

2011 Manual



Massachusetts
Science
Fair

State Middle School Edition

SCIENCE

ENGINEERING

MSSEF

61st ANNUAL

Massachusetts State

Science &
Engineering

Fair

Saluting Our 2010

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JUNE 30, 2010





• SUPPORTING •



At Cabot we strive to be a responsible corporate citizen and a good neighbor by how we operate our facilities and through our philanthropic programs and volunteerism. Our philanthropic activities give priority to science and technology education and community and civic improvement initiatives. These priorities reflect our belief that education is a cornerstone of community sustainability, and our commitment to making a positive and lasting difference in the places where we operate.



"Founded in 1878, Fish & Richardson P.C. is a leading global law firm unlike any other law firm in the world. With over 380 lawyers, the firm is one of the largest practicing IP strategy and counseling, IP litigation, and business litigation. As a law firm that has helped great innovators and entrepreneurs protect their intellectual property, we have a keen interest in promoting science education, and look forward to seeing the next century of great innovators."



Infoscitex provides research, development & engineering solutions to defense, aerospace, security, life science, & energy and environment markets. IST Energy provides environmentally beneficial & economically attractive solutions to energy & environmental markets. Infoscitex Foundation advances educational opportunities for our nation's youth by awarding college scholarships to high school students possessing a high degree of interest and excellence in mathematics, science and technology.



Founded in 1898, Northeastern University is a private research university located in the heart of Boston. Northeastern is a leader in worldwide experiential learning, urban engagement, and interdisciplinary research that meets global and societal needs. Our broad mix of experience-based education programs—our signature cooperative education program, as well as student research, service learning, and global learning—build the connections that enable students to transform their lives. The University offers a comprehensive range of undergraduate and graduate programs leading to degrees through the doctorate in six undergraduate colleges, eight graduate schools, and two part-time divisions.



The University of Massachusetts Boston is a community of scholars that prides itself on academic excellence, diversity, and its commitment to serving students and the Commonwealth through its five undergraduate colleges in liberal arts, science and mathematics, management, nursing and health sciences and public and community service, and two graduate colleges in education and policy studies. The College of Science and Mathematics is strongly committed to the integration of research and teaching, and its students are enriched by opportunities to participate in independent research in productive and exciting research laboratories. Each year, UMass Boston offers a full scholarship to the Massachusetts State Science & Engineering Fair winner who enrolls at the university.



As a leading high technology company and employer headquartered in Hopkinton, Mass., EMC Corporation relies on an innovative and skilled workforce to compete in the global economy. EMC is committed to investing time, talent and financial resources to engage students and encourage science, technology, engineering and mathematics education as the strong foundation needed for the technology innovation and engineering workforce of tomorrow in Massachusetts and around the world.



Genzyme has developed a strategic giving program to support science education and health-related initiatives in communities where Genzyme has a significant business presence. From promoting basic science to raising awareness of the biotechnology industry, Genzyme strongly supports programs that help build excitement and enthusiasm about science education. We are also committed to promoting better understanding of health issues and to increasing the accessibility of health programs.



Intel believes that young people are the key to solving global challenges. A solid math and science foundation coupled with skills such as critical thinking, collaboration and digital literacy are crucial for their success. That is why we get directly involved today in education programs, advocacy, and technology access to enable tomorrow's innovators. Over the past decade alone, Intel has invested more than \$1 billion, and Intel employees have donated more than 2.5 million hours toward improving education in 50 countries.



The Noyce Foundation aims to help young people become curious, thoughtful, and engaged learners. The Noyce Foundation focuses on a few key areas: improving the teaching of math, science and literacy in public schools, developing leadership to support student achievement, education policy and research, and finally, on expanding opportunities for students to experience hands-on science in out-of-school settings



Wheaton College offers an expansive curriculum in the liberal arts and sciences that encourages independent exploration, creative thinking and innovative problem solving. Science and math occupy a central place in curriculum. The college promotes math and science study through partnerships with Battelle, Raytheon and the Southeast Alliance Pipeline project. As part of its merit scholarship program, Wheaton offers a scholarship each year to a Massachusetts State Science and Engineering Fair winner who earns admission to the college. In addition, Wheaton scholars have had outstanding achievement in recent years, including three Rhodes and two Goldwater scholarships.



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• **IN APPRECIATION** •

We are grateful to our supporters – companies, universities, foundations, individuals and professional organizations, for their help over the past 61 years in advancing inquiry-based learning and science fair programs throughout Massachusetts.

Generous contributions from our sponsors enable us to invest in our schools, communities and children. Working together, we will continue to inspire future generations of science and engineering leaders, build science literacy for all students, and open pathways to college and new careers for students in high-needs communities.

Massachusetts State Science & Engineering Fair, Inc. (MSSEF) is incorporated in the Commonwealth of Massachusetts as a not-for-profit corporation and is a Federal tax-exempt organization under Federal law 501c(3). Federal Tax Exempt Number: 04-2707499





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In Appreciation: Worcester Technical High School, Worcester



MASSACHUSETTS MIDDLE SCHOOL SCIENCE & ENGINEERING FAIR

About the Fair

The Massachusetts Middle School Science & Engineering Fair (MMSS&EF) is an annual one-day fair for students in grades 6, 7, and 8 attending public, private, parochial schools or home schooled in the Commonwealth. The Fair is sponsored by Cabot Corp., Boston and hosted by Worcester Technical High School. Administrative services are provided by University of Massachusetts Medical Center, Worcester.

Entrants exhibit their projects to their peers, a team of judges and the public. This experience is an outstanding opportunity for students to actively engage in an aspect of science and technology in which he or she is interested and to become proficient in the scientific process.

There are categories of projects: individual and team. Team projects may include up to, but not more than three members. The top 40 winning projects from each Regional Fair may enter the State Fair. Regional Fairs are held in the following regions: Worcester, Boston, Fall River., North Adams, Lowell, and Weston. Check the website for regional updates. In addition, one project may be sent to the State Fair directly from an individual school. All required safety forms and registration forms found in the Research and Registration Forms section must be submitted by deadlines indicated in the Deadlines section.

To The Teacher

CHOOSING A PROJECT

The project should be of an **experimental** nature. Although the aesthetics of the exhibit will be taken into consideration, the main concerns are the scientific approach and thought processes used in completing the project. It is not the choice of topic that is of prime importance, but the manner in which the student handles the project. Often a simple project can offer a great experimental challenge to the imaginative student. The role of the teacher, mentor or parent should be one of guidance, encouragement and, as needed, constructive criticism. In some cases, supervising a safety-related component of the project will be required.

RESEARCH PLAN

Prior to a student beginning his/her independent research project for a regional or state fair, he/she is **required** to complete the Research Plan Form for teacher approval. The form is then sent to the Regional Safety Review Committee (RSRC) for approval. Contact information for the Regional Safety Review Committees is found in the Regional Contacts section of this Manual. **The RSRC must approve this research plan before the student begins the project.** The RSRC approved forms will be returned to the student to be submitted with the Registration Form. If during project completion the research plan changes significantly, a new research plan must be resubmitted. Any project that has not received approval by the RSRC will not be eligible to compete at the State or Regional Level. Research Plan Form 1A, 1B, Form C & Form D are found in the Research and Registration Forms section.

If your region does not have a Regional Fair or a RSRC, submit your research plans for safety approval to:

Sandra Mayrand, MMSSEF Chair
c/o Regional Science Resource Center
UMass Medical School
222 Maple Avenue
Shrewsbury, MA 01545.

RESEARCH REGULATIONS

1. The Science Fair projects may not involve at any stage of the project the following:

- Blood products, fresh tissue, teeth or bodily fluids
- Nonhuman vertebrate animals and their parts, exception eggs
- Ingestion or inhalation of any substance by humans subjects
- Pathogenic agents*
- Recombinant DNA
- Carcinogenic or mutagenic chemicals
- Compressed gas (including, but not limited to CO₂)
- Controlled substances*
- Explosive chemicals
- Hazardous substances or devices (including, but not limited to BB guns, paint ball guns, potato cannons, air cannons)
- High voltage equipment
- Highly toxic chemicals
- Lasers (any strength)
- Ionizing radiation X-rays or nuclear energy
- Radioactive materials (except non-ionizing, naturally occurring materials)

****FURTHER EXPLANATIONS***

Controlled Substances

Controlled substances, including DEA-classed substances, prescription drugs, alcohol and tobacco are **not** allowed.

Pathogenic Agents

- Pathogenic agents are disease causing, or potential disease-causing organisms such as bacteria, viruses, viroids, prions, rickettsia, fungi, mold and others.
- Organisms collected, isolated and/or cultured from any environment (e.g., air, soil) are considered potentially pathogenic and experiments using these procedures will not be allowed.
 - Raw or partially processed human/animal waste is considered to contain potentially pathogenic agents.

Please refer any safety questions to:

MMSSEF Review Committee
Sandra Mayrand, 508 856-5097, or
Sandra.Mayrand@umassmed.edu

2. All human research projects must have an Informed Consent Form (Form C) attached.

- All human research projects including surveys, professional tests, questionnaires, and studies in which the human subject used is also the researcher need Regional Safety Review Committee (RSRC) approval. Copies of standardized and/or student prepared tests, surveys, etc. to be used must be attached to the Research Plan for approval. Questions 1, 2, and 3 on the Informed Consent Form must be filled out by the student researcher before submission to the RSRC for approval.
- After safety approval, Informed Consent Form (C) must be signed by all subjects involved in human research projects prior to the experimentation. Copies of all signed Informed Consent Forms must be submitted with the Registration Form to enter the Fair. If a participant is under 18 years old, the parent/guardian signature is required.

3. Experiments with non-pathogenic microorganisms* must have a Designated Supervisor Form (Form D) completed and submitted for RSRC approval.

Experiments with any non-pathogenic organisms may only be conducted in a laboratory setting (not in the home) with the following capabilities:

- a. The laboratory work is to be supervised by an individual with general training in microbiology.
- b. Standard practices for sterile technique must be observed.
- c. Work is to be done on an open bench or fume hood.

d. Purchased microorganisms must be identified and certified as non-pathogenic from the supply house with full name of microorganism, source of purchase and catalog number.

e. Lab coats must be worn.

f. Culture plates/tubes of bacteria must be sealed and not opened in the laboratory after culturing and growth.

g. Sub-culturing is not allowed.

h. Decontamination must be achieved by either chemical disinfectants or steam autoclaving.

***Two exceptions: Baker's and Brewer's yeast do not need Form D.**

4. Special Safety Concerns

Other situations such as use of power tools, chemicals, etc. which require adult supervision of the middle school student's project need to be documented on Form D, Designated Supervisor.

5. General Requirements

- Only new research project done in the current school year will be eligible for participation.
- Individual projects must be entirely the work of the individual student and team projects must be entirely the work of the team.
 - Students are expected to keep a bound logbook with original, hand-written, and dated entries that record each step taken in the development of the project.
- During judging and exhibition times, students must remain with their projects. Parents, advisors, mentors, teachers and guests must wait outside the project area until public display begins.
- Cell phone use is not allowed during the judging period.

PROJECT DISPLAY GUIDELINES

Students must adhere to all display guidelines provided in this Manual. If the MMSS&EF Safety Committee considers the presence or operation of any equipment or material to be dangerous or unsafe, it shall have the right to prohibit the presence or operation of such equipment or material. Exhibitors may demonstrate the safe use of materials through photographs, videotapes, charts, diagrams and other simulations.

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

- Projects must fit into a 40" x 26" table space. Wall space for posters is not available. Design your exhibit so that all posters, charts and displays are free standing.
- No laser pointers allowed.
- Glass is prohibited from display area but may be either encased in a break-resistant container or replaced by a break-resistant container. The exception is glass light bulbs. Mercury thermometers are **prohibited**.
- No liquids may be displayed.
- Knives and other sharp objects may not be displayed.
- Microorganisms may not be displayed.
- Drugs, over-the-counter medications, antibiotics, and vitamins may **not** be displayed.
- All power driven parts must be suitably guarded to prevent unauthorized or accidental access.
- Access to electrical outlets is limited, so please bring a heavy-duty/three-pronged extension cord. Please check the appropriate space on the registration card if electricity is needed.
- All exhibits that require an external source of electricity for operation must be designed for a standard 110-125 volt AC supply. *(continued next page)*

- 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 approved connectors with insulated connecting wires. No exposed wires, switches, joints, or un-insulated fasteners will be permitted.
- The power supply cord for the electrical apparatus must terminate in a three-prong grounded outlet. **All power supplies and electrical equipment must be grounded.**
- Bare wire and exposed knife-type switches are permitted on 12-volt DC circuits or less. Approved standard enclosed switches are required for all other electrical installations.
- Wet-cell batteries with open tops are not permitted. Closed-cell or dry-cell batteries are permissible.
- The operation of high-pressure vessels and pressurized systems is **not** permitted.
- There must be no open flame, torch or burner in the display area.
- All microwave and radio frequency sources must be designed and operated in compliance with state and federal regulations as well as applicable standards of the American National Standards Institute.
- Robotics projects should have interlocks or other controls.



TOPICS FOR CONSIDERATION IN JUDGING

The judging process will focus on what the student has learned about his or her chosen project and the process used in completing the project. In addition the project will be judged on the basis of the student's ability to discuss intelligently the overall scope and significant results of his or her work. Judging criteria for team and individual projects are identical.

1. Scientific Approach

- A. Did the student start with a clearly stated hypothesis or statement of an engineering goal?
- B. Was the student orderly and logical with the setup and follow through of the project?
- C. Were the student's conclusions consistent with the data he or she collected?

Possible 25 points

2. Knowledge of Project Area

- A. How effectively did the student conduct preliminary research?
- B. What was the extent of the student's knowledge of material related to project?
- C. Was the student aware of both the scope and limitations of the project?

Possible 20 points

3. Thoroughness

- A. Did the student do sufficient research in the literature before starting the project?
- B. Was thorough use made of data and observations?
- C. Was the original plan successfully followed through to completion?

Possible 20 points

4. Written Records and Reports

- A. Did the student keep an original handwritten, bound logbook with all plans, procedures, observations, and conclusions for failures as well as successes?
- B. Did the student put together an accurate written report, complete with a bibliography?

Possible 15 points

5. Ingenuity and Creativity

- A. Was the explanation of the project clear and precise?
- B. How well did the student use his or her materials in the solution of problems?
- C. Did the student present any new or unique ideas?

Possible 15 points

6. Visual Presentation

- A. Was the project displayed in a logical and organized manner?
- B. Were charts and graphs used where needed?
- C. Did the display and posters effectively convey the message in an understandable manner?

Possible 5 points



Timelines – Regional & State Middle School Science and Engineering Fairs

2011 Form Due Dates

Due prior to experimentation

The following Forms must be sent to either your Middle School Regional Safety Review Committee (see contact information in Manual) or Middle School State Safety Review Committee):

- Research Plan Forms 1A and 1B
- If necessary, human Informed Consent Form (Form C) that will be given to subjects before experimentation, and
- Designated Supervisor Form (Form D)

Massachusetts Middle School Science & Engineering Fair Worcester Technical High School Saturday, June 4, 2011

Due prior to, but no later than May 6, 2011

- Registration Form (Approved Research Plan, 1 A and B included), and
- Approved Forms C and D, if necessary

To enter the Massachusetts Middle School Science and Engineering Fair:

Contact: Sandra Mayrand at 508 856-5097, or Sandra.Mayrand@umassmed.edu

Mail to: Regional Science Resource Center, UMass Medical School, 222 Maple Avenue, Shrewsbury, MA 01545



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sandra.mayrand@umassmed.edu

MSSEF, Inc. is incorporated in Massachusetts as a not-for-profit corporation and is a Federal tax-exempt organization under Federal law 501 (c) (3)



MMSSEF Regional Fair District Information

Middle school teachers should contact their respective regional chairs for further information about the regional middle school science fairs.

Region I: Western Massachusetts

Western Massachusetts Middle School
Science & Engineering Fair
Massachusetts College of Liberal Arts
Saturday, April 30, 2011

Chair: Lisa Provencher & Lauren Moffatt
Massachusetts College of Liberal Arts
Tel: (413) 662-5525
Email: region1scifair@gmail.com

Region II: Central Massachusetts

Worcester Regional Middle School Science &
Engineering Fair
Worcester Polytechnic Institute
Wednesday, May 4, 2011

Chair: Lisa Greenwald
379 Cross Street
Boylston, MA 01505
Tel: (508) 869-0194
Email: Greenwal@westborough.k12.ma.us

Region III: Southwest Massachusetts

Rensselaer @ BCC Region III Science Fair
Bristol Community College, Fall River
Combined Senior High/Middle School Fair
Saturday, March 12, 2011

Chair: Dr. James Pelletier
Bristol Community College
777 Elsbree Street
Fall River, MA 02720
Tel: (508) 678-2811, x2200
Fax: (508) 675-2366
Email: James.Pelletier@bristolcc.edu

Region IV: Northeastern Massachusetts

Northeast Regional Middle School Science &
Engineering Fair
University Massachusetts @ Lowell
North Campus/Comnock Hall
Saturday, April 30, 2011

Chair: Marjorie Dennis, Project Manager
UMass Lowell -- Office of School Partnerships
600 Suffolk Street, 4th Floor
Lowell, MA 01854
Tel: (978) 934-4666
Email: Marjorie_Dennis@uml.edu

Region V: Southeastern Massachusetts

Southeastern Massachusetts Middle School Science &
Engineering Fair
Regis College
Saturday, April 30, 2011

Chair: Walter Horner
Regis College
235 Wellesley Street
Weston, MA 02493
Tel: (781) 768-7125
Fax: (781) 768-7159
Email: Walter.Horner@regiscollege.edu

Region VI: Boston

Boston Public Schools Regional Science Fair
Northeastern University, Boston
Combined Senior High/Middle School Fair
TBD 2011

Chairs: Ruth O'Day & Maryann Benda
Boston Public Schools
1216 Dorchester Avenue
Dorchester, MA 02125
Tel: (617) 635-8750
Email: Rmoday@verizon.net

Region VI includes all public schools within the City of Boston. Private and parochial schools within the City of Boston are included in Region V

Regional Districts' Cities and Towns

Region I: Western Massachusetts

Adams	Hinsdale	Shutesbury
Agawam Holyoke	South Hadley	
Alford	Huntington	Southampton
Amherst	Lanesborough	Southwick
Ashfield	Lee	Springfield
Becket	Lenox	Stockbridge
Belchertown	Leverett	Sunderland
Bernardston	Leyden	Toland
Blandford	Longmeadow	Tyringham
Buckland	Ludlow	Ware
Charlemont	Middlefield	Warwick
Cheshire	Monroe	Washington
Chester	Monson	Wendell
Chesterfield	Montague	Westfield
Chicopee	Monterey	Westhampton
Clarksburg	Montgomery	West Springfield
Colrain	Mt. Washington	West Stockbridge
Conway	New Ashford	Whately
Cummington	New Marlboro	Wilbraham
Dalton	New Salem	Williamsburg
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Erving	Otis	Regional High Schools
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Hawley	Sheffield	Mohawk Trail
Heath	Shelburne	Monument Mountain
		Mount Greylock
		Pioneer Valley
		Turners Falls

Region II: Central Massachusetts

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Ashland	Leicester	Upton
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Boylston	Millbury	West Brookfield
Brimfield	Millville	Westminster
Brookfield	New Braintree	Whitinsville
Charlton	Northborough	Winchendon
Clinton	Northbridge	Worcester
Douglas	North Brookfield	
Dudley	Oakham	Regional High Schools
East Brookfield	Oxford	Algonquin
Fitchburg	Paxton	Assabet Valley
Framingham	Phillipston	Bay Path
Gardner	Princeton	Blackstone-Millville
Grafton	Royalston	Lincoln-Sudbury
Hardwick	Rutland	Montachusett
Harvard	Shrewsbury	Narragansett
Holden	Southborough	Nashoba
Holland	Southbridge	Nipmuc
Holliston	Spencer	Oakmont
Hopedale	Sterling	Quabbin
Hopkinton	Stow	Quaboag
Hubbardston	Sturbridge	Shepherd Hill
Hudson	Sudbury	South Middlesex
	Sutton	Tahanto
		Tantasqua
		Wachusett

Region III: Southwestern Massachusetts

Acushnet	Mansfield	Swansea
Attleboro	New Bedford	Taunton
Berkeley	Norfolk	Westport
Dartmouth	North Attleboro	Wrentham
Dighton	Norton	
Fairhaven	Plainville	Regional High Schools
Fall River	Raynham	Apponequet
Foxborough	Rehoboth	Bristol-Plymouth
Franklin	Seekonk	Dighton-Rehoboth
Lakeville	Somerset	Diman Regional
		King Philip

Region IV: Northeastern Massachusetts

Acton	Lawrence	Tewksbury
Amesbury	Lexington	Topsfield
Andover	Lincoln	Townsend
Arlington	Littleton	Tyngsboro
Ashby	Lowell	Wakefield
Ayer	Lynn	Waltham
Bedford	Lynnfield	Watertown
Belmont	Malden	Wenham
Beverly	Manchester	Westford
Billerica	Marblehead	West Newbury
Boxborough	Medford	Wilmington
Boxford	Melrose	Winchester
Burlington	Merrimac	Winthrop
Cambridge	Methuen	Woburn
Carlisle	Middleton	
Chelmsford	Nahant	Regional High Schools
Chelsea	Newbury	Acton-Boxborough
Concord	Newburyport	Concord-Carlisle
Danvers	North Andover	Greater Lawrence
Dracut	North Reading	Greater Lowell
Dunstable	Peabody	Groton-Dunstable
Essex	Pepperell	Hamilton-Wenham
Everett	Reading	Masconomet
Georgetown	Revere	Metropolitan
Gloucester	Rockport	Nashoba Valley Tech
Groton	Rowley	Northeast
Groveland	Salem	North Middlesex
Hamilton	Salisbury	Pentucket
Haverhill	Saugus	Shawsheen Valley
Ipswich	Shirley	Triton
	Somerville	Whittier Regional
	Stoneham	
	Swampscott	

Region V: Southeastern Massachusetts

Abington	Lakeville	Truro
Avon	Marion	Walpole
Barnstable	Marshfield	Wareham
Bellingham	Martha's Vineyard	Wayland
Bourne	Mashpee	Wellesley
Braintree	Mattapoisett	Wellfleet
Brewster	Medfield	West Bridgewater
Bridgewater	Medway	Weston
Brockton	Middleborough	Westwood
Brookline	Millis	Weymouth
Canton	Milton	Whitman
Carver	Nantucket	Yarmouth
Chatham	Natick	
Cohasset	Needham	Regional High Schools
Dedham	Newton	Apponequet
Dennis	Norwell	Blue Hills
Dover	Norwood	Bridgewater-Raynham
Duxbury	Orleans	Cape Cod Regional
East Bridgewater	Pembroke	Dennis-Yarmouth
Eastham	Plymouth	Dover-Sherborn
Easton	Plympton	Martha's Vineyard
Falmouth	Provincetown	Nauset
Freetown	Quincy	Old Colony Regional
Halifax	Randolph	Old Rochester
Hanover	Raynham	Silver Lake
Hanson	Rochester	Southeastern Regional
Harwich	Rockland	Upper Cape Cod Regional
Hingham	Sandwich	Whitman-Hanson
Holbrook	Scituate	
Hull	Sharon	All Boston parochial
Hyannis	Sherborn	and private schools.
	Stoughton	

Region VI Boston

Boston Public Schools Regional Science Fair

Includes all public schools within the City of Boston. Private and parochial schools within the City of Boston are included in Region V.