Manual

Massachusetts

Science Fair

State High School Edition

Massachusetts Science Fair

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Special Acknowledgment: Science Service/International Science & Engineering Fair

THE EXPERIENCE

The High School Science Fair

"An Opportunity for Students to Learn… An Opportunity for Students to Grow"

The Massachusetts State Science & Engineering Fair gives high school students throughout Massachusetts a unique opportunity to compete for college scholarships, awards, honors programs, and other exciting prizes. But better yet, it brings them something even more precious: a valuable learning experience.

Each year, young scientists and engineers from public, private and parochial high schools (grades 9-12) pursue specialized fields of science by working on individualized research projects, either as part of their core curriculum or through independent study. These projects broaden scientific awareness and allow students to delve deeply into areas of special interest giving them a chance to explore, to gather information, to think critically, to arrive at conclusions, and to present ideas in a competitive forum. Science projects help develop higher level thinking skills.

Involvement in science fair projects provides students with opportunities to problem-solve, an understanding of and familiarity with the scientific method, and a basis of empirical knowledge, that carries over into many other parts of their lives. Curiosity and interest stimulate respect for evidence and develops a sense of stewardship. The science fair process demands an open mind and the use of analysis to process information. The student learns that success in investigation and research requires persistence and that such persistence can be both fun and rewarding.

Communities, through their local school systems, often share in the recognition their students receive, and through the guidance of parents, teachers, mentors, and Qualified Scientists, students are directed toward more advanced study, helping to maintain our scientific leadership now and for future generations.

Taking part in the MSSEF is a rewarding experience. It is an opportunity for students to learn and provides an opportunity for students to grow.

MSSEF ETHICS STATEMENT

Massachusetts State Science & Engineering Fair, Inc. has adopted an ethics statement that each student is required to adhere to and will be asked to sign as a part of the research plan and application process.

The Statement

The primary reason that science project work enables such a wide range of learning to take place for each individual student is that the students themselves "own the question". Students pose a scientific problem and seek the necessary avenues to find a solution.

When students work with a mentor either at school, in a lab or wherever project work takes place, adults working with students should bear in mind that it is the student's project. The mentor's job is to help students acquire background information, teach the techniques required to test the purpose or hypothesis and above all to look out for the safety of young scientists.

The mentor should not suggest or assign a specific topic to the student (the idea must come from the student), take data for the student (unless the student is willing to give credit to the data taker and does not claim the data as their own) or analyze the data for the student. These actions take away the opportunity for students to do these activities on their own, and devalue student science project work in general. The motive for introducing science projects to young people is to help encourage responsible future scientists. The behavior of adult mentors should model the honesty and integrity expected of scientists in our world.

Before experimentation begins each student is required to complete a Research Plan, which includes signing the Ethics Statement that the student will, "adhere to all MSSEF/ISEF rules when conducting research." Students may compete in only one MSSEF affiliated fair, except when proceeding to the state fair from their affiliated regional fair. Students are only eligible to compete in their assigned science fair region, which is determined by the MSSEF. The student(s) will be judged only on the most recent year's research.

Any act of plagiarism associated with science project work exhibited at the Massachusetts State Science & Engineering Fair will lead to disqualification. *Webster's New Collegiate Dictionary* defines plagiarize as "to steal and pass off (the ideas or words of another) as one's own: use (a created production) without crediting the source: present as new and original an idea or product derived from an existing source."

(Continued on next page)

In terms of science project work this means the student MUST:

- Complete all the necessary paperwork and permission forms, before, during and after experimentation, honestly.
- Document their work in a dated notebook recording development of the project including all references, procedures, original data and other relevant material.
- Include a bibliography as part of their background research
- Cite the author of any original statement that is not their own.
- Give credit to anyone giving assistance to the student. If another person(s) performed any part(s) of the experiment, data, collection, etc., credit must be given in the student's journal/log, display, and report.

  In the lab - It is generally assumed that work discussed at science fairs is the work of the student. When this is not the case the student needs to make this very clear in their oral and written presentations of the project.

  Photographs and Visuals - Any photographs included in the student's paper or on their presentation board are assumed to have been taken by the student. Any photographs NOT taken by the student MUST be clearly labeled giving credit to the photographer. This includes any visuals taken from magazines, newspapers, journals, the internet or texts where appropriate permission must be solicited and included. The use of photographs of persons requires a photo release signed by the subject, and if under 18 years of age, also by the guardian of the subject. Sample consent text: "I consent to the use of visual images, (photos, videos, etc.) involving my participation/my child's participation in the research."

Any form of cheating associated with the performance of research, completion of paperwork or in adhering to the stated rules, at any time during the process, will lead to disqualification. *Webster's Dictionary* defines cheat as "mislead; defraud; swindle; to practice deception or trickery". The following acts are considered cheating and will lead to failure to qualify.

Students MUST NOT:

- In any way falsify a permission form or scientific paper.
- Use another person's results or thoughts as their own even with the permission of this person. This includes work done by a family member or a mentor.
- Use information or data obtained from the Internet without proper citation.
- Enter a project for a second or third year with only minor changes.

Please Note:
MSSEF, Inc. is responsible for all decisions relative to project acceptance. All decisions are final.

MSSEF, Inc. assumes no responsibility for project acceptance decisions made at the school or regional levels.

HOW TO USE THIS MANUAL

This manual is composed of six sections arranged to help students, teachers, parents, etc. become part of the science fair process in a logical progressive manner.

Section I: How to Enter the Massachusetts High School Science Fair

This section begins with a brief introduction of how the competitive hierarchy of science fairs works from the classroom through the school, regional, state, and international fairs. It also presents a time line of the key dates of the science fair year and judging criteria. The rules of participation that are necessary for the research plan are described.

Section II: Research and Safety Regulations

This section lists the Restricted Areas of Research and describes the special rules, laws and procedures that must be followed to allow entry into the science fair process. It also describes the role of the Scientific Review Committee (SRC) and the Institutional Review Board (IRB).

Section III: MSSEF Structure & Governance

This section describes the regional structure of the MSSEF system.

Section IV: MSSEF Awards Program

This section describes the MSSEF Award Recognition Program and provides a descriptions of the various existing award categories typically granted to winners of the state fair.

Section V: Science Fair Project Resources

This section offers a list of resources for teachers and students for selecting and working on science projects, and a description of available workshops for teachers.

Section VI: Glossary

This section gives some of the terms used in the science fair process.

Section VII: Appendix

This section includes general instructions, category descriptions, research plan forms, consent forms and checklists.

IMPORTANT!
MSSEF Manual Updates

Students are responsible for checking the website periodically to ensure that they are in compliance with all MSSEF Rules and Procedures.

Section I: How to Enter the Massachusetts High School Science Fair

Massachusetts State Science & Engineering Fair, Inc. (MSSEF) conducts an annual program of competitive science fairs open to high school (grades 9-12) and middle school (grades 6-8) students from all public, private, and parochial schools. This manual covers only the program for high schools and focuses on the annual Massachusetts High School Science Fair.

The MSSEF program is composed of six separate regional fairs and one state fair, thereby providing a competitive hierarchical path upward, from classroom and high school science project and fair to the regional, state, and International Science and Engineering Fair (ISEF).

Student projects are judged at all fairs, the results are announced, and awards are presented at public ceremonies.

Pathways to Science Fair Participation

The MSSEF is open to students from all public, private, and parochial schools (grades 9-12) throughout the state. All schools are encouraged to enter by sending one student and/or one team (2 or 3 member) project directly to the state fair. MSSEF Schools are encouraged to send entries to their respective regional fairs. Schools should contact the respective regional fair directors for details.

Each Regional Fair may send 40 student projects + 10% of all entries over 100, up to 50 projects, as long as the Regional Fair Chairperson certifies the students. In addition to the regional state fair entries, each school can sent one individual and one team project to the state fair. If one of the Region's state fair entries chooses not to attend the State Fair, only the Region can determine the replacement.

Step 1: Developing the Project

To be eligible for entry in the Massachusetts State High School Science Fair, a project must be the work of a single student or a 2-3-person team and must concern itself with only one subject.

Selecting the Subject

As early as possible in the school year, the student or team should select a subject, do background research in order to form a testable hypothesis/goal(s), and develop an experimental design. All students must fill out and submit the STUDENT CHECKLIST (1A) & RESEARCH PLAN, APPROVAL FORM (1B), and CHECKLIST FOR TEACHER /ADULT SPONSOR (1) prior to beginning research. Some students may need to submit additional forms based on their area of research. The RESEARCH PLAN must give a detailed description of the planned research. Students doing studies involving microbes must clearly state the method of disposal of all cultures, equipment, and materials in the RESEARCH PLAN See the www.scifair.com website for appropriate forms and instructions.

Students should bear in mind that it is not the choice of topic that is important, but the manner in which the project is handled. *Often, the simplest of projects presents the greatest*

challenge to an imaginative and intelligent student.

Working on the Project

MSSEF encourages independent thinking. Science fair projects must be entirely the work of the individual student or team. It is important that each project has a central theme and answers a definite scientific question. Only after doing considerable background research should the student or team seek assistance from a mentor at an industrial, hospital, or educational institution.

The teacher/adult sponsor/mentor role should be one of guidance, encouragement and constructive criticism as the need arises. **All students must have teacher approval for a project BEFORE experimentation begins. The parent/guardian cannot serve as the teacher, supervisor, mentor, Qualified Scientist, Designated Supervisor, adult sponsor, etc.**

Home-schooled students must contact their local secondary school for teacher sponsorship, signatures and necessary forms prior to the start of the project.

All projects must comply with the MSSEF Rules and Research & Safety Regulations as are referenced in the Table of Contents in this Manual and on **www.scifair.com**.

Step 2: Research Plan & Approval Forms

Easy to Enter

Early in the fall, MSSEF notifies all schools in the Commonwealth that the current Massachusetts Science Fair Manual is posted on our website, **www.scifair.com**. CDs containing the manual are also available upon request. In general, entering is a two-phase process. **Phase One** is the completion of the Research Plan with accompanying required Approval and Consent Forms to certify the project in terms of safety and legal issues, and **Phase Two** is the registration process completed in the spring and due no later than March 31.

MSSEF Information on registration will be forwarded to schools and teachers. Registration is accomplished on line, beginning on March 1 and ending on March 31. Regional entries must also register for state fair competition. Copies of the on line registration must be signed and submitted directly to MSSEF.

Special Note: The preceding student and school entry procedures pertain to MSSEF regulations. Contact your Regional Chairperson for specific entry requirements and procedures pertaining to the six Regional Science Fairs.

The Massachusetts State Science & Engineering Fair, Inc. and all its sponsors will not be responsible for the food, transportation, lodging, or other activities of the MSSEF exhibitors. These responsibilities lie with the local school authorities and with the students' parents/guardians.

Team Projects

Each school in Massachusetts may send ONE team project and ONE individual project directly to the Massachusetts State Science Fair.

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 regional, state, or international fairs. **All members of the team must be present at the local, regional, state, and international fairs to compete.** 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. In addition, an individual project cannot be converted into a team project.

Each team must appoint a team leader to coordinate the work and act as a spokesperson. However, each member of the team must be able to act as the spokesperson, be fully involved in the project, and be familiar with all aspects of the project. The final work must reflect the coordinated efforts of all team members and each member must be able to present all aspects of the project. Each member of the team and the team as a whole will be evaluated using the same rules and judging criteria as an individual project (See Judging Criteria).

Each team must complete the STUDENT CHECKLIST (1A) & RESEARCH PLAN, APPROVAL FORM (1B), and the CHECKLIST FOR TEACHER/ADULT SPONSOR (1) before the project begins. A separate APPROVAL FORM (1B) must be completed by each team member. The first student listed under Student Names in the STUDENT CHECKLIST (1A) will be considered the team leader.

The Methods or Procedures of the TEAM STUDENT CHECKLIST (1A) & RESEARCH PLAN should include an outline of each team members' tasks. The name of each member of the team must appear on all additional forms along with the title of the project. The project needs to meet the requirements and safety standards listed in this Manual. Research involving any of the restricted areas listed on the STUDENT CHECKLIST (1A), requires additional forms to be completed before experimentation begins. All forms must be submitted to the regional or MSSEF Scientific Review Committee (SRC) before experimentation begins if in a restricted area and at the time of registration for the fair.

Step 3: Restricted Areas of Research

Research Plans involving Restricted Areas of Research (described in Section II) need to be submitted to the Regional and State Scientific Review Committee (SRC) for approval before the student can begin experimentation or development. Additional Approval Forms may be necessary. These important forms are in accord with MSSEF/ISEF regulations, federal and state laws, and common sense safety considerations.

The SRC meets throughout the school year. Teachers and students can access their project status from the MSSEF website: **www.scifair.com**. Projects that may require several months of work are advised to submit their accurately completed Research Plans to the SRC as early as possible.
Students must keep all original signed forms. Students submit only legible COPIES to the SRC.

Step 4: Registration for the Fair

Registration occurs **after** the local and regional fairs have taken place. Regional and local school entries must complete an online (www.scifair.com) registration form. When completed the form must be printed, signed and mailed directly to MSSEF.

In addition to the Registration Form, copies of the approved STUDENT CHECKLIST (1A) & RESEARCH PLAN, APPROVAL FORM (1B), and the CHECKLIST FOR TEACHER/ADULT SPONSOR (1) must be submitted for all projects. Projects involving Restricted Areas of Research require additional forms as stated above and shown in Section II. The Preliminary Award

Preference Selection Form and the Abstract Form must also be completed.

Timeline for Participation & Registration

1. The present project year includes research conducted over a maximum, continuous 12-month period between January 1st of the previous year and May of the year of the fair.

2. Projects in restricted areas requiring SRC approval must be submitted to the Regional SRC before research can begin. Contact the appropriate regional SRC for dates of review and deadlines.

3. Experimentation and data collection must begin **only after** forms have been completed, submitted, and approved by the teacher and/or the SRC if the research topic is in a restricted area.

5. School fairs occur during February and March. School fairs must be held by the first week in March.

6. Regional fairs must be held by the third week in March. Check **www.scifair.com** for actual dates and locations.

7. MSSEF Registration Forms must be completed online starting March 1st and ending March 31st.

8. Massachusetts State Science & Engineering Fair is typically the first Thurs-Sat in May. Watch for the official Fair Date announcement on our website.

International Science & Engineering Fair (ISEF) Affiliation

The Massachusetts State Science & Engineering Fair is an affiliated fair of the International Science and Engineering Fair. The Massachusetts delegation consists of at least two students and their individual projects and one team project representing the Massachusetts Science Fair. These three projects are selected from the top six regional individual and team winners and are chosen by a team of judges in early spring. Additional delegates from the six regional fairs complete the official Massachusetts ISEF delegation.

Hosted annually in a North American city, ISEF hosts almost 1,500 student exhibitors from more than 40 countries and every state in the U.S. The weeklong program provides all participants with the opportunity to join with their national and international compatriots to share and exchange knowledge and develop lasting friendships. Each of our six regional fairs is also an ISEF affiliated fair. Each regional fair may send up to two individual students and their projects, and one team project directly to ISEF. These students are sponsored and funded by the regional fairs with assistance from MSSEF.

Official MSSEF Rules

All exhibits must conform to the following rules for exhibition at the Massachusetts High School Science Fair.

The present project year includes research conducted over a maximum, continuous 12-month period between January of the previous year and May of the year of the fair.

Rules must be followed throughout the development of the project. **Project supervisors should oversee and insure compliance with all rules before exhibition at local, regional, and state fairs. The project must be based on work carried out in compliance with all local, state, and federal health, safety, and environmental regulations and standards.**

MSSEF, Inc. cannot be held responsible for errors in interpretation or failure to comply with the following rules:

- **Project Classifications**

  a. INDIVIDUAL PROJECT

  The project must be the work of a single student and must concern itself with a single subject. An individual project can never be converted to a team project.

  b. TEAM PROJECT

  The team must consist of no more than three (3) participants and no fewer than two (2) participants. *Team project membership may be altered in subsequent years.* A team project may never be converted to or exhibited as an individual project during the project year. See section on team projects for complete rules on team projects.

- **Continuation or Multiple-Year Projects**

  Students with multiple-year projects must re-submit all prior STUDENT CHECKLIST (1A) and RESEARCH PLANS and approval(s) for each previous year(s). Each page of prior work must be clearly labeled in the upper right corner with the appropriate years. In addition a CONTINUATION PROJECTS FORM – (7) stating differences for each year of the project must be submitted. Judging will involve only research completed since the last MSSEF so the new project design and research plan must evidence substantial expansion of experimentation. Any continuing project must document new and different research (e.g. testing a new variable or new line of investigation, etc.). Repetitions of previous experiments or increasing sample size are examples of unacceptable continuations. Only research done in the current year can be displayed on project boards. Failure to comply with this rule will deem a project ineligible for participation in the science fair.

- **Changes in the Project**

  Any proposed changes in the Research Plan by the student after initial SRC/IRB approval must have subsequent SRC/IRB approval before such changes are implemented and before experimentation begins or resumes. No changes in the project will be allowed after the project has been approved for compliance with the rules, unless a new Research Plan is submitted and approved.

- **Project Journal/Scientific Notebook/Log**

  Students, including each team member, must keep a dated, step-by step, day-by-day notebook recording development of the project including all references, procedures, original data, and other

relevant material. Computer generated charts, data, graphs, and photographs may be printed and included in an additional notebook or attached to the scientific notebook. *Only spiral or bound notebooks are acceptable.*

- **Research Report**
  All projects must have a research report that includes a literature search and a technical report.

- **Exhibitor's Risk**
  Exhibits shall be accepted for display upon the express condition that neither the Massachusetts State Science & Engineering Fair, Inc., the Massachusetts Institute of Technology, nor any other Fair sponsor be held responsible for the loss or theft of, nor any damage to exhibits, nor exhibitor's personal property.

- **Exhibitor's Obligations**
  Students must participate fully in all Fair activities including the Banquet and the Awards Ceremony. During judging and exhibition times, the exhibitors must remain with their projects. If a personal emergency occurs during the Fair, an exhibitor must notify a MSSEF designated committee member at the Registration Table. Ask the committee member to contact the MSSEF President. An award may be forfeited if an exhibitor does not attend the Awards Ceremony.

- **Exhibitor's Expenses**
  MSSEF and all its sponsors assume no responsibility for food, travel, lodging, and other activities of the state fair exhibitors. These responsibilities lie with the local school authorities and with the students' parents and guardians.

- **Giving Credit to Others**
  Students may, at times, have procedures performed by a scientist or other person(s) that he/she cannot or did not perform. Credit must be given to the scientist or any other person performing any part of the student's research, collection of data, experimentation, analysis of data, etc. Since the student's journal/log is considered an historical document of all procedures pertaining to the student's research and experimentation, credit must be given to the person(s) performing any/all activities not directly performed by the student researcher, in the journal/log.

Updates of explanations of rules or changes in rules will be put on the website: www.scifair.com. Check periodically for any changes that may occur.

Failure to comply with all rules and regulations will lead to failure to qualify.

Guidelines for Mentorship

After exhausting school resources, the student may seek a mentor. The mentor must work closely with the teacher and the student. Project design and experimentation must be appropriate for each student's age and knowledge. The student must develop the question and design the related project. The project must be independent of the mentor's experimental work.

All experimentation with a mentor must be supervised. The mentor is obligated to acquaint himself or herself with all the MSSEF procedures, ethics statement, and rules in the Manual and on **www.scifair.com**. It is the responsibility of the mentor to complete all parts of QUALIFIED SCIENTIST FORM (2), RISK ASSESSMENT FORM (3), and REGULATED RESEARCH INSTITUTIONAL/INDUSTRIAL SETTING FORM (1C) as applicable. **The student should NOT fill out any part of these forms**.

No vertebrate animals can be sacrificed for a student's research.

Project Display Guidelines

If the MSSEF Safety Committee and the MIT Health, Safety and Environment professional staff consider the presence or operation of any equipment or material to be dangerous or unsafe, they shall have the right to prohibit the presence or operation of such equipment or material. Exhibitors should plan to demonstrate the safe use of hazardous materials through photographs, videotapes, charts, diagrams, and other simulations such as facsimiles.

All Science Fair participants must attend to the safety aspects of their project, as follows:

- No exhibit may be larger than 122 centimeters (cm) wide X 76 cm deep X 274 cm high from the floor. If the exhibit will be set on a table, the height cannot exceed 198 cm above the table.
- No oversized projects will be permitted.
- Due to safety and fire regulations, no portion of the project may occupy aisle space.
- The weight of the exhibit apparatus should not exceed what a typical folding table can support.
- Tape, tacks, and other such materials and wall space are not available. Students should construct their exhibit so that wall space is not necessary. Exhibitors must provide their own tape, thumbtacks, stapler and any other necessary tools.
- No display lighting is permitted.
- No running water is available.
- Quantities of water must be limited to small break-resistant containers/tanks and secondary containers used. The student shall protect experiments using any combination of water and electricity, by a Ground Fault Circuit Interrupter (GFCI).
- Anything that could be hazardous is prohibited, including the following:
  - live animals and poisonous plants
  - pathogenic microbial agents, e.g. viruses, bacteria, fungi
  - microbial agents used in recombinant DNA experiments
  - hypodermic needles, syringes, razor blades, and other sharp items
  - all chemical substances except water and saline. Any instruments containing mercury, e.g. thermometers
  - glass bottles and lab ware, either empty or containing any substance(must be replaced by break-resistant containers or placed in secondary containers)

- drugs, over-the-counter medications, antibiotics, and vitamins

- The following restrictions apply to acceptable chemical and microbial specimens:
  - All acceptable specimens to be used in the project must be fully and clearly labeled.
  - Abbreviations or formulas should not be used.
  - All acceptable specimens should be transported and displayed in break-resistant containers.
- All parts of the exhibit must be structurally sound and constructed of durable materials.
- Push buttons and levers must be securely mounted to the exhibit. They cannot be attached to tables or walls.
- All power driven parts must be suitably guarded to prevent unauthorized or accidental access.
- All wiring of electrical apparatus must conform to the Massachusetts and National Electric Code. If in doubt, consult a licensed electrician.
- All exhibits that require an external source of electricity for operation must be designed for a standard 110-125 volt AC supply.
- Antenna lines and long leads cannot be used.
- All wiring, switches, power cords and metal parts carrying current in an AC circuit must be properly selected for load requirements and soldered or fixed under UL approved connectors with insulated connecting wires. No exposed wires, switches, joints, or non-insulated fasteners will be permitted.
- The power supply cord for the electrical apparatus must be no longer than six feet and must terminate in a three-pronged outlet. All power supplies and electrical equipment must be grounded and connected to a Ground Fault Circuit Interrupter (GFCI).
- High voltage areas and any areas which could present an electrical hazard must be completely enclosed by a protective barrier equipped with a safety interlock to cut off all power if the cover, door, barrier is opened or removed.
- Bare wire and exposed knife-type switches are permitted on 12-volt DC circuits or less. UL approved standard enclosed switches are required for all other electrical installations.
- Wet-cell batteries with open tops are not permitted. Closed-cell or dry-cell batteries are permissible.
- Compressed gases must be handled in compliance with standards established by the Compressed Gas Association.
- The operation of pressure vessels and pressurized systems is permitted providing all parts conform to the Massachusetts Safety Code for such items. Similarly, vacuum systems present an implosion hazard and all vacuum vessels must be determined to be capable of tolerating a high vacuum pressure environment.
- Any exhibit producing temperatures exceeding 100 degrees C. (212 degrees F.) must be adequately insulated from its surroundings. Asbestos-free insulation materials should be used.
- Because of the fire and burn hazard, there must be no open flame, torch or burner in the display area.
- Projects involving ionizing radiation, such as x-rays and radioactive materials, must be equipped with minimum safeguards as required by the Massachusetts Department

of Public Health and the U.S. Nuclear Regulatory Commission.

- Lasers, welders, high-intensity visible light, infrared and ultraviolet radiation and other non-ionizing radiation must be displayed with safeguards as required by the U.S. Department of Labor, Occupational Health and Safety Standards and by the Massachusetts Department of Public Health. Class III and Class IV lasers are prohibited. A source for information on laser standards and research is the U.S. Food and Drug Administration, Office of Compliance and Surveillance, 1390 Piccard Drive, Rockville, MD 20850, phone (301) 427-1172.
- All microwave and radio frequency sources must be designed and operated in compliance with state and federal regulations as well as applicable standards of the American National Standards Institute.
- Robotics projects should have interlocks or other controls.

Any student or teacher-supervisor, mentor or Qualified Scientist who has a question about a project's compliance to these rules should contact the MSSEF Safety Committee.

Note: Students may petition the MSSEF Safety Committee for exceptions before April 1st of the year of the fair in written correspondence to:

Mr. Howard Harrison
MIT
77 Massachusetts Ave, NE49-2400
Cambridge, MA 02139-4307
Tel: (617) 452-3268
Fax: (617) 452-2342
E-mail: hharriso@mit.edu

SECTION II: RESEARCH & SAFETY REGULATIONS

Conducting Scientific Experiments at the Secondary School Level

Students engaging in scientific research and participating in a Science Fair must be aware that all research must be carried out safely and in compliance with health, safety, and environmental laws, regulations and standards at the local, state, national, and occasionally international level. Students are responsible for presenting supporting evidence for the safety design and production of scientific, non-subjective results. The project must include repeatable, quantitative results. MSSEF, Inc. requires that all scientific research exhibited at the State Science Fair be conducted in compliance with the laws, regulations, and standards of all existing laws.

Students and teacher/adult sponsors are responsible for obtaining copies of all forms and accompanying rules governing the type of research undertaken. In addition, students and teacher/adult sponsors are responsible for checking with the respective city/town boards to find any established local rules that must be considered in the proposed research plan (particularly important in the area of recombinant DNA). Disposal of chemicals and biohazardous materials must be done according to local/state/federal regulations. Students, teacher/adult sponsors, mentors and Qualified Scientists must carefully scrutinize and adhere to all rules and regulations for safe research and display.

All students must fill out either an individual or team STUDENT CHECKLIST (1A) & RESEACH PLAN, APPROVAL FORM (1B), and CHECKLIST FOR TEAHCER/ADULT SPONSOR (1) with the appropriate signatures prior to the start of the project. All students must meet with their teacher/adult sponsor to complete and review these forms before experimentation begins. In the fall, each high school principal/science department chairperson and science teacher should make themselves aware of the rules and regulations of the MSSEF. Additional MSSEF forms may be needed due to a project's topic, special equipment, special chemicals, etc. Please refer to the "Consent Form Checklist" on the www.scifair.com website for an easy reference to determine the forms needed. All MSSEF forms may be downloaded from **www.scifair.com**.

Proposed Changes to Approved Research Plans

If there are any proposed changes in the STUDENT CHECKLIST (1A) & RESEARCH PLAN, the form must be rewritten and submitted for approval before experimentation resumes.

Summer Science Fair Project Work

Students who intend to start their project work during the summer must complete approval forms and obtain approval before the current school year ends and the research begins. If students attending summer institutes or summer science training programs plan to submit their

research to a Science Fair, they must have the Qualified Scientist and the Scientific Review Committee (SRC) approve the research plan before the actual training at the institute or program begins.

Continuation Projects

If the project is a continued study, all prior RESEARCH PLANS and consent forms (for each previous year) must be submitted to the Scientific Review Committee. The current Project's design and research plan must indicate an expansion of prior work (e.g.testing a new variable or new line of investigation). Repetition of previous experimentation with the exact same methodology and research question or increasing sample size are examples of UNACCAPTABLE continuations.

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

- The study is a multi-year study testing or documenting the same variables in which time is the 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.)
- Each consecutive year must demonstrate time-based change.
- 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.

Each year, the student must complete a current/new STUDENT CHECKLIST (1A) ,RESEARCH PLAN, APPROVAL FORM (1B), CHECKLIST FOR TEACHER/ADULT SPONSOR (1), and CONTINUATION PROJECTS FORM (7). Forms from a previous year do not cover the current year's project.

The prior year(s) abstract and STUDENT CHECKLIST (1A) and RESEARCH PLAN and other applicable forms must be attached behind the current year's STUDENT CHECKLIST (1A) and RESEARCH PLAN and applicable forms. Each page of the previous year's forms must be clearly labeled in the upper right hand corner with the appropriate year. Retain all original paperwork from previous year(s) in case an SRC requests documentation of experimentation in any prior year(s).

Scientific Review Committee (SRC)

The Regional SRC reviews all research involving human subjects, vertebrate animals, potentially hazardous biological agents , human or animal tissue, recombinant DNA techniques, and other restricted areas before experimentation begins, and the MSSEF SRC will review all projects prior to entry to the state fair.

No Teacher/Adult Sponsor, parent, or the Qualified Scientist/Designated Supervisor who oversees a specific project is permitted to serve on the SRC or IRB reviewing that project.

No person may act or sign forms in more than one capacity for the project.

The SRC uses the following criteria in evaluating the research plan, the certifications, the research and the exhibit:

- the completed research plan
- evidence of literature search
- type, amount, and appropriate supervision

- use of accepted research techniques and demonstrated skill in such techniques
- completed forms, signatures and dates
- evidence of search for alternatives to animal use
- compliance with rules and laws governing human and animal research
- appropriate use of recombinant DNA, potentially hazardous biological agents (microorganisms, preserved and fresh tissues, blood and body fluid products), and hazardous chemicals, activities or devices, etc.
- appropriate documents and substantial expansion for continuation projects
- adherence to all rules

Additional forms and prior SRC approval are required if students are interested in conducting research involving any of the following:

- **Restricted Areas of Research:** human subjects (Form (4)) , vertebrate animals(Form (5A) or From (5B)) , potentially hazardous biological agents or rDNA, (Form(6A))human or animal tissue (Form(6B))
- **Hazardous Chemicals, Activities or Devices:** DEA-controlled substances, prescription drugs, alcohol and tobacco, firearms and explosives, non-ionizing and ionization radiation, toxic chemicals, lasers, and other hazardous laboratory devices (e.g. high voltage or welding equipment), or activities (Risk Assessment Form (3))

- **Qualified Scientist FORM (2)**
- **Continuation Projects FORM (7)**
- **Regulated Research Institutional/Industrial Setting FORM (1C)**

Research questions should be directed to:

MSSEF Scientific Review Committee
955 Massachusetts Avenue, #350
Cambridge, MA 02139
E-mail: src@scifair.com

MSSEF SRC Approval Status will be posted on **www.scifair.com.**

Institutional Review Board (IRB)

The Institutional Review Board (IRB) is a committee that, according to Federal law, must evaluate the potential physical or psychological risk of research involving human subjects. All proposed human research plans (including surveys, questionnaires, tapes, videos, photographs, pictures, etc.) must be approved by the school/institutional IRB. Due to the Federal regulations requiring local community involvement, an IRB must be developed **at the school level** to oversee human research projects. In addition, before experimentation begins approval by the SRC must be obtained.

An IRB at the school must consist of a minimum of three members. Additional members are recommended to avoid conflict of interest. The IRB must include:

(a) a science teacher other than the teacher of the student
(b) a school administrator (preferably a principal, vice principal, or department head)
(c) one of the following who is knowledgeable and capable of evaluating the physical and/or psychological risk in a given study and is versed in the nature of the research:

a licensed psychologist, psychiatrist, medical doctor, licensed social worker, licensed clinical professional counselor, physician's assistant, or registered nurse.

Institutional Review Boards (IRBs) exist at federally registered institutions, including hospitals, colleges, prisons, etc. That institutional IRB must initially review and approve the research. Then the school IRB and the Regional SRC must also review the research.

If the project is behavioral, a psychologist, psychiatrist, or an individual with human behavioral training must serve on the IRB. All subjects in a study must sign MSSEF Informed Consent Form giving consent. If the student used in the study is under 18 years of age, written informed consent must be obtained from all subjects and their parent/guardian on the MSSEF Informed Consent Form.

Note that neither the teacher/adult sponsor, parents, the Qualified Scientist, nor the Designated Supervisor who oversees a specific project is permitted to serve on the IRB that is reviewing that project. Consequently, to eliminate conflict-of-interest, none of these adults may sign the SRC/IRB portion of any form.

An IRB generally makes the determination of risk. However, if the SRC judges the IRB's decision as inappropriate or not in compliance with the rules, the SRC may override the IRB's decision and the project will fail to qualify for competition. The decision of the state SRC is final.

All students requiring SRC approval must submit legible copies of completed forms and all materials necessary to evaluate the Research Plan to each regional SRC. No project will be reviewed by the SRC unless it is submitted on the proper forms. Contact regional directors and SRC chairs for information on dates of review and deadlines.

Send legible COPIES of original forms to the SRC. Do not send original forms to the SRC. The student retains all original signed forms. **SRC Approval Status for entry to MSSEF will be posted on www.scifair.com.**

Restricted Areas of Research

Human Subjects

Human subjects research includes projects involving:

- Subjects participating in physical activities (e.g., physical exertion, or any medical procedure),
- Psychological and opinion studies (e.g., survey, questionnaire, test of any kind),
- Behavioral observations,
- Studies in which the researcher is the subject of the research.
- Data or Records that are not anonymous

All research projects involving human subjects, including any revisions, must be reviewed and approved by an Institutional Review Board (IRB) and the SRC before the research begins. Copies of standardized and student prepared tests, surveys, etc. must be attached to the RESEARCH PLAN. The completed HUMAN SUBJECTS FORM (4) and a sample of the MSSEF Informed Consent Form must also be attached to the RESEARCH PLAN. When developing the research plan, student researchers must evaluate and minimize the physical and/or psychological risks to their human subjects. Prior to experimentation, the

MSSEF Informed Consent Form must be obtained from all participants. If a participant is under 18 years old, a parent/guardian signature is required. Each human subject participating in a project that involves physical activity (e.g. physical exertion, any medical procedure, etc.) must obtain written certification from a medical professional (e.g. doctor, nurse practitioner, etc.) that he/she is physically fit for the activity.

Research conducted by a pre-college student at federally registered research institutions (e.g. university labs, medical centers, NIH, correctional institutions, etc.) must be reviewed and approved by that institution's IRB. Documentation must be provided that certifies the student was approved by the Institutional IRB to perform experimental procedures and that the project he/she is participating is identified in the research plan. A copy of the IRB approval for the entire project (which must include the research procedures/measures the student is using) and an official letter from the Institutional IRB attesting to this approval is necessary. A letter from the teacher, Qualified Scientist, or mentor attesting to this approval is NOT sufficient. This material must be sent to the state SRC for final approval.

A student may observe and collect data for analysis of medical procedures and medication administration only under the direct supervision of a medical professional (e.g. doctor, nurse practitioner, nurse, etc.). The medical professional must be named on the RESEARCH PLAN to be specifically approved by the IRB. Students are prohibited from administering medications and performing medical procedures on human subjects. The IRB must confirm that the student is not violating the medical practices and laws of the particular state or nation in which he/she is conducting the research.

The student researcher 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 421 (d)).

The use of the Internet to obtain data for human subjects research is possible and permissible. The Student Researcher, Teacher/Adult Sponsor and IRB must take additional care to ensure that survey responses remain confidential and that informed consent is documented. Student researchers must provide potential participants information about the purpose of the study, potential risks, and the participant's right to withdraw at any time. An internet informed consent form is available at www.sciserve.org/isef/document/index.asp. Recruiting participants under age 18 requires that the parent/guardian must give consent through MSSEF Informed Consent Form. The Consent Forms should be signed, collected and inserted in a large envelope. This envelope should be available for inspection and review by fair officials at regional and state fairs.

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's 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 test.

Any proposed changes to a previously approved research plan must be resubmitted to the IRB for another complete review. The proposed changes must not be implemented

until the modified/changed project is approved by the IRB and the SRC

Risk Analysis

When developing the RESEARCH PLAN, student researchers must evaluate and minimize physical and/or psychological risks to their human subjects. 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/ psychological examinations or tests.

The following are examples of activities or groups that contain **more than minimal risks**:

A. Risk Activities:

1. Exercise other than ordinarily encountered in DAILY LIFE by the subject
2. Emotional stress resulting from invasion of privacy or breech of confidentiality
   Questions on sexual activities or preferences, AIDS testing and results, suicide attitudes, divorce and its effects on psychological well-being must be considered more than minimal risk. All are overtly invasive or high-risk requiring HUMAN SUBJECTS FORM (4), MSSEF Informed Consent Form, and teacher or qualified scientist **direct** supervision. Student researchers should always carefully evaluate controversial questions for compliance with federal regulations. (See Privacy Act of 1974 - #45CFR5B)
3. Physical contact with any potentially hazardous materials This applies to the student researcher as well as the human subject(s).

INGESTION OF ANY SUBSTANCES (DRUGS, FOODS, FOOD ADDITIVES, VITAMINS, MINERALS, ETC.) IS NOT PERMITTED.

B. Risk Groups

1. Any member of a group that is naturally at risk
   Examples: pregnant woman, individuals with diseases such as cancer, asthma, diabetes, cardiac disorders, psychiatric disorders, dyslexia, AIDS, etc.
2. Special vulnerable groups covered by federal regulations
   Examples: children/minors, prisoners, pregnant woman, special needs persons (including the handicapped, mentally disabled, or gifted persons), Native Americans, economically or educationally disadvantaged persons, etc.

All research involving human subjects *must* comply with Federal regulations. This information should be available through your Member of Congress, or can be obtained by writing to:

Office of Protection of Research Risks
National Institute of Health
9000 Rockville Pike
Bethesda, MD 20205

Hazardous Chemicals, Activities or Devices

MSSEF allows students to conduct research involving hazardous chemicals, activities devices as long as students adhere to federal and state regulations and guidelines that are designed to protect the safety of researchers. Hazardous

substances can be defined as any dangerous chemical, any piece of equipment, or any radioactive material that exposes a researcher or any research subject to risk or harm. A RISK ASSESSMENT FORM (3) must be submitted and SRC approval is required before experimentation. The use of hazardous chemicals and equipment, firearms, radioactive substances and radiation require proper supervision by a Qualified Scientist or Designated Supervisor, who must be directly responsible for overseeing student experimentation.

Student researchers working with hazardous substances or devices must follow proper safety procedures for each chemical or device used in the research. Extra precautions should be taken in working with flammable, explosive, or highly toxic chemicals.

For all research requiring a Federal and/or State Permit, the student/teacher/Qualified Scientist/ Designated Supervisor will be expected to have the permit prior to the onset of the experimentation. A copy of the permit must be submitted for review to the Scientific Review Committee (SRC) along with the other appropriate forms after experimentation but prior to competition.

Use of radiation and radioactive substances are tightly regulated. Students must strictly adhere to safety standards of the authorized institution where such substances/devices are used in the research.

Toxicity and differentiation between hazardous and non-hazardous chemicals can best be determined using the Materials Safety Data Sheets (MSDS) available through http://www.ilpi.com/msds/index.html

All students must follow proper handling techniques and disposal methods. For detailed safety data refer to Safety In The High School that can be obtained from the American Chemical Society, Career Publications, 1155 16th Street, NW, Washington, DC 20056. Telephone (202) 872-6168.

Controlled Substances

Research involving controlled substances must be approved by the SRC before experimentation begins. Controlled substances, including DEA-classed substances, prescription drugs, consumable ethyl alcohol and tobacco, and firearms and explosives must be acquired and used according to existing local, state and federal laws. Student researchers must adhere to all regulations governing controlled substances.

Only under the direct supervision of a Qualified Scientist or Designated Supervisor may students use any federally controlled or experimental substances/medications (including prescriptions and experimental substances) in their research. Students must include detailed procedures in the experimental design and must state how controlled substances are being purchased and handled. Students under 18 years of age cannot purchase tobacco. Students under 21 years of age cannot purchase alcohol. Production of consumable ethyl alcohol is federally regulated and students must contact the U.S. Alcohol and Tobacco Tax and Trade Bureau (TTB).

Production of consumable ethyl alcohol is federally regulated and students must contact the U.S. Alcohol and Tobacco Tax and Trade Bureau (TTB) to obtain a permit.

Students under 21 years of age are prohibited by federal laws from purchasing and/or handling

explosive materials including smokeless powder or black powder for science projects. The purchase of a firearm by a minor is unlawful. The use of a firearm is controlled by the State of Massachusetts and students should consult the laws.

Student research involving firearms or explosive materials may only be performed under the direct supervision of a Designated Supervisor or Qualified Scientist. For further Regulations, contact the Firearms Explosives Division of the Bureau of Alcohol, Tobacco, and Firearms.

Any proposed changes in the STUDENT CHECKLIST (1A) & RESEARCH PLAN by the student after initial SRC approval must have subsequent SRC approval before such changes are made and before experimentation resumes.

***Sources of Information*:**

Alcohol, Tobacco and Firearms
The Bureau of Alcohol, Tobacco and Firearms
650 Massachusetts Ave., N.W.
Washington, DC 20226
http://www.atf.gov

Alcohol and Tobacco Tax and Trade Bureau
http://www.ttb.gov

Controlled Substances
http://deadiversion.usdoj.gov/schedules/schedules.htm

The Drug Enforcement Administration*
Information Services Section
2401 Jefferson Davis Hwy.
Alexandria, VA 22301
Washington, DC 20537
(202) 307-7255; http://www.usdoj.gov/dea

CONTACT APPROPRIATE STATE AGENCIES CONCERNING ADDITIONAL REGULATIONS.

Vertebrate Animals

An animal is defined as any live, non-human vertebrate mammalian embryo or fetus, tadpole, bird, and reptile eggs within three days (72 hours) of hatching, and all other nonhuman vertebrates at hatching or birth.
According to Massachusetts State Law (see below), no vertebrate animal can be subject to duress. Replace vertebrate animals with invertebrates or other types of organisms whenever possible. Prior to experimentation, an official VERTEBRATE ANIMAL FORM (5A) or (5B) must be completed, submitted to and approved by the SRC.

Any proposed changes in the RESEARCH PLAN (1A) & RESEARCH PLAN by the student after initial SRC approval must have subsequent SRC approval before such changes are made and before experimentation resumes.

Massachusetts State Science & Engineering Fair, Inc. promotes humane attitudes toward all animals used in scientific investigation. MSSEF, Inc. opposes projects that involve cruelty or abusive treatment, either during the preparation process or in the actual demonstration at the Fair. The basic aim of such projects is to achieve an understanding of life processes. Therefore, experimentation must be conducted in a manner that fosters a humane regard for animals and a respect for life. **No vertebrate animals can be sacrificed (killed) for student research.**

Before starting a project, students and teacher/supervisors should become thoroughly familiar with the following Massachusetts law that applies to classroom activities, school related

independent research and Science Fairs. If a project does not comply with the rules for students in public schools it cannot be exhibited at the fair.

Chapter 272, Section 80G, Massachusetts Statutes: An act regulating the use of live vertebrates for experimental or exhibition purposes in certain schools.

> **Section 80G:** No school principal, administrator or teacher shall allow any live vertebrate to be used in any elementary or high school under state control or supported wholly or partly by public money of the state as part of a scientific experiment or for any other purpose in which said vertebrates are experimentally medicated or drugged in a manner to cause painful reactions or to induce painful or lethal pathological conditions, or in which said vertebrates are injured through any other type of treatment, experiment or procedure including but not limited to anesthetization or electric shock, or where the normal health of said animal is interfered with or where pain or distress is caused.
>
> No person shall, in the presence of a pupil in any elementary or high school under state control or supported wholly or partly by public money of the state, practice vivisection, or exhibit a vivisected animal. Dissection of dead animals or any portions thereof in such schools shall be confined to the class room and to the presence of pupils engaged in the study to be promoted thereby, and shall in no case be for the purpose of exhibition.
>
> Live animals used as class pets or for purposes not prohibited in paragraphs one and two hereof in such schools shall be housed or cared for in a safe and humane manner. Said animals shall not remain in school over periods when such schools are not in session, unless adequate care is provided at all times.
>
> The provisions of the preceding three paragraphs shall also apply to any activity associated with or sponsored by the school.
>
> *A fine of not more than $100 (approved July 23, 1979) shall punish whoever violates the provisions of this section.*

Because the conditions for maintaining animals are critical, experiments involving small, common laboratory animals (e.g. mice, rats, hamsters, guinea pigs, gerbils and rabbits) are ONLY allowed in institutional settings or school settings; and only if environmental, housing, and husbandry standards are maintained. Animals **cannot** be kept in the student's home. However, non-invasive/observational studies and behavioral studies involving pets, including fish and livestock, may be conducted at home. Exceptions for behavioral and agricultural research may be granted only by the SRC. It must be carefully noted that all projects must fit within the confines of the state vertebrate law.

Examples of possible alternatives to the use of vertebrate animals include:

(a) cells and cell cultures
(b) plants, yeast, and fungi
(c) mathematical or computer models
(d) invertebrates with more primitive nervous systems (e.g. protozoa, planaria, and insects)
(e) chicken embryos prior to three days (72 hours) before hatching

Common laboratory animals must be obtained from licensed laboratory animal breeders. Pet store animals, except fish, are inappropriate because their genetic and nutritional background, as well as disease potential, is unknown. Fish may be obtained locally from pet stores or fish markets. 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.

Projects performed within a hospital, school, or clinical/research institution, must obey all rules of the state for high school students, and be directly supervised by a Qualified Scientist or Designated Supervisor that confers with the teacher.
Projects must be reviewed by the institution's Institutional Animal Care and Use Committee (IACUC) and the SRC prior to experimentation IUCAC documentation of this approval and VERTEBRATE ANIMAL FORM (5B) must be attached to the RESEARCH PLAN. A letter from the Qualified Scientist, Designated Supervisor, mentor, or teacher/adult sponsor attesting to this approval is not sufficient.

The following guidelines consistent with the Massachusetts laws for the use of animals in Science Fair projects are available and should be consulted:

1. Guidelines published in Safety in the Secondary Science Classroom, National Science Teachers Association, 1978, pp. 80 & 81. Available from NSTA, 1742 Connecticut Avenue, NW, Washington, DC 20009. Stock No. 471-14652.

2. Regulations for Animal Experimentation in Science Fairs. Canadian Council on Animal Care, 151 Slater Street. Ottawa, Canada KIP 5H3.

Any student or teacher who is unsure of a project's compliance should describe the project in written correspondence to:

MSSEF Scientific Review Committee
955 Massachusetts Avenue, #350
Cambridge, MA 02139
E-mail: src@scifair.com

Potentially Hazardous Biological Agents

Adopted Summer 2005. Previously classified as pathogenic and potentially pathogenic agents, recombinant DNA, and human and vertebrate animal tissues.

Projects incorporating microorganisms (including bacteria, viruses, viroids, prions, rickettsia, fungi, and parasites), recombinant DNA (rDNA) technologies or human or animal fresh tissues, blood, or body fluids may involve working with potentially hazardous biological agents. Students are permitted to do research projects with potentially hazardous biological agents as long as every effort is made to ensure that they work safely and that the projects meet the conditions and rules described below. Organisms collected, isolated, and/or cultured from any environment (e.g. air and soil) should be considered potentially pathogenic. Raw or partially processed human or animal waste is considered to contain potentially pathogenic agents. Agricultural use of animal waste as fertilizer is exempt.

The following rules were developed to protect students and to help them adhere to federal and international bio-safety 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** (as outlined further in this section). 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 is found further in this section. 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 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, RAC, IACUC) must approve all research before experimentation begins. The initial risk assessment determined by the student researcher and adults supervising the project must be confirmed by the SRC.

3) Experimentation with potentially hazardous biological agents, even BSL-1 organisms, **is prohibited in a home environment**. However, specimens are allowed to be collected at home as long as they are immediately transported to a laboratory with the appropriate level of biosafety containment. Naturally occurring plant pathogens may be studied (not-cultured) at home, but may not be introduced into a home/garden environment.

4) A risk assessment must be conducted by the student and adult supervisors prior to experimentation and a final biosafety level must be determined and confirmed by the SRC.

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) and must be reviewed and approved by the Institutional Biosafety Committee (IBC) or equivalent approval body at the research institution. **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 pre-college 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 and studies using such organisms require at least BSL-2 containment.

9) **Laboratory studies utilizing MRSA (Methicillin resistant Staphlococcus aureus) and VRE (Vancomycin-resistant enterococci) are prohibited.**

10) Purchased cultures and microorganisms must be identified with full name, source, and ATCC identification, or written documentation from the supplier, in the RESEARCH PLAN. See www.atcc.org for the pathogenicity and for ATCC identification number.

11) 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 bio-safety pick-up

12) Human blood and platelets must be documented free of HIV and hepatitis. Not exempt if cultured in a petri dish environment that could possibly be contaminated,

13) The following studies are exempt form SRC review but must complete Risk Assessment Form (3):
- Studies involving baker's yeast and brewer's yeast are exempt from these rules except when involved with rDNA studies.
- Studies involving protists, archae, and similar microorganisms
- Research using manure for composting or other non-culturing experiments and fuel production.
- Studies involving lactobacillus, bacillus thurgensis, nitrogen-fixing bacteria, oil-eating bacteria and algae-eating bacteria, slime mold, and algae-eating bacteria introduced into their natural environment.
- Commercially available coliform test kits.

Any proposed changes in the STUDENT CHECKLIST (1A) & RESEARCH PLAN by the student after initial SRC approval must have subsequent SRC approval before such changes are made and before experimentation resumes.

14) The following forms are required:
   a) **Checklist for Adult Sponsor(1)**
   b) **Student Checklist (1A) and RESEACH PLAN**
   c) **Approval Form (1B)**
   e) **Regulated Research Institution Form (1C)** - if applicable
   f) **Qualified Scientist (2)**, if applicable
   g) **Risk Assessment Form (3)**, if applicable
   h) **Potentially Hazardous Biological Agents Form (6A)**
   i) **Human and Vertebrate Animal Tissue Form (6B)** - for all studies involving body fluids and tissues.

A. **Additional Rules for Projects Involving Unknown Microorganisms or Pathogenic Materials**

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 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**. Also 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. <u>Additional Rules for Projects Involving Recombinant DNA (rDNA) Technologies</u>

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* hostvector 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) A rDNA technology study that involves BSL-1 agents that may convert to BSL-2 agents during the course of experimentation must be conducted entirely in a BSL-2 facility.

4) All rDNA technology studies involving BSL-2 organisms and/or BSL-2 host vector systems must be conducted in a regulated research institution and approved by the Recombinant Advisory Committee (RAC) or IBC prior to experimentation.

5) **Propagation of recombinants containing DNA coding for oncogenes or other human, plant or animal toxins (including viruses) is prohibited.**

6) Students must not handle ethidium bromide or handle gels stained with ethidium bromide or any suspected mutagen. If ethidium bromide must be used in the experiment, qualified laboratory personnel, not the student, must do this part of the research, and references made in the student notebook giving credit to the person or persons doing that part of the research.

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. No animal can be euthanized solely for the student's project, even though the study is conducted at a regulated research institution. **It must be noted that the Massachusetts laws preclude putting animals under duress which makes most vertebrate projects, even those done in laboratories, impossible for research projects and display. No animal can be sacrificed for a student's project, even those projects done in research laboratories under a Qualified Scientist. See vertebrate animal rules in the MSSEF Manual.**

2) If the tissue is obtained from a source within a research institution or commercial lab, please provide information regarding the origin of the vertebrate study from which the original tissue was obtained. Include the name of the research institution/laboratory, the title of the study, IACUC approval number, and the date of the IACUC approval.

3) 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 noninfectious 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.

4) 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.

5) 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 blood must be handled in accordance with standards and guidelines set forth in the Occupational Safety and Health Act, 29CFR, Subpart Z. Any tissue or instruments with the potential of containing bloodborne pathogens (e.g. blood, blood products, tissues which would release blood when compressed, blood contaminated instruments) must be properly disposed of after experimentation.

6) 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.

7) Any study involving the collection and examination of body fluids which may contain biological agents belonging to BSL-3 or 4 is prohibited for high school students.

8) Studies of human body fluids, where the sample can be identified with a specific person, must have IRB review and informed consent. (See Human Subjects section for IRB regulations.) Students using their own body fluids are exempt from this requirement.

9) 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 from commercial sources. State source and validate purchase.

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:

1) **Assignment of the biological agent to a risk group**
   a. 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.
   b. The study of unknown microorganisms and the use of fresh tissues should rely on the expertise of qualified adults supervising the project.

2) Determination of the **level of biological containment** available to the student researcher to conduct the experimentation. (Please see Levels of Biological Containment for more details.)

3) Assessment of the experience and **expertise of the adult(s)** supervising the student.

4) **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. If no approval body exists at the regulated

site, the SRC must 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*. (Not exempt if cultured in a Petri dish environment that could possibly be contaminated.)

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**

Any proposed changes in the RESEARCH PLAN (1A) & RESEARCH PLAN ATTACHMENT by the student after initial SRC approval must have subsequent SRC approval before such changes are made and before experimentation resumes.

Sources of Information:

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

Biosafety in Microbiological and Biomedical Laboratories (BMBL) - 4th Edition
Published by CDC-NIH
http://www.cdc.gov/od/ohs/biosfty/biosfty.htm

Microorganisms for Education Website
http://www.science-projects.com/safemicrobes.htm

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

Human or Vertebrate Animal Tissue

Also see new rules that apply to potentially hazardous biological agents (page 24). You must complete a FORM 6A and FORM 6B.

A Note on Stem Cells:

There are several classes of stem cells, including embryonic, umbilical cord, and adult stem cells. Embryonic stem cells are obtained from very young vertebrate embryos, including mammalian and human embryos, by opening up a blastocyst-stage embryo and removing its "inner cell mass" - this process directly causes the death of the embryo. Thus, since the embryos are very young members of their species, students cannot participate in research utilizing embryonic stem cells, because, as mentioned above, no vertebrate animals can be sacrificed (killed) for student research, nor for this same reason can students use embryonic stem cells obtained for the work of the student's supervising scientist. Stem cells obtained from umbilical cords or from adults of any species including humans can be used by students, since no harm is caused in obtaining them; however, the student must follow the rules given in the section on the use of human or vertebrate animal tissues.

SECTION III: MSSEF NETWORK

The Massachusetts Science & Engineering Fair (MSSEF) is the culmination of a yearlong program for high school students who have produced science projects, exhibited in local school or Regional Fairs and advanced to statewide competition.

A two-day event, held annually at Massachusetts Institute of Technology in Cambridge, the MSSEF is a valuable learning experience and provides students with the opportunity to win awards and scholarships and participate in additional science-oriented activities, i.e., International Science and Engineering Fair, and the National Youth Science Camp and expeditions. *The Massachusetts Secondary School Administrators' Association approves the Fair.*

Regional

Six Regional Fairs are held in March. Students are encouraged to participate in their respective Regional Fairs as this provides the student with an opportunity to meet students from other schools and sharpen communication skills. Schools that want to participate in a Regional Fair should contact the Regional Chair for registration information.

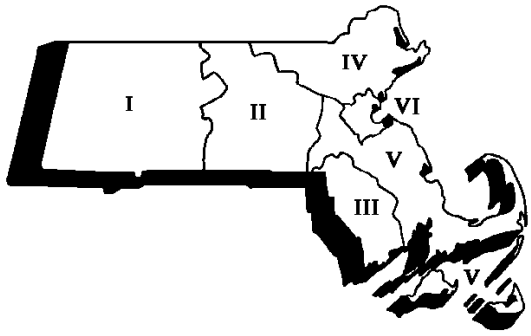
Each Regional Fair can certify and send 40 projects plus 10% of the number of entered projects over 100, up to a maximum of 50 projects to the State Fair. Each school may also send one individual project and one team project directly to the State Fair. If one of the Regional winners is unable to participate in the State Fair, the student must notify the Regional Chair who will designate another candidate. It is important to note that a winner in a Regional Fair is ineligible for the MSSEF if he or she has participated in a Regional Fair outside the school's assigned region.

The six MSSEF Regional Fairs, respective Chairpersons, and towns, cities and regional high schools in each region are available on the website: www.scifar.com

Local

Many high schools across the state sponsor their own Science Fairs. These local Fairs give students a chance to share with classmates their ideas, discoveries, and enthusiasms for science. Local Fairs provide an excellent training ground for students to sharpen communication and presentation skills. Each high school in the Commonwealth may send one individual student and one team project directly to the State Science & Engineering Fair.

Geographic breakdown of Massachusetts State Science & Engineering Fair network.



SECTION IV: AWARD RECOGNITION PROGRAM

The MSSEF Award Recognition Program is one of the most significant and comprehensive honors programs in educational competitions in the nation today. Over the last decade, over $4 million worth of awards has been distributed.. A special salute goes to the many corporations, educational institutions, professional organizations and individuals whose generosities have helped MSSEF to establish one of the premier award programs in the country.

As registered MSSEF entrants, students automatically become candidates for awards. Customary criteria used for award distribution include, but is not limited to, scoring results, prize values and individual student preferences. There is no consideration given to financial need. Massachusetts State Science & Engineering Fair, Inc. retains the sole responsibility for award distribution and all decisions are final.

Description of Awards

Through the generosity of MSSEF donors, there are several award categories – monetary, college scholarships, experiential, educational and miscellaneous. Following is a brief description of each category:

Monetary

Cash prizes are disbursed by check within three-four weeks following the Fair. MSSEF, Inc. will not be held responsible for cash awards if or when a winner does not cash award check within six months of date of issue. ***Note***: MSSEF Team Project Awards are usually monetary and are divided evenly by all of the respective project participants.

College Scholarships

Customarily, college or university scholarships are in the form of tuition-fee reductions. Individual donor institutions establish their respective admission requirements, renewal criteria and "payout" procedures. These scholarships are neither interchangeable nor exchangeable.

Experience Awards

These awards involve educational travel, professional research internships and other opportunities where the student is directly involved in a scientific or technological environment. Typically, these awards have included the National Youth Science Camp in West Virginia, and non-paid research internships at prestigious Massachusetts (usually Boston area) corporate sites.

Educational Programs

These programs include waiver or reduction of tuition fees for special courses at local colleges, universities and other institutions. Professional organizations also waive registration fees to seminars and courses.

Miscellaneous

Lab supplies, books, software, calculators, etc.

(Continued on next page)

Alternate Winners

MSSEF, Inc. selects alternate winners for some of the awards within the College Scholarship, Experience and Educational award categories. Winners are asked to notify MSSEF if they do not accept/plan to use an award. MSSEF, Inc. and/or the award donor will contact the alternate winner. Alternate winners should periodically contact MSSEF headquarters to inquire about the status of the award.

SECTION V: GLOSSARY

Definitions for MSSEF Terms

Abstract- a written summary of a project that gives pertinent information in 200-250 words.

Affiliated Fair- a fair in which one takes part and moves into another fair. Each of the regional fairs is affiliated with MSSEF. MSSEF and each regional fair is affiliated with the International Science and Engineering Fair (ISEF).

Alternatives- substitutes for the use of vertebrate animals in student research.

Animal Care Supervisor- an individual that is responsible for the care of all nonhuman vertebrate animal projects and must be well acquainted with the care and handling of all research animals used in the project.

Anonymity- process of collecting research data in such a way to make it impossible to connect the data the student researcher collects (personal interviews, questionnaires, etc.) with the individual who provided the data. Personal identifiers such as names, birthdates, social security numbers, etc. should not be collected or linked with the data.

Approval Form (1B)- this form has the names and signatures of all necessary persons giving permission for the project before experimentation begins. The student signature indicates that the student will adhere to the MSSEF ethics statement.

Approval Forms- forms that must be completed for all projects that involve restricted areas of research.

BSL- Biosafety Level

Bibliography- part of the RESEARH PLAN Must list at least five major references (scientific journal articles, books, internet sites, etc.) from library research. If vertebrate animals are used, give an additional animal care reference.

Breach of Confidentiality- personal information given that could identify the subject(s) in the study.

Categorizing Project- the student is asked as part of the application process to choose a category or categories in which he/she would like to be judged.

Confidentiality- involves taking careful measures to insure that the research data and/or responses are not disclosed to the public or unauthorized individuals with identifiable information (e.g., names, social security numbers) that links the data with a specific individual or group of individuals.

Consent Forms- needed for projects that involve human subjects.

Continuation- the act of extending or prolonging one's research in a given subject or project area; also, a project which may reference prior work, but which follows a new line of investigation. A valid continuing project for the MSSEF must

demonstrate new and different research from that done previously with a new hypothesis/purpose.

Controlled Substances- any substance controlled by the Drug Enforcement Administration, Bureau of Alcohol, Tobacco and Firearms, or Food and Drug Administration including those that are illegal for use by minors.

Designated Supervisor- an adult properly trained in the specific procedures used in the investigation who will directly supervise the student. The Designated Supervisor cannot be the student's parent. A teacher/adult sponsor may act in this capacity.

End Date- the complete date (month, day, year) when laboratory experimentation ceases and/or the date when the allowable twelve month research period stops.

Ethics Statement- an ethical statement that each student is required to adhere to and sign as part of the research plan and application process.

Hazardous Substance- any dangerous chemical, organism, equipment, or radioactive material that exposes a researcher or research subject to risk or harm.

Human and Vertebrate Animal Tissue- includes viable flesh, tissue, organs, human or animal parts (including blood), blood products, teeth, primary cell cultures, and body fluids. Use of any of the above requires a Form (6A) or Form (6B) and SRC Approval before the beginning of experimentation.

Human Subject- a person about whom an investigator (professional or student) conducting research obtains data through (1) active or passive intervention or interaction with the person, or (2) a source of identifiable private information.

IBC- Institutional Biosafety Committee

Identifiable Information- any information that could be used to identify a subject or subjects as participating in a research study. Basic identifiers include names, social security numbers, birth dates, and phone numbers. In some situations, variables such as race and ethnicity may identify a subject when there are very few individuals of a particular race in the sample.

Individual Project- one student working to complete a science project in which one research report is produced. An individual project cannot become a team project.

Informed Consent- is a process that involves providing detailed information to potential research subjects (and parents/guardians, when appropriate) about the proposed research project so that the potential subjects (and parents/guardians) can make an informed decision about whether to participate. Informed consent procedures require the subject (and the parent/guardian) to sign a MSSEF Informed Consent Form prior to participation in the research.

Institutional Animal Care and Use Committee (IACUC)- a committee that must approve all animal research within an institution and must supply a copy of the approval document for review by the Scientific Review Committee (SRC),

Institutional Laboratory- a formal, established laboratory within an academic, commercial, medical, or government setting, but not in the home or high school.

Institutional Review Board (IRB)- a committee of specific composition at an affiliated fair, high school or institution that reviews research plans and consent forms to evaluate potential physical or psychological risk of research involving human subjects. Each school must have an IRB to oversee local projects. The regional and state SRC acts as the IRB at those levels.

Invasion of Privacy- stating facts or asking questions that are considered private information (history of abuse, drug use, opinions, fingerprints, genetic material, blood samples, tissue samples, etc.).

Mentor- a person who helps a student with a project. The mentor may be a teacher, Qualified Scientist, or a person that helps a student with a field research project. **It may not be the student's parent/guardian.**

Pathogenic Agents- disease-causing or potentially disease-causing agents (including soil bacteria).

Plagiarism- the offering of another's work as one's own by copying, imitating, forging, stealing, etc.

Potential Pathogen- any organism that has or may have the LATENT ability to cause disease in humans, vertebrate animals or plants.

Project Year- the present project year includes research conducted over a maximum, continuous 12-month period between January of the previous year and ending in May during the year of the Fair.

Protocol- See Research Plan

Qualified Scientist- an individual who possesses (1) an earned doctoral degree in science or medicine or (2) a master's degree with equivalent experience and/or expertise, and who has a working knowledge of the techniques to be used by the student. **The Qualified Scientist cannot be the student's parent.**

RAC- rDNA Advisory Committee

Recombinant DNA (rDNA)- According to the National Institutes of Health (NIH) guidelines, recombinant DNA molecules are either: (1) molecules that are constructed outside living cells by joining natural or synthetic DNA segments to DNA molecules that can replicate in a living cell or (2) DNA molecules that result from the replication of those described in 1.

Regional Fair- there are six regions in the state that sponsor a fair. The towns/school in each region are listed on the www.scifair.com website.

Registered Research Institution- a scientific or medical facility or organization involved in the study and investigation of scientific, medical or engineering topics such as university laboratories, National Institutes of Health (NIH), medical centers, pharmaceutical firms, private foundations and which are registered for grant application with the federal government.

Research Plan- must include the question being addressed, the hypothesis/problem/engineering goals, a detailed description of methods and procedures including chemical concentrations and drug dosages, and a bibliography. See RESEARCH PLAN with STUDENT CHECKLIST (1A) or more required information. Also referred to as the protocol.

Research Report- paper that organizes data and thoughts. It should include a title page, table of contents, introduction that includes a summary of previous literature review, hypothesis, problem or engineering goals, an explanation of what prompted the research, what the student hopes to achieve, methods and materials, data, graphs, and statistical calculations, discussion, conclusion, acknowledgements, and a reference bibliography.

Risk- the potential for psychological or physical harm to human subjects as a result of participation in a research project. Risks may be physical in nature (e.g., fatigue, illness, injury, death) or psychological in nature (e.g., emotional stress, invasion of privacy, breech of confidentiality).

Risk Determination- the local IRB evaluates the research plan and all materials (surveys, questionnaires, tapes, exercises, etc.) to be used before any experimentation (research) begins. The local IRB evaluates the risk value. Copies of the research plan and all supplementary materials are then sent to the regional and state fair committees for final approval.

Safety Committee- a group of qualified individuals responsible for checking compliance of exhibits with display and safety rules that are active at each fair.

Scientific Fraud or Misconduct- the act of misleading or deceiving others by intentionally falsifying scientific data or statements as research or by misbehavior or improper actions.

Scientific Review Committee (SRC)- a group of qualified individuals that is responsible for evaluation and approval of student research, certifications, research plans, and exhibits for compliance with the MSSEF Rules and Guidelines.

Special Needs Person- a person regardless of age who has been classified as such according to Title 45CFR, including but not limited to gifted, learning disabled, medically disabled, mentally or emotionally disabled, or mentally compromised (e.g. persons with Alzheimer's disease or Parkinson's disease).

Start Date- the date (month, day, year) on which actual experimentation and data collection in a project begins, excluding a literature search.

Supervision- direct guidance by a knowledgeable adult in the planning, execution, and evaluation of student research.

Teacher/Adult Sponsor- teacher, university professor, or scientist in whose lab the student is working. This mentor must have a solid background in the area in which the student researcher is working and maintain close contact with the student during the course of the project. This person is ultimately responsible for the health and safety of the student conducting the research as well as the health and safety of the humans and animals used as subjects. A teacher must serve this role, but may share this with a university professor or scientist. Both should fill out a Teacher/Adult Sponsor Form (1).

Team Project- two or three students working to complete one science fair project in which one research report is produced. A team project cannot become an individual project.

SECTION VI: APPENDIX

Categorizing the Project

See next page

See www.scifair.com for the following:

Judging Criteria

Resources for Students and Teachers

General Instructions for Forms

Individual Student Checklist 1A

Team Student Checklist 1A

Research Plan

Consent Form Checklist

Consent Forms

CATEGORIZING THE PROJECT

Five qualified judges review each project. So that the judging may be done fairly and accurately, it is mandatory that the students properly categorize his or her project.

A brief description of the categories and examples of the types of projects follows:

Behavioral Science: Concerned with observable, tangible, and measurable data regarding behavior activities. Other topics in this category are psychology, educational testing, animal behavior, learning and archaeology.

Biochemistry: The study of chemical substances occurring in living organisms and the reactions and methods for identifying these substances. Other topics in this category are molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry and hormones.

Biology: The science of life, including the study of the development, structure, and behavior of living organisms. Other topics in this category are botany, zoology, plant science, hydroponics, medicine, dentistry, pharmacology, nutrition, dermatology, veterinary medicine, microbiology, genetics, physiology, anatomy and invertebrate biology.

Chemistry: A science that treats the composition of substances, their structure, their behavior, reactions, analysis and synthesis. Other topics in this category include physical organic, inorganic, materials, plastics, fuels, pesticides, metallurgy, and soil chemistry.

Computers: A study of computer construction, programming, languages, techniques and general operations.

Earth & Space Science: Earth Science is the study of weather, climate, local rock formations, mineral resources, soils, natural vegetation, and animal life. Other topics in this category are geology, geophysics, physical oceanography, meteorology, seismology, mineralogy and topography. Astronomy/Space Science is the science regarding the celestial bodies and the observation and interpretation of the radiation received in the vicinity of the earth from the component parts of the universe. Other topics in this category include optical astronomy, radio astronomy, astrophysics, astrometry and astrophotography.

Environmental Science: The study of pollution sources (air, water and land) and the effects of pollution on the environment, the study of ecology, the relationships of organisms and their environments.

Engineering: Applied science concerned with utilizing products of earth, properties of matter, sources of power in nature, and physical forces for supplying human needs in the form of structures, machines, manufactured products, precision instruments, the means of lighting, heating, refrigeration, communication, transportation, sanitation, public safety and other productive work. Other categories are civil, mechanical, aeronautical, chemical, electrical, photographic, sound, automotive, marine, materials, ocean, biomedical, geothermal and solar.

Mathematics: That science which treats the exact relationships existing between quantities or magnitudes and operations, and of the methods by which, in accordance with these relations, quantities sought are deductible from others known or supposed. Topics may include calculus, geometry, abstract algebra, number theory, statistics, complex analysis and probability.

Physics & Electronics: Physics is a natural science covering matter, energy, and their mutual relations that do not involve change in composition. Topics covered by physics are solid-state theory, optics, acoustics, particle, nuclear, atomic, plasma, thermodynamics, semi-conductors, magnetism, quantum mechanics, biophysics and mechanics. Electronics is the study, control and application of the conduction of electricity through gases or a vacuum or through conducting or semi-conducting materials. Other topics in this category include electronic phenomena, devices and systems.