SIXTY EIGHTH ANNUAL

2017

Massachusetts State **Science & Engineering** Fair

2017 | High School MANUAL

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THE EXPERIENCE

The High School Science & Engineering Fair

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

The Massachusetts State Science & Engineering Fair (MSSEF) 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 and engineering 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 and engineering projects help develop higher level thinking skills.

Involvement in science and engineering projects provides students with opportunities to problem-solve, an understanding of and familiarity with the scientific method/engineering design process, 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 and engineering 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 and engineering 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.

Roles and Responsibilities of Students and Adults

The Student Researcher

The **student researcher is responsible for all aspects of the research project** including enlisting the aid of any required supervisory adults (Teacher/Adult Sponsor, Qualified Scientist, Designated Supervisor, etc.), obtaining necessary approvals, (SRC, IRB, etc.) following the Rules and Guidelines of MSSEF, and performing the experiment, engineering, data analysis, etc.

Scientific/engineering fraud and misconduct are not condoned at any level of research or competition. This includes plagiarism, forgery, use or presentation of other researcher's work as one's own and fabrication of data. Fraudulent projects will fail to qualify and MSSEF reserves the right to revoke recognition of a project subsequently found to have been fraudulent.

The Adult Sponsor

The **Adult Sponsor** may be a teacher, parent, professor, and/or other professional scientist/engineer in whose lab the student is working. This individual must have a solid background in science/engineering and should have close contact with the student during the course of the project.

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

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

The Qualified Scientist

A **Qualified Scientist** should have a doctoral/professional degree (PhD, MD, or Master's degree with additional experience and/or expertise) in a scientific discipline that relates to the student's area of research. The **Qualified Scientist** must be thoroughly familiar with the local, state, and federal regulations that govern the student's area of research.

The **Qualified Scientist** and the **Adult Sponsor** may be the same person, if that person is qualified as described above. The student researcher may work with a **Qualified Scientist** in a city, state or country that is not where the student resides. In this case, the student must work locally with a **Designated Supervisor** who has been trained in the techniques to be applied by the student.

The Designated Supervisor

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

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

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/engineering 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/engineering 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/engineering project work in general. The motive for introducing science and engineering 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 and engineering 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."

In terms of science/engineering 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.

(Continued on next page)

- 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 and engineering 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 and engineering fair process in a logical progressive manner.

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

This section begins with a brief introduction of how the competitive hierarchy of science and engineering 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 and engineering 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 and engineering 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 description of the various existing award categories typically granted to winners of the state fair.

Section V: Science & Engineering Fair Project Resources

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

Section VI: Glossary

This section gives some of the terms used in the science and engineering 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 & Engineering Fair

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

The MSSEF is open to students from all public, private, and home schools (grades 9-12) throughout the state. 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. If one of the Region's state fair entries chooses not to attend the State Fair, only the Region can determine the replacement. In addition to the regional state fair entries, each school can send two additional projects directly to the State Fair.

Step 1: Developing the Project

To be eligible for entry in the Massachusetts State High School Science & Engineering 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. The research must be done over a maximum of 12 continuous months between January first of the previous year and May of the year of the fair.

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/engineering 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 and engineering 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 or solves an engineering problem. 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/qualified scientist/designated supervisor role should be one of guidance, encouragement and constructive criticism as the need arises. **All students must have teacher/adult sponsor approval for a project BEFORE experimentation begins.**

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 State Science & Engineering Fair High School Manual is posted on our website, **www.scifair.com**, and available for download. 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 for the event itself, completed in the spring and due in late March. MSSEF Information on registration will be distributed to schools and teachers via email. Registration takes place online, during the month of March, after all Regional Fairs take place.

Team Projects

Teams may have up to three members. 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 to an individual project or vice versa, but may be altered in subsequent years.

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.

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Teams composed of members that attend different high schools are eligible to compete in MSSEF as a direct entry through the school of enrollment for the Team Leader. The teacher of record must be employed by the same school as the Team Leader. The MSSEF SRC must approve the research prior to experiment if required and again prior to state fair. The following team compositions are allowed:

- Students attending different high schools with the same Massachusetts Region.
- Students attending different high schools in different Massachusetts Regions.
- Students attending different high schools in different states as long as the Team Leader attends a Massachusetts High School.
- Students attending different high schools in different countries as long as the Team Leader attends a Massachusetts High School.

Note: Any Multi-school team project may only participate in one (1) ISEF affiliated fair.

Each team must complete the TEAM 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 in the RESEARCH PLAN should include an outline of each team member's task(s). 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 TEAM 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, p18) need to be submitted to the Regional 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.

Projects that may require several months of work are advised to submit their accurately completed Forms and Research Plans to the Regional SRC as early as possible. Contact the Regional SRC chairperson for dates and deadlines.

Students must keep all *original signed forms* throughout the submission and approval processes during the year.

Step 4: Registration for the MSSEF Fair

Registration for the STATE FAIR occurs **after** the local and regional fairs have taken place. Both Regional and Direct school entries must register online. Information on how to access the online registration will be provided to regional winners and schools. These entries proceeding to State Fair after the Regional Fair must then register for the State Fair competition which is separate from regional registration.

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.

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

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 experimentation begins. Contact the appropriate regional SRC for dates of review and deadlines.

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

5. School fairs occur during January and February. 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 of regional fairs.

7. MSSEF Registration must be completed online during the registration window advertised in March. Registration will close at a specific time and date to be announced, so it is important to register as early as possible.

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

International Science & Engineering Fair (ISEF) Affiliation

The Massachusetts State Science & Engineering Fair is an affiliated fair of the International Science and Engineering Fair (ISEF). Because registrations for ISEF are due in April, the Massachusetts delegation consists of eight projects, six represented by highest scoring project from each of the regional fairs, plus two additional top-scoring regional

projects from Regions chosen by lottery each year. Each of our six regional fairs is also an ISEF affiliated fair. ISEF designates the number of projects that each regional fair can send. These entries are sponsored and funded by the regional fairs with assistance from MSSEF.

Hosted annually in a North American city, ISEF hosts almost 1,700 student exhibitors from more than 70 countries and many states 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.

Official MSSEF Rules

All exhibits must conform to the following rules for exhibition at the Massachusetts High School Science & Engineering 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, execution, and presentation 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:

1. 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 (p9) for complete rules on team projects.

2. 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 PROJECT FORM (7) stating differences for each year of the project and must be submitted and displayed with the project at the fairs. 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 and engineering fair.

3. 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.

4. 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. Pages in the notebook should be numbered and a table of contents should appear at the beginning. 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.*

5. Research Report/Project Summary

All projects must have a Research Report/Project Summary that includes a literature search and a technical report.

6. 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, or any damage to exhibits or exhibitor's personal property.

7. 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 High School Committee Chair.

8. 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/or with the students' parents and guardians.

9. 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.

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

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

Guidelines for Mentorship

After exhausting school resources, the student may seek a mentor (Qualified Scientist/Designated Supervisor). 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 must be aware of the MSSEF procedures, ethics statement, and Rules and Regulations 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), VERTEBRATE ANIMAL FORM (5B), POTENTIALLY HAZARDOUS BIOLOGICAL AGENTS FORM (6A), HUMAN AND VERTEBRATE ANIMAL TISSUE FORM (6B) and REGULATED RESEARCH INSTITUTIONAL/INDUSTRIAL SETTING FORM (1C) as applicable.

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, videos, charts, diagrams, and other simulations such as facsimiles.

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

1. 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.

2. 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
3. The following items cannot be included on the board or visual display: any awards, medals, personal websites, social media addresses, emails, QR codes, the name of any industrial/educational institution where the project was completed, school name, postal addresses or telephone numbers,.
4. No display lighting is permitted.
5. No running water is available.
6. 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).
7. 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.
8. All parts of the exhibit must be structurally sound and constructed of durable materials.
9. Push buttons and levers must be securely mounted to the exhibit. They cannot be attached to tables or walls.
10. All power driven parts must be suitably guarded to prevent unauthorized or accidental access.
11. All wiring of electrical apparatus must conform to the Massachusetts and National Electric Code. If in doubt, consult a licensed electrician.
12. All exhibits that require an external source of electricity for operation must be designed for a standard 110-125 volt AC supply.
13. Antenna lines and long leads cannot be used.
14. 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.

15. 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).
16. 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.
17. 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.
18. Wet-cell batteries with open tops are not permitted. Closed-cell or dry-cell batteries are permissible.
19. Compressed gases must be handled in compliance with standards established by the Compressed Gas Association.
20. 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.
21. 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.
22. Because of the fire and burn hazard, there must be no open flame, torch or burner in the display area.
23. 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.
24. 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:

      U.S. Food and Drug Administration
      Office of Compliance and Surveillance
      1390 Piccard Drive, Rockville, MD 20850
      phone (301) 427-1172
25. 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.
26. Robotics projects should have interlocks or other controls.

27. Participants may only present judges with a copy of their official abstract that was submitted at the time of registration and appears in the abstract book. Students may not present judges with and other hand-out items, such as flyers, pens, flash drives, pins, disks, CD's business cards, brochures, etc.

Any student, Teacher/Adult Sponsor, Qualified Scientist, Designated Supervisor, or Mentor 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
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 & Engineering 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 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 & Engineering Fair be conducted in compliance with the laws, regulations, and standards of all existing laws.

Students and teachers are responsible for obtaining copies of all forms and accompanying rules governing the type of research undertaken. In addition, students and teachers are responsible for checking with the respective city/town boards/commissions 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, Teachers, Adult Sponsors, Qualified Scientists and Designated Supervisors must carefully scrutinize and adhere to all rules and regulations for safe research and display.

All students must complete either an INDIVIDUAL or TEAM STUDENT CHECKLIST (1A) & RESEARCH 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 are available online at **www.scifair.com**.

Proposed Changes to Approved Research Plans

If there are any proposed changes in the STUDENT CHECKLIST (1A) & RESEARCH PLAN that requires SRC prior approval, the forms must be rewritten and submitted to the Regional SRC for approval before experimentation resumes.

Summer Science & Engineering Fair Project Work

Students who intend to start their project work during the summer must complete the appropriate forms and obtain approval by the Regional SRC 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 & Engineering

Fair, they must have the Qualified Scientist and the Regional 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 same methodology and research question, even with an increased sample size, is an example of an UNACCEPTABLE continuation.

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 demonstrates time-based change.
- The display board is based on collective past definitive 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/RESEARCH PROGRESSION PROJECTS FORM (7), and any other applicable forms relative to the area of research. 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 added to the FORM (7). 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, parent, adult sponsor or the Qualified Scientist/Designated Supervisor is permitted to serve on the SRC or IRB reviewing that project.

The SRC uses the following criteria in evaluating a project:

- the completed research plan
- evidence of literature search and appropriate attribution
- type, amount, and appropriateness of 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 for substantial expansion of continuation projects
- compliance with all MSSEF rules and ethics statement

Institutional Review Board (IRB)

The Institutional Review Board (IRB) is a committee that, according to Federal regulations, 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 Regional SRC must be obtained. The REGIONAL or STATE SRC may overrule a determination made by the school or institutional IRB

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) an educator other than the teacher of the student

(b) a school administrator (preferably a principal or vice principal)

(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:
licensed psychologist, nurse practitioner, medical doctor, licensed social worker, licensed clinical professional counselor, physician's assistant, or registered nurse.

Note: ISEF and MSSEF have revised the Human Participants Form (4) to provide an "expedited" review for studies involving either:

1. Human participants will only provide feedback on student-designed invention or prototype, where the feedback received is a direct reference to the design, where personal data is not collected, and where the testing does not pose a health or safety hazard.

2. Student researcher is the only subject of the research and no more than minimal risk is involved.

In either of the above cases only ONE IRB member signature is required.

If the student is conducting the research at federally registered institutions, including medical centers, universities, NIH, correctional facilities, etc., that institutional IRB must initially review and approve the research. Then the school IRB and the Regional SRC must also review the research ensuring that the project is appropriate for a pre-college student and adheres to the MSSEF rules. The Regional SRC may override the IRB's decision and the project may fail to qualify for entry. The decision of the SRC (Regional or State) is final.

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 the MSSEF Human Informed Consent Form giving assent/consent, unless the IRB has waived the requirement for documentation of written informed consent/assent/parental permission. If the subject 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 Human Informed Consent Form.

Special Note: *Neither the teacher, nor the parents, nor the adult sponsor, nor the Qualified Scientist, nor the Designated Supervisor for a project are 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.*

Restricted Areas of Research

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

- **Restricted Areas of Research:**
  1. **Human Subjects** (Form (4))
  2. **Hazardous Chemicals, Activities or Devices** (Risk Assessment Form (3))
     - DEA-controlled substances, prescription drugs, alcohol and tobacco, firearms and explosives
     - non-ionizing and ionization radiation
     - toxic chemicals
     - lasers
     - other hazardous laboratory devices (e.g. high voltage or welding equipment) or activities
  3. **Vertebrate Animals** (Form (5A) or Form (5B))
  4. **Potentially Hazardous Biological Agents (PHBAs)** or **rDNA** (Form(6A))
  5. **Human or Vertebrate Animal Tissue** (Form(6B))
- **Research conducted at an Institutional/Industrial Setting**: Form (1C) and Qualified Scientist Form (2)

Research questions should be directed to:

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

1. Human Subjects

Human subject research includes projects involving:

- Subjects participating in physical activities (e.g., physical exertion, or any medical procedure)
- Psychological, educational, or opinion studies (e.g., survey, questionnaire, test of any kind)
- Studies in which the researcher is the subject of the research
- Testing of student designed invention or concept by human participants other than student researcher
- Data/record review projects that include data that is not deidentified/anonymous (data set that includes name, birthdate, phone number or other identifying variables)

- Behavioral observations that include interaction with observed individuals, researcher modified environment (e.g. post a sign, place an object), occur in non-public or restricted access settings (e.g. day care setting, doctor's office) or recording any personally identifiable information

All research projects involving human subjects, including any revisions, must be reviewed and approved by an Institutional Review Board (IRB) and the Regional SRC before the research begins. Copies of standardized and student prepared tests, surveys, visual or auditory materials, etc. must be added to the RESEARCH PLAN. The completed HUMAN SUBJECTS FORM (4) and a sample of the MSSEF Human Informed Consent Form must also be added 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. If required by the IRB or SRC, the MSSEF Informed Consent Form must be obtained from all participants prior to the experiment. 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

Obtaining **informed consent** from an adult or minor assent is **always** required. However, the IRB may **waive** the requirement for documentation of **written informed consent/assent and/or parental permission** if the research involves **only minimal risk and anonymous data collection and if it is one of the following:**

- Research involving normal educational practices.
- Research on individual or group behavior or characteristics of individuals where the researcher does not manipulate the participants' behavior and does not involve more than minimal risk.
- Surveys and questionnaires determined to involve perception, cognition or game theory and do not involve gathering of personal information, invasion of privacy or potential for emotional distress.
- Studies involving physical activity where the IRB determines that no more than minimal risk exists and where the probability and magnitude of harm or discomfort anticipated in the research are not greater than those ordinarily encountered in **DAILY LIFE** or during performance of routine physical activities.

If there is any uncertainty regarding the appropriateness of waiving written informed consent/assent or parental permission, it is strongly recommended that documentation of written informed consent/parental permission be obtained. Parental permission for minor participants younger than high school age should always be obtained.

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) or an official letter from the Institutional IRB attesting to this approval is necessary. A letter from the teacher, Qualified Scientist, or Designated Supervisor attesting to this approval is NOT sufficient. This material must be sent to the Regional SRC for approval before research can begin.

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 invasive medical procedures on human subjects. The IRB must confirm that the student is not violating state or federal medical practices and laws.

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 of the participants. (Public Health Service Act, 42, USC 421 (d)).

The use of the internet to obtain data for human subject research (e.g., email, web-based surveys) is possible and permissible but will pose challenges in collecting anonymous data, obtaining informed consent, and ensuring that the participants are of the appropriate age to give informed consent.
Go to https://student.societyforscience.org/human-participants#riskass to find more information regarding internet usage.

The student researcher, teacher, 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. Signed Informed Consent Forms (when required by the IRB) should be 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 published instruments 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 instrument.

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 Regional 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 breach 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 Human 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).)
4. **INGESTION OF ANY SUBSTANCES (DRUGS, FOODS, FOOD ADDITIVES, VITAMINS, MINERALS, ETC.) IS NOT PERMITTED.**
5. Any research activity (e.g. survey, questionnaire, viewing of stimuli) or experimental condition that could potentially result in **emotional distress** would be considered **more than minimal risk.** Examples: questions relating to sexual/physical abuse, divorce, depression, anxiety, suicide, or stimuli that result in emotional distress, anxiety, depression, or low self-esteem.
6. Possible negative consequences due to invasion of privacy or breach of confidentiality. Wherever possible, students should collect data anonymously.

B. Risk Groups

1. Any member of a group that is naturally at risk
    - Examples: pregnant woman, developmentally disabled persons, economically or educationally disadvantaged persons, individuals with diseases such as cancer, asthma, diabetes, cardiac disorders, psychiatric disorders, learning disorders, dyslexia, AIDS, etc.
2. Special vulnerable groups covered by federal regulations
    - Examples: children/minors, prisoners, pregnant woman students receiving services under the Individuals with Disabilities Education Act (IDEA)

All research involving human subjects *must* comply with Federal and STATE regulations. (FERPA and HIPAA, protection of medical information.) 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

Please consult https://student.societyforscience.org/human-participants#riskass for a complete guide to evaluating Risk in Human Subject projects.

2. Hazardous Chemicals, Activities or Devices

MSSEF allows students to conduct research involving hazardous chemicals, activities or 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, piece of equipment, or radioactive material that exposes a researcher or any research subject to risk or harm. A RISK ASSESSMENT FORM (3) must be submitted and Regional SRC approval is required before experimentation.

The use of hazardous chemicals and devices, DEA-controlled substances(Qualified Scientist required), firearms, radioactive substances and radiation require proper supervision by a Qualified Scientist and/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 Regional 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 Academic Chemistry Laboratories that can be obtained from:

American Chemical Society, Publications Support Services
1155 16th Street, NW, Washington, DC 20036
Phone: 800-227-5558
www.acs.org/education

Controlled Substances

Research involving controlled substances must be approved by the Regional 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 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 or acquired 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) 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 or engineering 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. www.atf.com

A fully assembled rocket motor, reload kit or propellant modules containing more than 62.5 grams of propellant are subject to the permitting, storage and other requirements of federal explosive laws and regulations.

Potato guns and paintball guns are not considered firearms unless they are intended to be used as weapons. However, they must be treated as a hazardous device.

Project involving unmanned aircraft systems (UAS)/drones must follow all State and Federal laws.

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

Sources of Information:

- **Alcohol, Tobacco and Firearms**
  - The Bureau of Alcohol, Tobacco, Firearms and Explosives http://www.atf.gov
  - Alcohol and Tobacco Tax and Trade Bureau http://www.ttb.gov
- **Controlled Substances**
  - Drug Enforcement Agency http://www.justice.gov/dea/index.htm
  - List of Controlled Substances http://www.deadiversion.usdoj.gov/schedules/
- **(UAS)/Drones**
  - Federal Aviation Administration www.faa.gov.uas/regisitration

*****CONTACT APPROPRIATE STATE AGENCIES CONCERNING ADDITIONAL REGULATIONS.***

3. Vertebrate Animals

An animal is defined as any live, non-human vertebrate mammalian embryo or fetus, tadpoles, bird and reptile eggs within three days (72 hours) of hatching, and all other nonhuman vertebrates (including fish) at hatching or birth. Zebrafish embryos are not considered vertebrate animals until 7 days post-fertilization.

According to Massachusetts State Law (see below), no vertebrate animal can be subject to duress. Student researchers must 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 and approved by the Regional SRC. **Any proposed changes in the RESEARCH PLAN (1A) & RESEARCH PLAN by the student after initial Regional SRC approval must have subsequent Regional 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, teachers, adult sponsors, Qualified Scientists, and Designated Supervisors should become thoroughly familiar with the following Massachusetts law that applies to classroom activities, school related independent research and Science & Engineering 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 Regional SRC. It must be carefully noted that all projects must fit within the confines of the state 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, university, 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 who confers with the teacher. **Projects must be reviewed by the institution's Institutional Animal Care and Use Committee (IACUC) and the Regional 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, or teacher attesting to this approval is not sufficient.

Vertebrate animal studies may be conducted at a home, school, farm, ranch, in the field, etc. This includes:

(a) Studies of animals in their natural environment.
(b) Studies of animals in zoological parks.
(c) Studies of livestock that use standard agricultural practices.
(d) Studies of fish that use standard aquaculture practices

These studies must adhere to **BOTH** of the following guidelines:

(a) The research involves only agricultural, behavioral, or observational studies.
(b) The research involves only non-invasive and non-intrusive methods that do not affect an animal's health or well-being.

No vertebrate animal deaths due to the experimental procedures are permitted in any group or subgroup or the project. Any death that occurs must be investigated by a veterinarian or the qualified scientist to determine the cause of death. The project must be suspended during such an investigation and results are confirmed in writing. If the

death was the result of the experimental procedure, the study must be terminated the project will fail to qualify for competition.

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

- **Principles and Guidelines for the Use of Animals in Pre-college Education**
  http://dels.nas.edu/global/ilar/Guide
- **Guidelines for use of Fish in Research**
  http://www.fisheries.org

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

4. Potentially Hazardous Biological Agents (PHBAs)

Projects incorporating microorganisms (including bacteria, viruses, viroids, prions, rickettsia, fungi, and parasites), recombinant DNA (rDNA) technologies or human or animal fresh/frozen 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 (Form 6A)** (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/frozen tissues (including primary cell lines, human and other primate cell lines and tissue cultures), blood, blood products, or body fluids must adhere to the rules below AND, depending on the study, to the additional rules in Section A, B or C on pages 31-34.

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 Regional SRC before the experiment can begin.

3) Experimentation with potentially hazardous biological agents, even BSL-1 organisms, **is prohibited in a home environment**. However, specimens can 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, teacher and qualified scientist or designated supervisor prior to experimentation and a final biosafety level must be determined and confirmed by the Regional SRC.

5) Research determined to be at Biosafety Level 1 (BSL-1) may be conducted in a BSL-1 or higher laboratory. The research must be supervised by a Qualified Scientist or a trained Designated Supervisor. The student must be properly trained in standard microbiological practices.

6) Research determined to be a Biosafety Level 2 (BSL-2) MUST be conducted in a laboratory rated BSL-2 or above (commonly found in a regulated research institution) 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 (BSL-3 or BSL-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 antibiotic resistant organisms and studies using such organisms require at least BSL-2 containment.

9) Laboratory studies culturing MRSA (Methicillin-resistant *Staphlococcus aureus*) and VRE (Vancomycin-resistant enterococci) and KPC (*Klebsiella pneumonia*) must have written justification for usage and be conducted in a BSL-2 laboratory in a Registered Research Institution with

documented IBC review and approval. Students are prohibited from culturing CRE (Carbapenem Resistant *Enterobacteriacae*).

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 biosafety level and 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** from Regional SRC review:
    a. Studies involving baker's or brewer's yeast (unless they are involved with rDNA studies).
    b. Studies involving *Lactobacillus*, *Bacillus thuringinensis*, nitrogen-fixing bacteria, oil-eating bacteria, and algae-eating bacteria introduced into their natural environment. (Not exempt if cultured in a petri dish environment.)
    c. Studies of mold growth on food items if the experiment is terminated at the first evidence of mold.
    d. Studies of edible mushrooms and amoebozoa (slime mold).
    e. Studies involving water or soil not concentrated in media conducive to their growth.
    f. Studies involving E.coli k-12 which are done at school and are not recombinant DNA studies.

14) The following studies **must be reviewed** by the Regional SRC and require a Risk Assessment Form (3):
    a. Studies involving protists, archaea and similar organisms.
    b. Research using manure for composting, fuel production, and other non-culturing experiments.
    c. Commercially available coliform kits which will remain sealed and will be properly disposed of.
    d. Studies involving the decomposition of vertebrate organisms (Must include source or receipt for such organisms).
    e. Studies with microbial fuel cells.

15) The following forms are required:
    - **Checklist for Teacher/Adult Sponsor (1)** ***(continued on next page)***
    - **Student Checklist (1A) and RESEARCH PLAN**
    - **Approval Form (1B)**
    - **Regulated Research Institution Form (1C)** - if applicable
    - **Qualified Scientist Form (2)**, if applicable
    - **Risk Assessment Form (3)**, if applicable

- **Potentially Hazardous Biological Agents Form (6A) –** for all studies involving microorganisms, rDNA, fresh/frozen tissue, blood and bodily fluids
- **Human and Vertebrate Animal Tissue Form (6B)** - for all studies involving fresh/frozen tissue, primary cell cultures, blood, blood products and body fluids

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

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 four steps:

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 below 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 Regional 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 luteus, Neurospora crassa, Pseudomonas fluorescens, Serratia marcescens*. (These are 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 Regional SRC approval must have subsequent Regional SRC approval before such changes are made and before experimentation resumes.

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 and engineering 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**. Other acceptable containment includes 2 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 Qualified Scientist/ Designated Supervisor.
2) If a culture is opened (except for disinfection for disposal) for identification, sub-culturing or isolation, it must be treated as a BSL-2 study and involve BSL-2 laboratory procedures.

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

Studies involving rDNA technologies in which microorganisms have been genetically modified require close review to assess risk level assignment. There are a few rDNA studies that can be safely conducted in a BSL-1 high school laboratory with prior review by the Regional 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 Regional SRC prior to experimentation. Examples include cloning of DNA in *E. coli K12*, *S. cerevesiae*, and *B. subtilis* host vector systems.

2) Commercially available rDNA kits using BSL-1 organisms under the supervision of a Qualified Scientist or trained Designated Supervisor must be approved by the Regional SRC before experimentation begins.

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 under the supervision of a Qualified Scientist and approved by the IBC and the Regional SRC before experimentation begins.

4) All rDNA technology studies involving BSL-2 organisms and/or BSL-2 host vector systems must be conducted in a regulated research institution and approved by the IBC and Regional SRC 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, the Qualified Scientist, not the student, must do this part of the research, and references must be 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 or after 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, documentation of the IACUC approval for the original animal study from which tissues were obtained is required.**

3) Biosafety level 1 studies may involve the collection and examination of fresh/frozen 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 BSL-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 blood borne 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) and domestic unpasteurized animal milk are considered BSL-2.

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

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.) Student researchers using their own body fluids are exempt from this requirement.

9) Self –sampling by researcher of capillary blood for analysis can be conducted in a home setting (e.g. glucometer reading).

10) The following types of tissue do not need to be treated as potentially hazardous biological agents:
    a) Plant tissue (except those know to be toxic or hazardous).
    b) Plant and non-primate cell lines and tissue culture collections (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) Fresh or frozen meat or meat by-products, pasteurized milk or eggs obtained from food stores, restaurants, or packing houses.
    d) Hair, hooves, nails, and feathers
    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/or validate purchase.

Sources of Information:

- ***NIH Guidelines for Research Involving Recombinant DNA Molecules,*** published by National Institutes of Health http://oba.od.nih.gov/oba/index.htm

- ***Biosafety in Microbiological and Biomedical Laboratories (BMBL) - 4th Edition,*** published by CDC-NIH http://www.cdc.gov/biosafety/
- ***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

5. Human or Vertebrate Animal Tissue

Also see new rules that apply to potentially hazardous biological agents (page 27). 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 from 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.

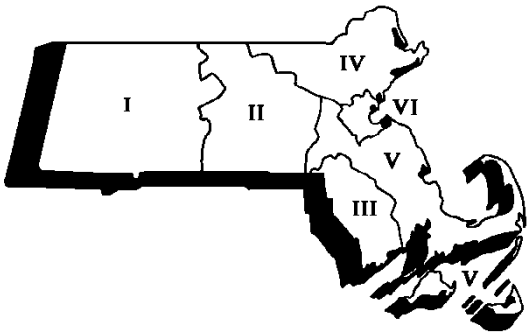
SECTION III: MSSEF NETWORK

The Massachusetts Science & Engineering Fair (MSSEF) is the culmination of a yearlong program for high school students who have produced science or engineering 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., 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.



Geographic breakdown of the Massachusetts State Science & Engineering Fair network

The pathway to the International Science & Engineering Fair is only through participation in the Regional fairs. 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 two projects 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.scifair.com

Local

Many high schools across the state sponsor their own Science & Engineering 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 two projects directly to the State Fair.

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, almost $6 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 about 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 sixty (60) from 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

Other awards include lab supplies, books, software, calculators, etc.

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 are 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. It should be in APA format.

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 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

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.

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, breach 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, and 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: The student researcher's science/engineering/ math/computer science teacher of record for the year the project began. This teacher may fill out Form (1) attesting to the fact that he/she has reviewed the Rules and Guidelines, reviewed the student's Forms and Research Plan, and discussed risks involved with the project. The teacher may serve as a Designated Supervisor or Qualified Scientist.

Team Project- two or three students working to complete one science and engineering fair project in which one research report is produced. A team project cannot become an individual project or vice versa within the same project year. .

SECTION VI: APPENDIX

Categorizing the Project (see page 44)

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 Forms & Checklist**

PROJECT CATEGORIES

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 & 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 & 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.