper and put together a display or 'board'.

5) **Plan Your Experiment:** Give careful thought to experimental design. Once you have a feasible project idea, write a research plan. This plan should explain how you will do your experiments and exactly what will be involved. Remember you must design your experiment so that it is a 'controlled' experiment. This is one in which only one variable is changed at a time. The results are then compared to the 'standard' data you take originally before you change that one variable. Thus, you have designed an investigation with adequate control and limited variables to investigate a question. Also, in your experimental design, make sure you include sufficient numbers in both control (if applicable) and experimental groups to be statistically valid. The experimental design should also include a list of materials. Once finished with the experimental design (called 'procedure') all students are required to fill out the appropriate forms.

6) **Consult with Your Adult Sponsor and get Approvals:** You are required to discuss your research plan with an Adult Sponsor and obtain a signature of approval. In reviewing your research plan, you should determine if additional forms and prior approval are needed.

7) **Conduct your experiment:** During experimentation, keep detailed notes of each and every experiment, measurement and observation in a log book. Do not rely on memory. Besides, judges love logbooks! Use data tables or charts to record your quantitative data.

8) **Analyze Your Results:** When you complete your experiments, examine and organize your findings. Use appropriate graphs to make 'pictures' of your data. Identify patterns from the graphs. This will help you answer your testable question. Did your experiments give you the expected results? Why or why not? Was your experiment preformed with the exact same steps each time? Are there other explanations that you had not considered or observed? Were there experimental errors in your data taking, experimental design or observations? Remember, that understanding errors is a key skill scientists must develop. In addition, reporting that a suspected variable did not change the results can be valuable information. That is just as much a 'discovery' as if there was some change due to the variable. In addition, statistically analyze your data using the statistics that you can understand and explain their meaning.

9) **Draw Conclusions:** Did the variable(s) tested cause a change when compared to the standard you are using? What patterns do you see from your graph analysis that exist between your variables? Which variables are important? Did you collect enough data? Do you need to conduct more experimentation? Keep an open mind – never alter results to fit a theory. If your results do not support your hypothesis, that's ok and in some cases good! Try to explain why you obtained different results than your literature research predicted for you. Were there sources of error that may have caused these differences? If so, identify them. Even if the results do differ, you still have accomplished successful scientific research because you have taken a question and attempted to discover the answer through quantitative testing. This is the way knowledge is obtained in the world of science. Think of practical applications that can be made from this research. How could this project be used in the real world? Finally, explain how you would improve the experiment and what would you do differently.

Elements of a Successful Project

1) Project Data Book:

A project data book is your most treasured piece of work. Accurate and detailed notes make a logical and winning project. Good notes show consistency and thoroughness to the judges and will help you when writing your research paper. Data tables are also helpful. They may be a little 'messy' but be sure the quantitative data recorded is accurate and that units are included in the data tables. Make sure you date each entry.

2) Research Paper:

A research paper should be prepared and available along with the project data book and any necessary forms or relevant written materials. A research paper helps organize data as well as thoughts. A good paper includes the following sections.

a) **Title Page and Table of Contents:** The title page and table of contents allows the reader to follow the organization of the paper quickly.

b) **Introduction:** The introduction sets the scene for your report. The introduction includes the purpose, your hypothesis, problem or engineering goals, an

explanation of what prompted your research, and what you hoped to achieve.

c) **Materials and Methods:** Describe in detail the methodology you used to collect data, make observations, design apparatus, etc. Your report should be detailed enough so that someone would be able to repeat the experiment from the information in you paper. Include detailed photographs or drawings of self-designed equipment. *Only include this year's work.*

d) **Results:** The results include data and analysis. This should include statistics, graphs, pages with your raw collected data, etc.

e) **Discussion:** This is the essence of your paper. Compare your results with theoretical values, published data, commonly held beliefs, and/or expected results. Include a discussion of possible errors. How did the data vary between repeated observations of similar events? How were your results affected by uncontrolled events? What would you do differently if you repeated this project? What other experiments should be conducted?

f) **Conclusions:** Briefly summarize your results. State your findings in relationships of one variable with the other. Support those statements with empirical data. (one average compared to the other average, for example). Be specific, do not generalize. Never introduce anything in the conclusion that has not already been discussed. Also mention practical applications.

g) **Acknowledgments:** You should always credit those who have assisted you, including individuals, businesses and educational or research institutions.

h) **References/Bibliography:** Your reference list should include any documentation that is not your own (i.e. books, journal articles, websites, etc.). See an appropriate reference in your discipline for format or refer to the Instructions to Authors of the appropriate publication.

Three common reference styles are:

APA (American Psychological Association) **Style** :

http://apastyle.apa.org/

http://owl.english.purdue.edu/owl/resource/560/01/
This resource, revised according to the **5th edition** of the APA manual, offers examples for the general format of APA research papers, in-text citations, endnotes/ footnotes, and the reference page.

MLA (Modern Language Association) **Format:**

http://www.mla.org/style

http://owl.english.purdue.edu/owl/resource/557/01/
This resource, updated to reflect the *MLA Handbook for Writers of Research Papers* (**6th ed.**) and the *MLA Style Manual and Guide to Scholarly Publishing* (**2nd ed.**), offers examples for the general format of MLA research papers, in-text citations, endnotes/footnotes, and the Works Cited page.

Chicago Manual of Style

http://www.chicagomanualofstyle.org/home.html

The Chicago Manual of Style presents two basic documentation systems. The more concise author-date system has long been used by those in the physical, natural, and social sciences. In this system, sources are briefly cited in the text, usually in parentheses, by author's last name and date of publication. The short citations are amplified in a list of references, where full bibliographic information is provided.

3) Abstract:

After finishing research and experimentation, you need to write an abstract. The abstract needs to be a maximum of 250 words on one page. An abstract should include the a) purpose of the experiment, b) procedures used, c) data, and conclusions. It also may include any possible research applications. Only minimal reference to previous work may be included. The abstract must focus on work done in the current year and should not include a) acknowledgments, or b) work or procedures done by the mentor. See below for an example of an appropriately written abstract. See page 28 of the International Rules for the proper formatting of an Official Intel ISEF Abstract and Certification. Please Note: The Official abstract form is only for those participating in ISEF and may not be required for many Affiliated or local fairs.

Sample Abstract

Effects of Marine Engine Exhaust Water on Algae
Jones, Mary E.
Hometown High School, Hometown, PA

This project in its present form is the result of bioassay experimentation on the effects of two-cycle marine engine exhaust water on certain green algae. The initial idea was to determine the toxicity of outboard engine lubricant. Some success with lubricants eventually led to the formulation of "synthetic" exhaust water which, in turn, led to the use of actual two-cycle engine exhaust water as the test substance.

Toxicity was determined by means of the standard bottle or "batch" bioassay technique. *Scenedesmus quadricauda* and *Ankistrodesmus* sp. were used as the test organisms. Toxicity was measured in terms of a decrease in the maximum standing crop. The effective concentration - 50% (EC50) for *Scenedesmus quadricauda* was found to be 3.75% exhaust water; for *Ankistrodesmus* sp. 3.1% exhaust water using the bottle technique.

Anomalies in growth curves raised the suspicion that evaporation was affecting the results; therefore, a flow-through system was improvised utilizing the characteristics of a device called a Biomonitor. Use of a Biomonitor lessened the influence of evaporation, and the EC 50 was found to be 1.4% exhaust water using Ankistrodesmus sp. as the test organism. Mixed populations of various algae gave an EC 50 of 1.28% exhaust water.

The contributions of this project are twofold. First, the toxicity of two-cycle marine engine exhaust was found to be considerably greater than reported in the literature (1.4% vs. 4.2%). Secondly, the benefits of a flow-through bioassay technique utilizing the Biomonitor was demonstrated.

Patent and Copyright Information

You may want to consider applying for a patent or copyright if you want to protect your work. You can contact the Office of Public Affairs, U.S. Patent Office, at 1-800-786-9199 for Patent information or the Library of Congress at 202-707-3000 for copyright information.

4) **Visual Display:**

You want to attract and inform. Make it easy for interested spectators and judges to assess your study and the results you have obtained. You want to 'catch the eye' of the judges and convince them that the research is of sufficient quality to deserve closer scrutiny. Most displays or boards have three sections and are free standing. For the most part, the displays are put on a table. Most judges get a chance to look at the board before the interviews. Make the most of your space using clear and concise displays. You never get a second chance to make a first impression! Please be sure to reference the Display and Safety Rules on page 6 of the International Rules and Guidelines; this information is also available on the Science Service website at www.sciserv.org.

Helpful hints for display:

a) **Current Year:** Make sure the board reflects the current year's work only. Prior year's data books are permitted at your project.

b) **Good Title:** Your title is an extremely important attention-grabber. A good title should simply and accurately present your research and depict the nature of the project. The title should make the casual observer want to know more.

c) **Take Photographs:** Many projects involve elements that may not be safely exhibited at the Fair, but are an important part of the project. You might want to take photographs of important parts/phases of your experiment to use in your display. Photograph or other visual images of human test subjects must have informed consent (Human Subject Form 4. Please see page 7 of the International Rules). Credit must be given for all photographs.

d) **Be Organized:** Make sure your display follows a sequence and is logically presented and easy to read. Reach out to the 'skim-reader'. A glance should permit anyone (particularly the judges) to locate quickly the title, abstract, experiments, results and conclusions. When you arrange your display, imagine that you are seeing it for the first time. Highlight your results using key graphs that show the relationships of the two variables tested. Use the graphs to give a 'picture' of the data for your viewers. These graphs will provide an easier method of viewing the data rather that just seeing the recorded quantitative data.

e) **Eye-Catching:** Make your display stand out. Use neat, colorful headings, charts and graphs to present your project. Pay special attention to the labeling or graphs, charts, diagrams, photographs, and tables to ensure that each has a title and appropriate label describing what is being demonstrated. Anyone should be able to understand the visuals without further explanation.

f) **Correctly Presented and Well-Constructed:** Be sure to adhere to the size limitations and safety rules when preparing your display. Display all required forms for your project. Make sure your display is sturdy, as it will need to remain intact for quite a while. You must also consider the weight of the project for shipping. It can be very costly to ship a heavy board. Keep your materials light, but strong.

Please Note: The judges are judging your research, not the display. So don't spend an excessive amount of time or money on the board. You are being judged on the science not the show!

5) **Judging**

Judges evaluate and focus on 1) what the student did in the current year; 2) how well a student followed the scientific, engineering, computer programming or mathematical methodologies; 3) the detail and accuracy of research as documented in the data book; and 4) whether experimental procedures were used in the best possible way.

Judges look for well thought-out research. They look at how significant your project is in it's field; how thorough you were, and how much of the experiment thought and design is your own work.

Initially, judges get their information from your board, abstract and research paper to learn what the project is about, but it is the **Interview** that will be the final determination of your work. Judges applaud those students who can speak freely and confidently about their work. They are not interested in memorized speeches or presentations – they simply want to **talk** with you about your research to see if you have a good grasp of your project from start to finish. It is important to start the interview off right. Greet the judges and introduce yourself. You want to make a good first impression. Appearance, good manners, appropriate attire, and enthusiasm for what you are doing will impress the judges.

Judges often ask questions to test your insight into your projects such as: "How did you come up with this idea? "What was your role?", "What didn't you do?", "What further plans do you have to continue research?" and "What are the practical applications of your project?" Remember that the judges need to see if you understand the basic principles of science behind your project or topic area. They want to determine if you have correctly measured and analyzed the data. They want to know if you can determine possible sources of error in your project and how you might apply your findings to the 'real' world. Finally, the judges seek to encourage you in your scientific efforts and your future goals/career in science. Relax, smile and enjoy your time to learn from them and accept their accolades for your fine work.

Intel ISEF Judging Criteria (points)

	Individual	Team
Creative Ability	30	25
Scientific Thought and Engineering Goals	30	25
Thoroughness	15	12
Skill	15	12
Clarity	10	10
Teamwork	---	16