An Examination of Science and Mathematics Competitions

For The National Science Foundation

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Introduction

With the tremendous growth in science and mathematics competitions in the United States in the last 50 years, questions are now being raised regarding their impacts. Do such competitions spark students' interest in science and mathematics? Do they improve mathematics and science education and achievement? Do they identify the young people who have both the interest and the aptitude in developing and using scientific and mathematical principles? Do they encourage students to consider mathematics and science careers? The National Science Foundation is interested in learning how such programs have been evaluated and what impact they have had on students, in terms of interest in mathematics and the sciences in school and as careers.

After identifying and investigating over 60 individual science and mathematics competitions through an Internet search and other sources and studying 36 of them closely, we found that few formal evaluations have been conducted. The list of 36 competitions described below is in no way exhaustive. These competitions do, however, represent what we believe to be the largest national competitions and similar to many local and regional competitions.

As an overview, this paper first presents a taxonomy of programs, aimed at describing what exists and how the various competitions differ. This taxonomy is a first step, a small step, in understanding these programs and thinking about their evaluation. This paper discusses the various types of competitions by describing eleven dimensions which define them and then provides full descriptions of each program as hyperlinks from a program matrix chart and in the Appendix.

Following the taxonomy, we suggest a set of preliminary research questions and considerations designed to build a more complete picture of the competitions: who competes, who is successful, what do they gain, what are lasting impacts, what interactions are there with other math and science education, are certain types of competitions more valuable educationally, etc. While this is not a full research agenda, it provides a starting place for designing an evaluation strategy. We suggest some areas where evaluations to date have revealed some general outcomes of the competitions, as well as some inconsistencies in the findings.

Finally, we review the evaluation data that do exist, and with hyperlinks from each question, we return to the competitions and compare our research questions to the evaluations conducted on the programs.

	1: Type			2: Content Area											3: Grade Level				4: Program Goals								
Competition Name	Fair	Contest	On-line, Website	Mathematics	Computer Science/ Technology	Engineering	Earth Science	Space Science	Chemistry	Biology	Physics	Mechanics	Electronics	Others	Lower Elementary	Upper Elementary	Middle School	High School	Generate Enthusiasm for Science, Engineering, and Mathematics	Encourage Technical and Scientific Careers	Promote and Reward Achievement	Improve Science or Mathematics Knowledge	Improve Research Methods or Problem Solving Skills	Understand How Real Scientists and Engineers Work	Integrate Sciences Across Disciplines	Explore Future Technology	Use Current Technology
Afro-Academic, Cultural, Technological and Scientific Olympics (ACT-SO)	X			X	X				X	X	X	X	X					X			X						
American Computer Science League Computer Science Contest		X			X												X	X				X					
Apple Computer Clubs National Merit Competition*	X			X	X													X			X						X
Craftsman/NSTA Young Inventors Awards	X					X						X				X			X	X	X	X	X	X	X		
Duracell/NSTA Invention Challenge	X					X					X	X	X				X	X	X	X	X	X		X	X		
Future City Competition		X		X	X	X	X	X	X	X	X	X	X				X		X	X	X	X	X	X	X	X	X
Innovations: The Virtual Science Fair	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X									
Intel Science Talent Search	X			X	X	X	X	X	X	X	X	X	X	X				X	X	X	X		X	X	X	X	X
International Bridge Building Contest		X				X					X							X	X	X	X						
International Science and Engineering Fair	X			X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X
Internet Science and Technology Fair	X		X		X	X	X	X	X	X	X			X			X	X	X	X			X	X	X		X
Junior Science and Humanities Symposia	X			X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	
Junior Solar Sprint*		X				X						X	X				X		X	X		X					
Math Olympics			X	X											X	X	X	X	X		X	X					
McDonald's Science Fair	X				X		X	X	X	X	X				X	X			X			X	X				
NASA Student Involvement Program	X						X	X							X	X	X	X	X			X			X	X	
National American Indian Science and Engineering Fair	X			X	X	X	X	X	X	X	X			X			X	X	X	X	X						
National Association of Rocketry Annual Meet		X				X					X	X	X					X			X						
National Chemistry Olympiad		X							X									X	X		X	X	X	X			
National Engineering Design Challenge		X				X												X	X					X	X		
National FFA Agriscience Fair	X			X	X	X			X	X							X	X	X	X	X	X	X				
National FFA Agriscience Student Recognition Program	X					X	X		X	X				X				X	X	X	X	X	X	X			X
National Physics Olympiad		X									X							X	X		X	X	X	X			

	5: Screening			6: Participation							7: Product of Competition								8: Judging Criteria										9: Judges		
Competition Name	Upper Level of Competition (fed by other competitions)	Application, Proposal, etc.	None	Over 1,000	500 - 1,000	200 - 499	50 -200	Less than 50	Individuals	Teams	Description of Design	Actual Design	Plan for Research Experiment	Actual Experiment Results	Short Answers About Principles	Long Solutions Using Principles	Presentation about/of Project	Internet Website/Computer Program	Ingenuity, Creativity, Innovation	Workability, Effectiveness, Performance of Design	Practicality	Application of Principles	Illustration or Written Description	Environmental or Energy Concerns	Craftsmanship	Student Interest in Science or Math	Consistency with Specified Theme	Accuracy	Science, Engineering, Industry Professionals	Educators	Local Teachers
Afro-Academic, Cultural, Technological and Scientific Olympics (ACT-SO)	X				X				X			X		X			X			X		X	X						X		
American Computer Science League Computer Science Contest			X	X						X					X	X		X				X						X			X
Apple Computer Clubs National Merit Competition*		X				X			X	X								X	X	X	X		X								
Craftsman/NSTA Young Inventors Awards		X		X					X		X	X					X		X	X			X						X	X	X
Duracell/NSTA Invention Challenge		X		X					X	X	X	X					X		X	X	X		X	X	X		X	X	X	X	
Future City Competition			X	X						X	X	X					X	X	X	X	X	X	X	X	X	X			X		X
Innovations: The Virtual Science Fair			X					X	X					X				X		X			X								
Intel Science Talent Search			X	X					X				X	X			X		X			X	X			X		X	X	X	
International Bridge Building Contest	X						X			X		X								X									X		
International Science and Engineering Fair	X			X					X	X		X	X	X			X		X	X		X	X			X		X	X	X	X
Internet Science and Technology Fair		X						X		X				X				X		X			X				X	X	X		
Junior Science and Humanities Symposia	X			X					X					X			X		X			X	X			X		X	X	X	X
Junior Solar Sprint*			X	X						X		X							X	X		X			X						X
Math Olympics			X	X					X	X					X													X			X
McDonald's Science Fair			X	X					X					X					X			X	X								X
NASA Student Involvement Program			X	X					X	X	X		X				X		X		X	X	X		X				X	X	
National American Indian Science and Engineering Fair			X	X					X	X		X		X					X			X	X			X	X		X		
National Association of Rocketry Annual Meet	X					X			X	X		X								X					X						X
National Chemistry Olympiad	X			X					X	X					X	X						X						X	X		
National Engineering Design Challenge			X	X						X		X					X		X	X	X				X		X		X		
National FFA Agriscience Fair	X					X			X	X	X	X	X	X			X		X	X	X	X	X					X	X		
National FFA Agriscience Student Recognition Program	X							X	X				X	X	X				X			X	X			X		X	X		
National Physics Olympiad	X			X					X	X					X	X						X						X	X		

	10: Awards												11: Competition Sponsors							12: Evaluation					
Competition Name	Over $20,000 Scholarships or Savings Bonds	$5,000 - $19,999 Scholarships or Savings Bonds	$1,000 - $4,999 Scholarships or Savings Bonds	$500 - $999 Scholarships or Savings Bonds	Less than $500 Cash or Gift Certificates	Sponsor-Donated Products	Gold, Silver, Bronze, Trophies, Plaques, Ribbons, Certificates	Trips to Final Event or Awards Ceremonies	Trips to Science Centers	Opportunity to Interact with Scientists	Certificates to All Entries	Teacher/School Awards	Corporation	Government Agency	Association	School, District, State	University	Non-Profit Organization	Separate Managing Organization	No Evaluation Conducted	Participant Survey	Formal Evaluation	Some Data	Report Not Available	Unclear/No Response
Afro-Academic, Cultural, Technological and Scientific Olympics (ACT-SO)				X			X	X							X					X					
American Computer Science League Computer Science Contest						X	X											X		X					
Apple Computer Clubs National Merit Competition*						X		X					X												X
Craftsman/NSTA Young Inventors Awards		X		X		X		X			X	X	X		X						X			X	
Duracell/NSTA Invention Challenge	X	X	X	X	X		X	X			X	X	X		X						X		X		
Future City Competition		X		X		X	X	X	X	X		X	X		X	X	X	X			X		X		
Innovations: The Virtual Science Fair							X										X			X					
Intel Science Talent Search	X	X	X				X	X	X	X	X	X	X					X	X			X	X		
International Bridge Building Contest	X					X					X	X	X				X				X			X	
International Science and Engineering Fair	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X			X			
Internet Science and Technology Fair							X				X	X	X	X			X				X		X		
Junior Science and Humanities Symposia		X	X		X			X	X	X	X			X	X		X		X		X		X		
Junior Solar Sprint*						X	X							X						X					
Math Olympics							X				X		X					X			X			X	
McDonald's Science Fair							X				X		X			X		X			X		X		
NASA Student Involvement Program							X	X	X	X	X	X		X							X			X	
National American Indian Science and Engineering Fair							X	X						X	X										X
National Association of Rocketry Annual Meet							X						X			X				X					
National Chemistry Olympiad							X		X	X	X			X	X					X				X	
National Engineering Design Challenge				X		X	X	X			X		X		X		X	X			X			X	
National FFA Agriscience Fair			X	X	X		X				X		X					X			X			X	
National FFA Agriscience Student Recognition Program		X	X	X			X	X			X		X					X				X		X	
National Physics Olympiad							X		X	X				X				X							X

	1: Type			2: Content Area											3: Grade Level				4: Program Goals								
Competition Name	Fair	Contest	On-line, Website	Mathematics	Computer Science/ Technology	Engineering	Earth Science	Space Science	Chemistry	Biology	Physics	Mechanics	Electronics	Others	Lower Elementary	Upper Elementary	Middle School	High School	Generate Enthusiasm for Science, Engineering, and Mathematics	Encourage Technical and Scientific Careers	Promote and Reward Achievement	Improve Science or Mathematics Knowledge	Improve Research Methods or Problem Solving Skills	Understand How Real Scientists and Engineers Work	Integrate Sciences Across Disciplines	Explore Future Technology	Use Current Technology
National Science Bowl		X		X	X		X	X	X	X	X							X	X	X	X						
National Science Olympiad		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X		
New York City Science, Mathematics and Technology Expo	X			X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X
OM School Program		X		X	X	X	X					X	X	X	X	X	X	X	X	X		X	X		X	X	X
Science and Technology Expo	X			X	X	X	X	X	X	X	X						X	X	X								
SuperQuest*	X			X	X	X	X	X	X	X	X	X	X	X				X			X		X	X			X
Tests of Engineering Aptitude, Mathematics and Science		X		X		X					X	X	X					X	X					X	X		
Technology Student Association Competitive Events		X			X	X					X	X	X	X			X	X			X						X
ThinkQuest, ThinkQuest Jr.			X	X	X	X	X		X	X	X						X	X				X	X	X	X		X
Thomas Edison/Max McGraw Scholarship*	X					X	X	X	X	X	X						X	X	X		X	X					
Toshiba/NSTA ExploraVision Awards Program	X				X	X		X				X	X		X	X	X	X								X	X
USA Computing Olympiad		X			X													X					X				X
USA Math Olympics		X		X														X	X		X	X	X				
Totals 36 Competitions	19	15	4	19	22	25	18	16	19	18	22	16	15	12	7	8	17	32	26	15	23	20	18	15	14	8	13

*inactive program

	5: Screening			6: Participation							7: Product of Competition								8: Judging Criteria										9: Judges		
Competition Name	Upper Level of Competition (fed by other competitions)	Application, Proposal, etc.	None	Over 1,000	500 - 1,000	200 - 499	50 -200	Less than 50	Individuals	Teams	Description of Design	Actual Design	Plan for Research Experiment	Actual Experiment Results	Short Answers About Principles	Long Solutions Using Principles	Presentation about/of Project	Internet Website/Computer Program	Ingenuity, Creativity, Innovation	Workability, Effectiveness, Performance of Design	Practicality	Application of Principles	Illustration or Written Description	Environmental or Energy Concerns	Craftsmanship	Student Interest in Science or Math	Consistency with Specified Theme	Accuracy	Science, Engineering, Industry Professionals	Educators	Local Teachers
National Science Bowl	X			X						X					X													X	X		
National Science Olympiad	X			X					X	X		X		X	X	X	X		X	X		X		X	X		X	X	X	X	
New York City Science, Mathematics and Technology Expo	X				X				X			X	X	X			X		X	X		X	X			X		X	X	X	X
OM School Program	X			X						X						X	X		X	X		X	X		X		X	X	X	X	X
Science and Technology Expo			X		X				X	X		X		X			X		X			X						X	X	X	
SuperQuest*		X					X		X	X	X		X					X	X	X		X							X		
Tests of Engineering Aptitude, Mathematics and Science			X	X						X					X	X												X	X		
Technology Student Association Competitive Events			X	X					X	X	X	X					X		X	X		X	X		X			X			
ThinkQuest, ThinkQuest Jr.		X		X						X								X		X	X	X						X	X	X	
Thomas Edison/Max McGraw Scholarship*		X							X		X		X	X			X		X		X					X					
Toshiba/NSTA ExploraVision Awards Program			X							X	X								X	X		X	X							X	
USA Computing Olympiad			X		X				X							X		X		X									X		
USA Math Olympics	X							X	X							X												X	X		
Totals 36 Competitions	14	7	15	21	4	3	2	4	25	25	9	15	8	14	8	8	16	8	22	21	8	22	19	3	9	8	6	20	26	12	11

*inactive program

	10: Awards												11: Competition Sponsors							12: Evaluation					
Competition Name	Over $20,000 Scholarships or Savings Bonds	$5,000 - $19,999 Scholarships or Savings Bonds	$1,000 - $4,999 Scholarships or Savings Bonds	$500 - $999 Scholarships or Savings Bonds	Less than $500 Cash or Gift Certificates	Sponsor-Donated Products	Gold, Silver, Bronze, Trophies, Plaques, Ribbons, Certificates	Trips to Final Event or Awards Ceremonies	Trips to Science Centers	Opportunity to Interact with Scientists	Certificates to All Entries	Teacher/School Awards	Corporation	Government Agency	Association	School, District, State	University	Non-Profit Organization	Separate Managing Organization	No Evaluation Conducted	Participant Survey	Formal Evaluation	Some Data	Report Not Available	Unclear/No Response
National Science Bowl						X	X	X	X	X	X	X	X	X			X								X
National Science Olympiad		X					X			X	X	X	X	X	X	X	X	X			X	X		X	
New York City Science, Mathematics and Technology Expo		X	X	X	X	X	X	X							X		X			X					
OM School Program			X	X	X		X	X			X		X		X	X	X	X			X			X	
Science and Technology Expo		X	X	X	X		X								X	X				X					
SuperQuest*			X			X			X	X		X	X	X			X					X	X		
Tests of Engineering Aptitude, Mathematics and Science				X			X				X		X		X		X	X			X		X		
Technology Student Association Competitive Events							X				X		X		X										X
ThinkQuest, ThinkQuest Jr.	X	X	X	X				X		X		X	X					X				X		X	
Thomas Edison/Max McGraw Scholarship*		X	X	X			X	X				X			X		X	X		X					
Toshiba/NSTA ExploraVision Awards Program		X	X		X			X			X	X	X		X						X			X	
USA Computing Olympiad							X		X	X					X		X			X					
USA Math Olympics							X	X	X	X			X	X				X							X
Totals 36 Competitions	5	13	13	14	8	11	29	19	11	13	20	14	23	12	17	6	15	16	3	10	15	6	8	12	6
*inactive program																									

Taxonomy

Competitions can be classified according to the following variables.

Variable 1: Type of Event

The science and math competitions vary in process and include both contests and fairs. We define contests as direct competitions between entrants, such as races between machines students have designed or between teams to solve a problem accurately first. We use fair to describe events where students display and present their research findings or inventions, and each entry is judged independently of other entries. A fair may not necessarily be a competition although those discussed here are generally competitive. Contests, more often than fairs, offer both team and individual events. Fairs and contests are usually held on-site at one central location. Some competitions require students to submit their entries by mail, and only finalists present their projects on-site.

A relatively new type of competition is the on-line fair. In this case, students complete projects and create Internet websites for their displays. All entries are linked to a competition's main website, and judges review the entries on-line. As with other fairs, the displays vary in sophistication. In some cases the website is the project, and science and mathematics is just one entry category or the Internet research process is the focus. Such competitions encourage an educational component considerably beyond the scope of on-site fairs because they promote the interactive kinds of learning technology creates. Moreover, the research findings are available to a much broader audience.

Another on-line competition uses the Internet technology as a way of broadening the scope of eligible participants. After playing an off-line computer software-based game, students' scores are posted on the Internet and tabulated with scores from other students and classes around the country (Math Olympics). In this way students are able to compete in their own classrooms but with a much larger pool of competitors.

In some cases these distinctions are blurred, and a competition may incorporate some elements of both fairs and contests and may use Internet technologies. As technology use expands, it is likely that the media for competitions will also become more varied.

Variable 2: Content Area

Science and mathematics competitions cover the full range of academic disciplines and subdisciplines in mathematics and science. Some competitions are limited to one specific discipline, and others include multiple disciplines but are divided into categories of entry. The typical categories are:

- biology
- chemistry
- computer science/technology
- earth science
- electronics
- engineering
- environmental science
- mathematics
- mechanics
- physics
- space science

Seventeen of the competitions accept entries in six or more categories, and six only offer one subject category. Some competitions use more specific categories, such as botany, biochemistry, zoology, microbiology, and environmental science. Three of the competitions also have events in the humanities.

Variable 3: Grade Level

Some competitions are open to the full K-12 student population, and most are open to both public and private school students. Thirty-two of the 36 competitions offer a high school level, and seventeen of those are open only to high school students. Similarly, seventeen competitions offer a middle school or junior high level (grades 5-8), with two open only to middle school students. Eight programs offer elementary levels, and one is only open to upper level elementary (grades 3-6) and not lower elementary grades.

The competitions are generally age-appropriate both in terms of the type of entry and the categories and events offered. Certainly a biology project from a first grade student (mold growth on bread) would be different from one of a tenth grade student (the gill withdrawal reflex of a marine mollusk). Similarly, some areas, such as electronics, are not typically offered for younger students. However, whereas an area such as space science may seem more relevant for upper level students, these competitions generally recognize the importance of starting early; the NASA Student Involvement Program includes a category for third through fifth graders for future aircraft/spacecraft design and is in the process of adding events for K-3. Some competitions, such as the Intel Science Talent Search,[1] are open to high school seniors only

[1] The Science Talent Search was formerly the Westinghouse Science Talent Search but is now sponsored by Intel.

(however, it is estimated that students spend from six months to two years on their research (NSTA, 1990), so presumably, the projects are begun during the junior year at the latest), and, accordingly, require a much higher level of research sophistication.

Eleven of the competitions are open only to individuals, and eleven only allow teams (usually of three to five students). Fourteen are open to both teams and individuals in separate judging categories. Two combine team and individual work for an overall team score.

Variable 4: Program Goals

That the programs recognize the value of nurturing young people's science abilities indicates the major overarching goal of most of the competitions. Science Service, a non-profit organization that administers and manages two of the largest competitions (Intel's Science Talent Search and International Science and Engineering Fair (ISEF)), asserts that "the popularization of science and the recruitment of new generations of mathematicians, scientists, and engineers into universities and industry through science competitions have strengthened U.S. research and technology at all levels" (Science Service Website). The programs generate enthusiasm for science, engineering, and mathematics among all students or among particular populations of students, such as middle school students (Junior Solar Sprint, Internet Science and Technology Fair, National Engineers Week Future City Competition) or agricultural studies students (National FFA Agriscience Student Recognition Program and Fair). Some are designed specifically to promote and reward achievement (Afro-Academic, Cultural Technological, and Scientific Olympics (ACT-SO), ISEF-affiliated National American Indian Science and Engineering Fair, National Association of Rocketry Annual Meet).

Some competitions are designed to improve science and mathematics knowledge (National Science Bowl, American Computer Science League Computer Science Contest, Internet Science and Technology Fair, Math Olympics, Junior Science and Humanities Symposia, International Mathematical, Chemistry, and Physics Olympiads[2]) or to improve research methods and problem solving skills (Science Talent Search, Odyssey of the Mind, SuperQuest, National Science Olympiad, Craftsman/NSTA Young Inventors

[2] We found six unrelated "Olympic/Olympiad" events in our search. The Math Olympics program is not associated with the International Mathematical Olympiad program or its feeder, the USA Mathematical Olympiad. Other International Olympiads are fed by the National Chemistry Olympiad, National Physics Olympiad, USA Computing Olympiad. The Science Olympiad is another national competition that is not associated with the discipline-specific Olympiads. Individual states, such as Georgia and Michigan represented in this document, hold state competitions that feed to this national Science Olympiad. One study referred to a North Carolina Science Olympiad; it is unclear how this competition relates to the others. The Afro-Academic, Cultural Technological, and Scientific Olympics (ACT-SO) is a completely separate competition for African-American students.

Awards, Tests of Engineering Aptitude, Mathematics and Science). Several competitions are designed to create understandings of how real scientists and engineers work and how they approach real life problems (National Engineers Week Future City Competition, Duracell/NSTA Invention Challenge, Thomas Edison/Max McGraw Scholarship, National Engineering Design Contest) or encourage scientific and technical careers (International Bridge Building Contest). Others encourage students to explore the possibilities of technology in the future (ExploraVision Awards Program, National Engineers Week Future City Competition). Still others promote the use of the technology available today (Innovations: The Virtual Science Fair, ThinkQuest and ThinkQuest Junior, Internet Science and Technology Fair, International Computer Problem-Solving Contest, SuperQuest, Apple Computer Clubs National Merit Competition, Technology Student Association Competitive Events).

Most of the competitions have explicit, stated goals. In some cases goals are implied, more often for those goals that are more process-oriented, such as improving research and problem-solving skills, interacting with real scientists, and using current technology. However, because they aligned with the competition product and/or the judging criteria, they have been included as competition goals. We found that, when asked, competition managers and coordinators tended to offer more goals and objectives than their competitions' literature specified.[3]

A study on establishing research-based science fairs determined that having clearly stated goals was critical not only in improving student performance by providing motivational structures, but also in lessening the anxiety associated with competition (Slisz, 1989).

Variable 5: Screening

Only seven of the 36 competitions use any selection criteria on students' applications or written proposals to enter the competition, other than following competitions' submission rules. Thirteen of the competitions do not require applications, but are fed by other competitions. That is, the winners of local and regional competitions are eligible to compete in the highest level. However, no screening procedures are indicated for the local and regional competitions. Thus, at the entry level, 29 of the programs are open to all eligible students, with no screening or application process.

[3] Managers and coordinators were sent copies of this document, the program matrix, and a program description of their competition to review for accuracy and any additional information they could provide. In their reviews, they most frequently checked off additional goals and academic content areas.

Variable 6: Participation

While the programs all attempt to spread interest in science, mathematics, and engineering, participation varies greatly among the different competitions. Perhaps the largest is the Intel International Science and Engineering Fair (ISEF). ISEF coordinators estimated that 2 million students complete projects for local fairs that feed into the ISEF; approximately 1,200 actually compete at the final, international fair. Teams of 15 students from 12,000 schools compete nationally in the Science Olympiad each year, and the Physics and Chemistry Olympiad teams are each selected from among about 10,000 entrants. Other competitions, such as the Junior Solar Sprint, do not have a national final competition but still involve over 100,000 students in regional competitions. Over 1,500 high school seniors enter the Science Talent Search each year. Over 1,300 students from 14 schools participated in the 1997 Math Olympics.

Competitions also exist on much smaller scales. The University of Central Florida's College of Engineering sponsors an entirely internet-based competition. In the first year 23 teams began the competition and eight teams actually completed project homepages.

Two of the larger competitions provide participation by gender. In 1999, the Intel Science Talent Search reported 47 percent females, and the Intel ISEF reported 50 percent females. While most of the individual competitions themselves do not break down participation by gender, several studies have done so for some competitions. Studies of several local North Carolina competitions, including the North Carolina Science Olympiad, (Jones, 1991) and the Science Talent Search (Campbell, 1991) have found that participation in science competitions by girls, while having grown dramatically in the past 20 years, still lags behind that of boys in some competitions. Interestingly, in the Science Olympiad (Georgia), a team competition, there is no gender gap, and a study of the Hawaii State Science and Engineering Fair (ISEF-affiliate) found that girls have actually outnumbered boys since the mid-1970s (Greenfield, 1995). A different report about the Science Talent Search indicated that almost half, about 45 percent, of entrants are girls and that 17 of the 40 finalists in 1991 were girls (Huler, 1991). Girls' projects tend more often to be in the life sciences, rather than physical science, earth science, computer science, and mathematics (Jones, 1991). Moreover, girls are less likely than boys to prepare projects based on experimental research as opposed to library research (Greenfield, 1995). These differences are attributed largely to the ways children are socialized; girls are less likely to engage in competitive activities and less likely as young children to play with toys that encourage exploration and assembly. Similarly, the coordinator of the Toshiba/NSTA ExploraVision program noted that girls are more likely to enter as teams than as individuals. The authors suggest that these participation rates have implications for girls' future science and technical careers (Greenfield, 1995, Jones, 1991), as well as their self-confidence and feelings of achievement in science.

Critics of some science competitions have suggested that the programs highlight economic disparities (Huler, 1991). High schools that focus significant resources on the Science Talent Search have been able to send a higher number of students to the competitions. Students with access to lab equipment at the school or other research labs have a clear advantage in the competition. Supporters of the competition claim the Science Talent Search is "a competition for students who can compete at this level" rather than a program to teach science (Huler, 1991, 22).

In the Math Olympics, a software-based arithmetic competition (not associated with the International Mathematical Olympiad), organizers estimated that most students are from parochial schools in inner-city areas. Publicity for the competition has been largely word of mouth by the founders and has been spread largely through those circles. As Internet connectivity spreads to more and more schools, it is likely that the access to all on-line competitions will increase.

Variable 7: Product of Competition

Competitions address their goals through three sorts of projects. In design projects, students create devices to accomplish certain goals or to fit certain specifications and use primarily engineering and physics principles. For research experiment projects, students ask a question and determine how it might be answered, using physical or life sciences. In some competitions the substance is purely academic knowledge of scientific or mathematical principles.

Within these three sorts of projects, the products of the competitions vary. In design projects, the product may be the actual machine, tool, or vehicle design, or it may be a description and/or drawing of the design; and in either case the product may be computer-generated. The design may also be an Internet website itself or a computer program or application. Similarly, research experiments may be a representation of the actual experiment undertaken, including data and conclusions, or they may be plans for an experiment, with only the hypothesis and methodology. Often the feasibility and scope of the research determine this; one category for the NASA Student Involvement Program is to plan an experiment to take place on Mars. In academic knowledge competitions, students may answer short questions about scientific or mathematical principles, or they may solve longer problems using those principles. In some cases speed and accuracy are critical. In some competitions a research question may be answered by running a computer program that the researchers have written. Design and academic knowledge competitions, more so than research competitions, often offer team competitions in addition to individual competitions.

Variable 8: Judging Criteria

Different competition products must necessarily be judged differently although there is considerable overlap in criteria. Typical judging criteria include, in various combinations:

- ingenuity, creativity, inventiveness, innovation
- workability, effectiveness, or performance of design
- practicality
- application of principles
- illustration or written description
- environmental or energy concerns
- craftsmanship
- student interest in science or mathematics
- consistency with specified theme
- accuracy
- speed

Since some competitions require additional materials besides the actual product, the criteria can often extend beyond what applies to the actual product. Additional materials may include idea logs tracking the progress of the project, written descriptions of the projects or essays, or letters of recommendation. Some competitions interview students. The various materials are sometimes staged by the level of competition the student reaches; for example, usually only finalists participate in interviews. Student essay about their projects are usually submitted as part of the entry, but are occasionally submitted first and used as a gatekeeper to limit the number of final entries.

Variable 9: Judges

Judges for the larger competitions are science, engineering, and industry professionals and often must meet requirements of years of relevant experience or academic degree obtained. Twenty-six competitions state that judges are professionals. The four competitions sponsored by the National Science Teachers Association are also judged by a panel of science educators. Competitions that give special industry or professional association awards have the industry send representatives to the competitions to judge for the special awards. In smaller competitions, local experts or teachers usually serve as judges.

Variable 10: Awards

The range of awards in the competitions varies greatly with the scale of the competitions and the size of the category. Most offer awards in several categories. Local competitions generally do not offer awards beyond trophies, plaques, certificates, or ribbons for winners, and certificates for all participants. In the case of several local competitions, those affiliated with the International Science and Engineering Fair (ISEF) and the International Mathematical, Chemistry, and Physics Olympiads, the award is advancement to the next level of competition. Other awards include cash, gift certificates, sponsor-donated products (Sears, Toshiba products, National Science Teacher Association publications).

Larger competitions offer trips to awards ceremonies for winners and their families and teachers. Some large competitions offer only medals and the prestige of winning. Others offer various amounts of cash and scholarships, often in the form of savings bonds, from $500 to $40,000 over four years. These larger scholarships are designed to encourage students to continue their science and mathematics educations at the university levels; often letters of recommendation are written for competition winners as well. One competition usually offers a half-tuition scholarship for four years to the university where the competition is held that year. Some competitions continue to promote their goals through the awards by sending winners on trips to science centers, including NASA Field Offices, Space Camp, the U.S. Department of Energy research laboratories, summer or short-term internships, or other conferences, such as Disneyworld's Youth Education Series or the London International Youth Science Forum. Some give winners the opportunity to meet and interact with renowned scientists. The Mathematical, Computing, Chemistry, and Physics Olympiad winners attend two-week-long camps where they interact with scientists and mathematicians to develop their skills at the same time as they compete for spots on the national teams for the international competition. Some competitions offer students mentoring opportunities during and after the competitions as well.

Variable 11: Competition Sponsors

The awards competitions offer depend largely on the sponsoring or funding organization. Generally, the competitions with multiple corporate sponsors are able to provide larger awards. Government sponsors, such as NASA, the U.S. Departments of Agriculture, Commerce, and Energy, and the energy labs, are able to provide scientific experiences because they have access to the facilities providing them. Large national associations, such as the NAACP and the American Association for the Advancement of Science, and well-funded non-profits, such as the OM Association, Inc. and National

FFA, are also able to offer awards. Local governments, schools, districts, state agencies, and universities sponsor and fund competitions but generally do not offer large awards. Many state and county fairs offer science competitions as part of the general fair competitions. In some cases these fairs feed into the International Science and Engineering Fair, but in others the state fair is the final level.

Often an organization manages or administers a competition but does not fund it. The largest of these is Science Service, a Washington, D.C. non-profit dedicated to advancing the understanding and appreciation of science through several publications and educational programs. Science Service administers both the Intel Science Talent Search and the Intel International Science and Engineering Fair, the two largest competitions. The National Science Teachers Association administers four competitions: Toshiba/ExploraVision, Craftsman/Young Inventors, Duracell/NSTA Invention Challenge, and NASA Student Involvement Program.

In some cases administering organizations must be members of the sponsoring organization or the larger competition. In order to run local, regional, or state competitions and participate in the OM World Finals, an organization must be a chartered association with OM Association, Inc. A regional contest feeding into the International Bridge Building Contest must meet certain requirements before it can become an approved region. Similarly, a science fair that intends to feed into the various regional and state-level science competitions of the International Science and Engineering Fair must register with Science Service to become an ISEF-Affiliated Science Fair and must meet certain size requirements. In some cases entrants must be members of the sponsoring organization, including Future Farmers of America, National Association of Rocketry, Technology Student Association, Science Olympiad, and Apple Computer Clubs. Administering organizations generally register entrants and coordinate the submission of entries, plan the actual fairs and display of projects, organize the judging, distribute awards, and field participant questions.

Evaluation

There are a wide range of questions that might be posed in evaluating these competitions. A long, but probably not exhaustive, list is presented below. These research questions fall into three broad categories: (1) competitions' impacts on students, (2) the mediating factors on those impacts, such as characteristics of competitions, and (3) school inputs and outcomes.

<u>How do competitions benefit students?</u>

- Do competitions provide educational benefits to students? Does participation improve students' classroom performance and achievement?
- Do competitions provide educational benefits outside of science and mathematics? Does participation affect achievement in other subject areas?
- Do competitions provide non-educational benefits to students? Do competitions have social and personal benefits, such as improving self-esteem or networking with other developing scientists?
- Are these benefits lasting? Do they continue through school and college? What factors determine this?
- Do competitions affect students' higher education and career choices?
- Is entry in competitions sufficient for realizing benefits, or must students be winners? Are there negative effects for non-winners?
- Are students conducting research projects only to participate in the competitions, or are there external motivators?

<u>What competition characteristics seem to make a difference?</u>

- What types of competitions provide the greatest benefits? How are benefits different for contests and fairs and for team and individual competitions? How are benefits different for different content areas?
- What effects do awards and competitive events have on students' motivation and success?
- Do competitions at different grade levels have different effects on students?

<u>What factors and impacts are important for schools?</u>

- Do competitions change the ways schools are educating students? Do schools where multiple students participate teach other students differently? Are there spillover effects to other students?

- Do girls and boys participate and benefit equally? Do students who are in all levels of math and science "tracks" participate and benefit equally?
- What factors determine student and school success in the competitions? How do student or school resource levels, teacher knowledge, or subject matter choice affect success?

Although few programs have conducted formal evaluations that ask these questions, most have been addressed to some degree by several of the existing evaluations. Of the 36 competitions we reviewed, we found 21 evaluations, ranging from informal, open-ended participant questionnaires to surveys of past participants to case studies of participating teams and schools.

In reviewing the findings of the evaluations, we must be aware of several caveats about the data. We were able to obtain a range of evaluation data from the programs. Some programs provided survey instruments and raw data; others provided only summary findings. Still others indicated that they conduct evaluations, but the findings are only available to member organizations or participants.

Fifteen of the 21 program evaluations conducted by the competition organizers or their contractors were based on informal participant surveys administered at the end of or just after events. Surveys were typically short, with several open-ended questions and some Likert rating scales. In contrast, there is a small body of literature investigating science competitions largely in terms of participation by gender and race/ethnicity and selection of research topic.

Another problem with the available data is that most of the surveys generated relatively low response rates, and therefore may not be representative of the impacts of the programs. The Duracell/NSTA Invention Challenge surveyed past winners and teachers, but the survey had a response rate of 35 percent for contest winners and 29 percent for teachers (Duracell/NSTA, 1996). The National Engineers Week Future City Competition has also conducted surveys of volunteer engineer and teacher advisors, with an even lower response rate of 18 percent for engineers (18 of 100 returned) and 16 percent for teachers (33 of 206 returned) (Future City, 1995). Similary, a program survey for the Tests of Engineering Aptitude, Mathematics and Science obtained a response rate of 29 percent of regional hosts (28 of 98 returned) (TEAMS, 1999). Even for the evaluation of SuperQuest, the most in-depth evaluation we found, data were collected from 50 percent of teachers and 35 percent of students. The Junior Science and Humanities Symposium (JSHS) program conducts annual program reviews; in 1997, 27 percent of students (63 of 235) and 31 percent of participating adults (33 of 105) responded (JSHS, 1997). JSHS also has conducted a survey of "selected former participants," and while 67 percent (26 of 39 returned) of the questionnaires were returned (Osborne, 1986), we do not know on what basis former participants were selected to complete the survey.

In studies that were conducted outside of the actual programs, response rates were somewhat higher. For example, the National Science Teachers Association (NSTA), as part of their compendium of science and mathematics competitions, conducted a small survey of 164 men and women whom they believe to comprise all living Nobelists and Medal of Science winners from the United States (NSTA, 1990). They obtained a response rate of almost 60 percent.

Overall, students and their teachers generally report positive experiences, ones that improve their problem-solving skills and encourage further education in or careers in the sciences. However, few evaluations expanded on what is meant by “positive” or how the positive experiences affected students. Several studies said that the learning that goes on while working on a project is of the most value because it allows an in-depth, directed focus on a subject over a period of time. Participants enjoy the teamwork aspects and meeting scientists during competitions. Many students remain heavily involved in science, engineering, and computer science. Support from the schools and at home was critical to students’ success and good experiences; in fact, one study found that the most critical factor to success in the program was a supportive school administration. Technical support locally or through university connections was also important.

Some studies question the value of competition at an early age and suggest that competitions may unintentionally exclude some students; others question the educational value of those competitions where students must seek one correct answer. Finally, several reports mentioned earlier suggest that the competitions may perpetuate economic and gender participation disparities. Even with these findings, the potential and actual impacts of mathematics and science competitions are still unclear.

Conclusion

The numerous science and mathematics competitions available to K-12 students provide a variety of opportunities for them pursue their emerging science and mathematics interests. While surely hundreds of thousands of students would not be competing if they did not see value for themselves in these programs, considerably more research is needed to determine how different programs impact students, schools, and the scientific community. These might include longitudinal studies of students and their educational and career paths, demographic information on winners and non-winners, understanding of students’ processes in participating in the competitions, and teachers’, mentors’, and parents’ impressions of the competitions.

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Existing Findings

1. **Do competitions provide educational benefits to students? Does participation improve students' classroom performance and achievement?**

In general, the competitions report that their participants felt the experiences were positive, but few evaluations expanded on what is meant by "positive" or how the positive experiences affected students. In the National Engineers Week Future City Competition evaluation, most of the teachers said their students began with no knowledge of engineering, and over 90 percent said that students acquired engineering knowledge. Several teachers also noted that the contest improved students' problem solving skills and abilities to work cooperatively. Direct evidence beyond student and teacher self-reporting for these findings is unavailable. Most of the SuperQuest students reported positive experiences, particularly with the access to technology and learning technical skills. Several NSTA respondents said that the learning that goes on while working on a project is of the most value because it allows an in-depth, directed focus on a subject over a period of time that sits outside of the formal, exam-driven education many students get in school.

None of the studies attempted to make any link to classroom performance and achievement.

2. **Do competitions provide educational benefits outside of science and mathematics? Does participation affect achievement in other subject areas?**

The Duracell/NSTA Invention Challenge surveyed past winners and teachers and concluded that the invention competition fosters inventiveness among participants who then continue to be innovative in other ways and in other fields; no evidence or examples were provided. None of the studies reported on effects on achievement in other subject areas.

3. **Do competitions provide non-educational benefits to students? Do competitions have social and personal benefits, such as improving self-esteem or networking with other developing scientists?**

Many SuperQuest participants identified visiting a college campus and the program's social aspects as positive features. Science Service also reports that Science Talent Search students say what they value most in the competition is the opportunity to meet and interact with each other and other scientists. One woman respondent to the NSTA survey who competed on her high school's math team as the only girl thought that her successes reinforced the idea that she could succeed among men. Opportunity for teamwork was also cited as a benefit.

4. Are these benefits lasting? Do they continue through school and college? What factors determine this?

Most of the SuperQuest students remain heavily involved in science, engineering, and computer science years after the competition; all of the respondents from the 1989 through 1995 competitions still had access to the Internet, and most have regular contact with science professionals in 1996. Almost half of the Duracell competitors said the competition influenced their studies or careers, and twenty percent of the respondents have further developed their devices or are working on other inventions.

The Science Talent Search reports that past finalists have gone on to win a remarkable number of science and mathematics awards. The competition does not directly imply a causal relationship between participation in the competition and winning awards in the future.

A study of Polish students competing in the Biological Olympiads, a feeder to the International Biological Olympiad, argues that the competitions can be an important means of enhancing students' interest in science and maintaining that interest beyond high school (Stazinski, 1988). It reports on two studies that examine participants and their future scientific involvement. Ninety eighth grade students who won in the district level (one level below the national competition) and their current teachers were interviewed two to three years after the competition on their further development of interests in biology, stability of their interest, and subsequent school achievement. Eighty-seven percent were still highly interested in biology, and nearly half participated in extra-curricular biology work. Most continued to read biology literature and did well in their biology courses.

5. Do competitions affect students' higher education and career choices?

Science Service reports that their statistics show that 95 percent of former Science Talent Search winners pursue some branch of science, and over 70 percent earn Ph.D.s or M.D.s although they make no explicit connection between winning the competition and future educational attainment.

The Junior Science and Humanities Symposium program has conducted several evaluations on the impact of JSHS in shaping students' interest and development in the sciences. The first asked about participants' universities attended and degrees attained, present employment status and description, and whether attendance at JSHS had affected or influenced their choice of career, acted as an incentive for educational pursuits, broadened scientific interests, or contributed to their professional growth and development. The responses about the impact of the program were overwhelmingly positive, over 70 percent indicating JSHS affected their career choice and over 90 percent indicating JSHS affected each of the other three questions. This study provided more detail of the progression of students' subsequent science- and math-related activities, and it asked participants to make a direct causal link between the program and the outcomes.

One NSTA respondent who was winner in the Science Talent Search said the event led to a summer research job and a career in chemistry. Another recalled that his research for the competition led to publishing a paper in graduate school. A study of 95 former Olympians found similar achievement results; 40 percent of these students went on to make "important scientific contributions" (Stazinski, 1988, 176), and a further 50 percent planned on scientific careers.

None of these studies include any commentary about how participation affects educational attainment or career choice or which aspects of competitions encourage these outcomes.

6. Is entry in competitions sufficient for realizing benefits, or must students be winners? Are there negative effects for non-winners?

One scientist surveyed in the NSTA study questioned the value of the competitions because those who do not win may be forever discouraged from science, and competitions cannot identify all students with a potential future in science. Another had a negative opinion of competitions because the way they are often judged favors elaborate and overly ambitious projects and does not recognize the creativity that is often part of failed projects.

We found no studies that focus on non-winners.

7. Are students conducting research projects only to participate in the competitions, or are there external motivators that encourage them to participate?

Among the NSTA respondents, the 35 percent of the scientists who found great value in the competitions often likened them to athletic events as another place for young people to excel. However, many of the competitions are entered as classroom activities and that may be the only external motivator for some participants. Whether participation as part of a class assignment can create the same impacts is unknown.

8. What types of competitions provide the greatest benefits? How are benefits different for contests and fairs and for team and individual competitions? How are benefits different for different content areas?

The Internet Science and Technology Fair, a program which requires teams of students to work with local experts to find solutions to technology problems, identifies one of the factors that contributed to lower than expected participation during the first year of the contest as a lack of technical advisors for entrants. These difficulties may be inherent in a competition requiring experts' participation.

Some respondents to the NSTA study, as well as a scientist from Belarus, Oleg Davydenko, who runs a plant genetics club for students, believe that the Olympiads themselves and other competitions may not be of too much value. The Olympiads, Davydenko says, "require a lot of memorizing, and that's not all there is to ability in science." (Subotnix, 1995, 19) His group of approximately ten high school age students are engaged in actual research on genetics, rather than answering questions about the science.

Surprisingly, little has been said about the value of team versus individual events or the outcomes from different content areas, either within the same competition or across different competitions. One study on establishing science fairs found that in certain situations both team and individual events are desirable (Slisz, 1989). The author found that teams are preferred for inquiry-based learning and promote positive attitudes, whereas individual competitions may be more effective for high ability students.

9. What effects do awards and competitive events have on students' motivation and success?

The 15 percent of NSTA respondents who thought competitions were detrimental found the competitive nature of the events problematic both for the students and for science. Many of the scientists who thought competitions were irrelevant (about half), although not detrimental, said that they were impelled towards science because of certain teachers, experiences in school, and parental encouragement, rather than competitions. Several indicated that the opportunity to interact with scientists and use scientific labs and equipment could be afforded in more beneficial ways.

The study of Polish students competing in the Biological Olympiads argues that the competitions can be an important means of enhancing students' interest in science and maintaining that interest beyond high school (Stazinski, 1988); the article describes the competition process, highlighting the intensive support required by the students' biology teachers, as a critical factor.

No studies were found that compare the benefits of competitive events to the benefits of non-competitive events, or the effects of different types and amounts of awards.

10. Do competitions at different grade levels have different effects on students?

Another explanation the Science and Technology Fair had for lower than expected participation was a lack of technical information appropriate for middle grade students, suggesting that the competition may be more appropriate for more advanced students. SuperQuest found that 16-year-old students participating in the program were more successful than either older or younger students due to conflicting demands of older students and immaturity in working with professional scientists of younger students.

11. Do competitions change the ways schools are educating students? Do schools where multiple students participate teach other students differently? Are there spillover effects to other students?

Little research has been found concerning this question. SuperQuest may be the program which has the greatest effects back in the school environment since project work continues for the year following the competition and involves teachers.

Science Service and Intel have formed a partnership with Northwestern University to develop a curriculum to be made available on the Internet to help teachers teach the kinds of inquiry-based learning that lead students to scientific research and competitions.

12. Do girls and boys participate and benefit equally? Do students who are in all levels of math and science "tracks" participate and benefit equally?

Most of the teachers who participated in the National Engineers Week Future City Competition felt the program appealed to girls as well as boys, although in some cases, the girls did not stick with the project (no explanation was provided). Many also said the program attracted students who were not already on the "math track."

Statistics from the Toshiba/ExploraVision Awards program show that since the program began in 1993, there have consistently been more girls winning regional contests than boys. While the statistics fluctuate for most grade levels, in the seventh to ninth grade category, girls consistently won more often.

Moreover, for the 1996, 1997, and 1998 competitions, over half of the entrants were girls, indicating further that the contest appeals to girls.

The researchers studying winners of the Mathematics Olympiad conclude that single-sex education, mentoring, and homogenous grouping support more successful participation in the competitions by girls and other underrepresented groups in mathematics (Subotnix, et al, 1996). There have been only 2 girls in the history of the American Olympiad team and no African-Americans or Latinos; they attribute this lack of participation to a lack of exposure and challenge in mathematics due to course placement and selection, lower expectation for success, perceptions of the usefulness of math and science to long-term goals, and teacher behavior and the classroom environment. The authors suggest that the model of ability-grouping, academic pull-out programs, and skipping grades has developed the talent in Olympiad winners.

13. What factors determine student and school success in the competitions? How do student or school resource levels, teacher knowledge, or subject matter choice affect success?

SuperQuest found that the most critical factor to success in the program was a supportive school administration. Technical support locally or through university connections was also important. However, for teachers, innovation, experimentation, and participation in other reform efforts were more important that technical ability. Student involvement before and after the summer institutes was important, particularly in training and technical support back in the schools. Schools with a tradition of requiring and supporting students' research in science and math were more likely to benefit from the program although schools without a competition orientation also benefited. The best experiences were reported by teachers and students who set goals for their SuperQuest experiences, including redesigning curriculum, accessing technology, and meeting graduate students and other computer science-oriented high school students.

Researchers who have studied winners of the Mathematics Olympiad in the context of talent development of gifted students find that the Olympiad experience influences major life choices, but suggest that it is the preparation beginning in elementary school that creates the condition for such implications (Subotnix, et al, 1996). The researchers initially asked how educators could ensure support for students with mathematical talent through schooling and professional life. They argue that talent development for many Olympiad winners begins early in schooling and is best encouraged when students are placed in special gifted programs. Students and parents reported that parental support, including verbal encouragement, help with time management, driving to competitions, and a general commitment to these intellectual pursuits, rather than pressure to achieve, influenced winners. While not all winners were in special programs, researchers report that membership in a group that values academics is important.

Program Name: Afro-Academic, Cultural, Technological and Scientific Olympics (ACT-SO)

Sponsors: National Association for the Advancement of Colored People (NAACP)

Funding Sources: NAACP and contributions

Scope: Local to National

Grade Level: 9-12

Cycle: Annual

Description: ACT-SO is a year long enrichment program for African-American students. ACT-SO initiated the idea of an "Olympics" what would promote and reward academic achievers. The first national ACT-SO competition was held in 1978 in Portland, Oregon. Over 5,000 local participants and 900 national participants are African-American high school students and citizens of the U.S.

Students must compete in a local ACT-SO program to qualify for the National ACT-SO competition. Enrichment Centers for each category may be held at various locations. Professionals in the field provide expert coaching in the individual or group arrangements. The center may begin in January and operate through March. There may be continuous classes, a series of workshops, or one-on-one coaching sessions. This service may be provided to all students applying or may be offered only to local first place winners after local competitions have been held.

Local ACT-SO competitions usually take place in April. The National ACT-SO competition takes place in early July at the National NAACP Convention and is judged by industry professionals.

Besides competitions in the Humanities, Performing Arts, and Visual Arts, there are approximately 9 categories of competition within the Science. These categories include: Architecture, Biology, Chemistry, Computer Science, Mathematics, Physics/Electronics, Physics/Energy, Physics/General, and Oratory

Awards: Scholarships and prizes are won by participants. At the national level, gold, silver and bronze medals are awarded along with cash scholarships of $1,000, $750 and $500 in each category. Local winners are awarded certificates and other prizes.

Evaluation: Evaluation of program not done.

Contact Information: Rhonda K. Wilson, National Director, ACT-SO, 4805 Mt. Hope Drive, Baltimore, MD 21215. Phone: 410.486.9144. Fax: 410.764.7357.

Reference: http://www.naacp.org/programs/actso.html

Program Name: American Computer Science League Computer Science Contest

Sponsors: American Computer Science League (ACSL)

Funding Sources:

Scope: Local and regional to national in U.S. and Canada. Some foreign countries have been added (Croatia and Japan)

Grade Level: Jr. and Sr. High students. (Four divisions: Senior, Intermediate, Junior, Classroom) More than one division can be joined.

Cycle: Annual

Description: 1997 was the 19th year of operation. Contests are held at each of 228 participating schools. A school is given one overall score to answers to computer topics. Questions are created to reflect topics not covered in the school's curriculum. Some schools use the questions from the ACSL to create an entire course or an extracurricular club. Questions are short theoretical and applied questions completed in a 30 minute period and a practical problem to solve within a 72 hour period.

The regular season has four contests. A school's score is the sum of the scores of the three to five highest-scoring students. After the four contests are completed, high scoring students go to an "All-Star Contest."

Study materials, sample problems, and annotated solutions are provided to faculty advisors upon school registration.

Awards: Prizes are awards to outstanding students and schools at local and regional levels. Prizes include computers, software, books, and trophies.

Evaluation: no evaluation has been conducted

Contact Information: ACSL, Box 40118, Providence, RI 02940, (401)822-4312. Jerry Tebrow, Coordinator. Amcompsci@aol.com.

Reference: http://www.acsl.org, personal communication.

Program Name: Apple Computer Clubs National Merit Competition (inactive program)

Sponsors: Apple Computer Inc., Beagle Brothers, Claris Corporation, McGraw- Hill, Minnesota Education Computer Corporation, Microsoft Coporation, National Geographic Scoeity, Peter Li, Inc., Scholastic Inc, Sunburst Communications, Softdisc

Funding Sources: Apple, member fees

Scope: Apple Computer Club members, club membership is open to all K-12 students, and must be registered under the nme of an advisor, usually a teacher

Grade Level: K-12, teachers

Cycle: Annual

Description: Each year hundreds of students enter the June competition open only to club members who join by sending Apple $19.95. Entrants compete in three categories: Basic Programming where students at the secondary level create original programs in any computer language individually or in teams, Community Service where middle school students focus more on communities than computers, and Computers in the Curriculum where teachers compete. Past entries have included a program that allows teachers to input achievement test scores for the program to analyze and convert to lists of remedial skill lessons and a program that allows the user to draw a shape either freehand or by selecting shapes [these were pre-1989 entries before a user had a mouse]. Judging criteria includes performance, documentation, originality, creativity, usefuless of the program, and neatness and packaging.

Awards: 13 national first prize winners receive Apple computer systems for themselves or their schools and a trip to Washington, DC to exhibit their projects and compete for the grand pize, a Macintosh sytem-enhanced personal computer and a basic work station unit.

Evaluation: No response.

Contact Information: Mary Fallon, Apple Computer, Inc., 20525 Mariani Ave., Cupertino, CA 95014, 408/996-1010.

Reference: NSTA Science and Math Events catalog, 1990.

Program Name: Craftsman/NSTA Young Inventors Awards Program

Sponsors: Sears, Roebuck and Co., administered by the National Science Teachers Association

Funding Sources: Sears, Roebuck and Co.

Scope: National

Grade Level: Grades 4-6, U.S. citizens in U.S. and U.S. Territories

Cycle: Annual

Description: Upper elementary students conceive of, design, and with the help of an adult, build a tool that performs a practical function, including (but not limited to) tools that mend, make life easier or safer in some way, entertain, or solve an every day problem. Students must keep track of their progress by keeping an Inventor's Log, which must be submitted with the entry and photograph of the tool. Logs include both drawings and written descriptions of their ideas

Every contestant must be sponsored by a teacher/advisor.

Awards: National winner receives $10,000 U.S. Series EE Savings Bond; eleven regional winners receive a $5,000 U.S. Series EE Savings Bond. Winning teachers and schools receive prizes from Sears, Roebuck, and Co. retail stores (unspecified). All winners attend an awards ceremony hosted by Bob Vila, Craftsman's Spokesman. Every student who submits a completed entry receives a certificate and small tool gift.

Evaluation: Participant survey, report unavailable.

Contact Information: Craftsman/Young Inventors Awards Program, National Science Teachers Association, 1840 Wilson Blvd., Arlington, VA 22201–3000, 703/243-7100, younginventors@nsta.org, 888/494-4994

Reference: http://www.nsta.org/programs/craftsman.htm

Program Name: Duracell/NSTA Invention Challenge

Sponsors: Duracell Inc., administered by the National Science Teachers Association

Funding Sources: Duracell Inc.

Scope: National

Grade Level: Grades 6-12. U.S. citizens residing in the U.S. or U.S. territories. Two categories: Grades 6-8 and Grades 9-12.

Cycle: Annual

Description: Design competition in which the invented device must be powered by Duracell batteries. Students write a two-page description of the device and its uses. A schematic of the device is to be included along with a photograph of the device.

This competition is limited to individual entrants or teams of two. In 1999, there were 1,500+ representing 2,000 students.

Top 100 finalists are notified to send their devices for finals.

Awards: 50 winners in each category. First Place (2) $20,000 savings bond; Second Place (4) $10,000 savings bond; Third Place (10) $3,000 savings bond; Fourth Place (24) $1,000 savings bond; Fifth Place (60) $500 savings bond. First and second-place winners, parents, teacher/sponsor are flown to the Awards Ceremony at the NSTA Convention in a major American city. All students receive an unspecified entry gift and certificate.

Teachers receive prizes ranging from computer and computer equipment gift certificates, NSTA publication certificates and other prizes.

Evaluation: In 1996 NSTA conducted a survey of 142 (of 402 sent) winners of the competition from 1983 through 1994. The survey asked about students' processes in completing their devices, subsequent work on the devices, education attainment, influences of the competition, careers, and other comments. Teachers (77 of 263) who sponsored winners were also surveyed on their processes in sponsoring students, influence on their teaching, integration into class activities, and other comments.

Contact Information: Duracell/NSTA Scholarship Competition,1840 Wilson Blvd., Arlington, VA 22201-3000, 888/255-4242, duracell@nsta.org

Reference: http://www.nsta.org/programs/duracell.shtml

Program Name: National Engineers Week Future City Competition™

Sponsors: National Engineers Week Committee (NEWC). Founded in 1951 by the National Society of Professional Engineers. American Consulting Engineers Council, American Institute of Chemical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers International, The Institute of Electrical and Electronics Engineers -USA, and various engineering societies and associations, National Academy of Engineering, National Institute of Standards and Technology, National Science Foundation, US Air Force Office of the Civil Engineer, CH2M Hill, Bechtel Foundation, Bentley Systems, The Boeing Company, Chevron, Chrysler, Dell Computer, Eastman Chemical, Eastman Kodak, General Electric, Honeywell, IBM, International Foundation, Lockheed Martin, Motorola, Phillips Petroleum, Rockwell, Texaco, 3M.

Funding Sources: National Engineers Week Committee underwrites the cost of operating the program and the national competition. Grants received from the United States Engineering Foundation has allowed for expansion of the competition.

Scope: National

Grade Level: Seventh and eighth grade

Cycle: Annual

Description: For this competition, students teams with their teacher (who is to serve as a facilitator and advisor) to work under the guidance of a practicing engineer. Engineers are volunteers. The state goal is for students to see firsthand how engineers turn their ideas into the concrete. Students use the computer game *SimCity 2000* by Maxis to design their city. Teams build a scale model of a city section, write an essay, and prepare a verbal presentation. Schools compete regionally with first place school traveling to the national competition. Travel costs to the national competition are covered by NEWC.

The program states is to introduce students to “real life” problems encountered by engineers, such as politics, transportation, budgeting, and energy concerns. The projects are judged by many of these criteria, as well as teamwork. Team members also make a verbal presentation about their city to a panel of judges.

Awards: Several prizes are given at the regional level, including a NEWC-sponsored trip to participate in the national finals for regional winners. The national winning team receives a free trip to U.S. Space Camp in Huntsville, AL. The Society of Manufacturing Engineers sponsors a $1,000 scholarship to the second place team’s school technology program. The National Society of Professional Engineers awards a $500 scholarship to the third place team’s school technology curriculum.

Evaluation: Participant survey data, no summary report.

Contact Information: Carol Rieg, National Engineers Week, 1420 King Street, Alexandria, VA 22314, 703/684-2852, cardress@aol.com

Reference: http://www.futurecity.org, personal communication.

Program Name: Innovations: The Virtual Science Fair

Sponsors: Science Academy of South Texas, Rice University Center for Technology in Teaching and Learning

Funding Sources: Innovations (unclear)

Scope: National

Grade Level: Elementary, middle school, high school categories

Cycle: Annual (1998 is year 2)

Description: This science fair is run completely on the internet. Students submit projects on their own website. Projects are judged on the web as well. Criteria include providing convenient links to several elements: title, purpose/hypothesis, methods/materials, results, conclusions, and bibliography. Entry categories include behavioral and social sicences, biochemistry, botany, chemistry, computer science, earth and space sciences, engineering, environmental sciences, mathematics, medicine and health, microbiology, physics, and zoology.

Awards: First, second, third place for high school,middle school, and elementary levels.

Evaluation: None.

Contact Information:

Reference: http://malthus.stisd.k12.tx.us/innovations

Program Name: Intel International Science and Engineering Fair (ISEF)

Sponsors: Intel Corporation and Intel Foundation (Primary Sponsors); Science Service

Funding Sources: Intel Corporation

Scope: Local to International

Grade Level: 9-12

Cycle: Annual

Description: Each year, 2 million students complete science research projects and during the week-long Intel ISEF; approximately 1,000 of those high school students earn the right to complete with their peers from over 20 countries. Throughout the U.S. and around the world, 500 Intel ISEF-Affiliated Science Fairs send two individual finalists and one team project to compete on the international level.

Students complete for scholarships in 15 categories: Behavioral and Social Sciences; Biochemistry; Botany, Chemistry; Computer Science, Earth and Space Sciences; Engineering; Environmental Science; Gerontology; Mathematics; Medicine and Health; Microbiology; Physics; Team Projects; and Zoology.

Intel ISEF-Affiliated Science Fairs are those science competitions that are members of the ISEF network. All Intel ISEF-Affiliated Science Fairs are required to register with Science Service and must consist of 5 participating high schools and/or 50 students in the 9th-12th grades. Fairs are conducted at local, regional, state and national levels.

In addition to the awards, students are given the opportunity to meet scientists, collaborate with their peers, and experience the different culture represented by the various countries. The Intel ISEF is held in a different city each May; the 1998 finals were held in Forth Worth, TX. The Host City Committee is responsible for securing facilities, recruiting judges, promoting volunteerism, arranging tours as well as raising close to one million dollars for Intel ISEF support. Host Cities generate close to $8 million dollars for the local economy.

Judges are made up of approximately 1,200 science, engineering and industry professionals throughout the world. All judges have a Ph.D. or equivalent degree and eight years relevant experience.

Awards: Three top prizes of $40,000 scholarships and two trips to the Nobel Ceremonies in Stockholm, Sweden are awarded. More than 600 individual and team awards were presented at the 48th ISEF. Each entry is judged at least three times with category awards given in first, second, third and fourth place. First through fourth prize in each category are $3,000, $1,500, $1,000 and $500, respectively in each of the 15 categories. Additional awards worth over 1.5 million include tuition scholarships, summer internships, scientific field trips and laboratory equipment. In addition, *Grand Awards* were offered in the following 15 categories: Behavioral and Social Sciences, Biochemistry, Botany, Chemistry, Computer Science, Earth & Space Science, Engineering, Environmental Sciences, Gerontology, mathematics, Medicine and Health, Microbiology, Physics, Zoology and Team Projects. *Pinnacle Awards*. Attendance at the Nobel prize ceremonies in Stockholm. *Intel Young Scientists Award:* $40,000 scholarships to three winners. *Best of Category Award:* $5,000 to top scorer in each of the 15 categories. *Best Use of a Computer Award*: Computer system based on Pentium processor with MMX technology to five winners in any category.

Intel Fellows Award: $2,000 to five winners, any category. *Excellence in Teaching Award*: $1,000 to six winners and $5,000 to one winner. There are 70 professional associations and government agencies that award prizes as well.

Evaluation: No response.

Contact Information: Ann Korando, Science Service, 1719 N Street, NW, Washington, DC 20036, 202/785-2255.

Reference: http://www.sciserv.org/iisef.htm, http://www.intel.com/education/isef/index.htm

Program Name: Intel Science Talent Search (formerly Westinghouse Science Talent Search)

Sponsors: Intel Corporation, Science Service

Funding Sources: Intel Corporation

Scope: National

Grade Level: Last year of secondary education

Cycle: Annual

Description: The Intel Science Talent Search seeks to find and encourage talented high school students to pursue careers in science, math, engineering and medicine. The Search provides a forum in which these students' research projects are completed, winning them national recognition, admission to colleges and financial assistance. Research projects include physical sciences, behavioral and social sciences, engineering, mathematics, and biological sciences. Students spend from 6 to 9 months to several years on their projects.

The Search is sponsored in partnership with Science Service, a Washington-based nonprofit organization. Over the years, more than 115,000 students have completed independent research projects and submitted entries. Currently, some 1,500 seniors meet the entry requirements each year. Each completed entry consists of a written description of the student's research, plus a lengthy entry form that elicits evidence of student creativity and interest in science. The deadline for entries is around the first week of December each year.

Search candidates are judged by a board of 10 scientists from a variety of disciplines with 40 finalists selected from 300 semifinalists. Both groups are announced in January. In March, Intel provides the 40 finalists all-expense-paid trips to Washington, DC, where they undergo final judging. On the basis of interviews, 10 top scholarship winners are selected.

Awards: Scholarships total $330,000, with the top prize a $50,000 four-year scholarship. Second-place winners receive $40,000 scholarships, third-place winners receive $30,000, and fourth- through sixth-place winners receive $20,000 scholarships. Seventh- throught tenth-place winners receive $15,000 scholarships. The other 30 finalists each receive $3,000.

Evaluation: Website reports some statistics and subsequent accomplishments of winners

Contact Information: Ann Korando, Science Service, 1719 N Street, NW, Washington, DC 20036, 202/872-5148.

Reference: http://www.sciserv.org.intelsts.htm

Program Name: International Bridge Building Contest

Sponsors: International Bridge Building Committee

Funding Sources: small profit made from selling bridge kits to teachers, Illinois Institute of Techology Alumni, Anonymous contributors, Midwest Products

Scope: National

Grade Level: High school

Cycle: Annual

Description: Founded in 1977 by a group of physics teachers, the contest is run by a group composed of the physics teachers, an engineer or two, a student or two, and a professor or two from the department of physics at the Illinois Institute of Technology in Chicago. The goals of the competition are to promote science and engineering and an interest in physics and to encourage careers in these areas. Students who are one of the top two winners at the regional level compete in the international contest. Approximately 70 bridges are entered to the international contest. Students construct bridges which they test to destruction to determine efficiency. Judges are engineers and are usually obtained through regional contests' affiliations with local professional associations. Mail in entries are allowed and tested by an engineer or stand-in student. The contest is held in different cities every year.

Awards: The top three winners receive prizes such as computers and cameras. In the past, the first prize has also included a half-tuition scholarship to the Illinois Institute of Technology. Each school receives a trophy for participation, and each student receives a certificate as well as a science toy.

Evaluation: Participant surveys, no report

Contact Information: Carlo Segre, Illinois Institute of Technology, Chicago, IL 60616, 312/567-3494.

Reference: NSTA Science and Math Events, http://www.iit.edu/~hsbridge

Program Name: International Math Olympics

Sponsors: Youth Net

Funding Sources: Individual schools, personal expense of Youth Net coordinator (Youth Net is funded personally and by the Los Angeles Free Net), MECC software company

Scope: National (title is "International" but no foreign students participate anymore)

Grade Level: K-12

Cycle: Annual

Description: This Math Olympics, unrelated to other "olympics" programs, is run off Youth Net, an internet site for kids which is located in the Los Angeles Free Net. Students of all ages compete by using software that focuses on accuracy and speed in addition and multiplication facts. Individual students and teams compete in bi-monthly warm-up events and then the annual competition in April. After students compete by completing the arithmetic programs and follow specified rules on time and supervision, teachers post team and individual scores on a listserve or website. The scores are tabulated to gather class averages.

The program was originated by two teachers in differnet parochial schools who saw the internet as a way to improve students' basic math facts by competing as a class with students from around the country and internationally.

Awards: Students from all participating classes receive certificates and the top 3 winners in each age category receive ribbons.

Evaluation: No evaluation has been conducted, but anecdotal evidence shows that students learn more and enjoy the regular math curriculum as a result.

Contact Information: Linda Delzeit of Youth Net: linda@youth.net, Jerry Martin, founder: jemartin@llohio.wviz.org, Jean Stringer, founder: stjulie@tlcnet.muohio.edu

Reference: http://www.youth.net/math.oly, www.youth.net/olympic/holyplic/hypermail, personal communication.

Program Name: Internet Science and Technology Fair

Sponsors: University of Central Florida, College of Engineering

Funding Sources: Microsoft, Federal Express, BellSouth, Oracle and the US Department of Commerce

Scope: National

Grade Level: Middle school, junior high school, high school

Cycle: Annual

Description: Using the internet as a resource tool, teams of students work with their teacher and on-line with a scientist or engineer from a federal research laboratory or corporate facility using email and remote databases to locate information. The teams seek, obtain, analyze, and report on a National Critical Technology chosen for a list from the White House Office of Science and Technology Policy. General topics include energy, environmental quality, information and communication, living systems, manufacturing, materials, transportation. The list details aspects of these topics teams may investigate. Teams submit a 200-300 word concept paper with an explanation of why the team is interested in that technology application and what they hope to learn. Teams identify a technical advisor in the community or the Fair staff will assist them in locating the expertise they need. Each team creates a website with facts, figures, graphics, sound, and pictures that define the history and future of the critical technology. The website should identify a problem, describe a technology application which impacts the problem, evaluate the impact, and recommend how the technology could be improved or used for a different but related purpose.

Awards: Based on a rubric, a national panel of teachers, scientists, and engineers will evaluate each project on-line.

All projects that were determined to have followed the guidelines receive a Certificate of Achievement from the National Medal of Technology program at the Department of Commerce's Office of Technology Policy. The teams selected as best in each critical technology category will receive a Certificate of Meritorious Achievement" framed in a plaque for the school.

Evaluation: Each student and teacher completes a participant survey about their Fair experiences.

Contact Information: Bruce Furino, Director of Special Programs, College of Engineering, University of Central Florida, 12424 Research Parkway, Suite 433-A, Orlando, FL 32826-3271, 407/249-7141, bmf@digigo.com

Reference: http://istf.ucf.edu/

Program Name: Junior Science and Humanities Symposia

Sponsors: Departments of the Army, Navy, and Air Force and administered by the Academy of Applied Science

Funding Sources: Departments of the Army, Navy, and Air Force

Scope: Regional and National

Grade Level: High school

Cycle: Annual

Description: Since its inception in 1958, the primary aims of JSHS are to promote scientific research and experimentation in secondary schools and to publicly recognize students for original research achievements. JSHS symposia feature invited student research presentations and competitions and opportunities to explore interests in the sciences. At each symposium students and teachers interact with their peers and practicing researchers, visit research and development sites, and hear addresses by renown scientists and engineers. Students who have conducted original research in science, engineering, and mathematics apply to JSHS. Students progress through regional competitions to the national symposium.

At the regional level students submit a written report and deliver an oral presenation to the symposium. Judges review written reports to select invited presentations and then review oral presenations to select finalists who either attend or compete at the national level. Over 10,000 students and their teachers from 3,500 high schools attend regional symposia, where they make presentations about their original research. The 48 regional symposia are sponsored in cooperation with universities and science centers. The top five winners from each attend the National Symposium at West Point or another university at the symposium's cost. At the national event, students present their research in written and oral form.

The level of sophistication of the regional entries varies, but at the national level, many papers offer significant contributions. One past contestant developed a neural network model of visual processing and performed experiments on the model and on human subjects to test the prediction generate by the model.

Awards: Regional sponsors and the Academy for Applied Science award scholarships for outstanding student research. The first place winner at each regional contest wins $4,000 tuition scholarship. A $500 award is made to one teacher in each region. The eight first place winners are sent on an expenses paid trip to the London International Youth Science Forum, an international conference of over 400 students. The competition awards undergraduate tuition scholarships: eight each of $16,000, $6,000, and $2,000.

Evaluation: A survey was conducted of finalists in 1986. Twenty-six of 39 (67%) questionnaires were returned and indicated overwhelming personal growth after participating in JSHS. A survey of the 1997 national symposia obtained similar positive results.

Contact Information: National Junior Science and Humanities Symposia Program, P.O. Box 2934, Concord, NH 03302-2934, Telephone 603/228-4520; Fax 603/228-4730, trojano@jshs.org, cousens@jshs.org

Reference: Personal communication, NSTA Science and Math Events, 1990.

Program Name: Junior Solar Sprint (inactive program)

Sponsors: U.S. Department of Energy, managed by the National Renewable Energy Laboratory (NREL)

Funding Sources: Host sites (individuals, organizations, schools) outreach to middle/junior high schools, order and distribute kits, provide technical mentors to students and teachers, and plan and execute race day.

Scope: 83 regional sites in 26 states

Grade Level: Middle school, junior high school

Cycle: Annual

Description: Junior Solar Sprint is a program for 6th, 7th, and 8th graders to develop the theoretical and hands-on engineering skills to design and construct a solar-powered vehicle model that will complete a 20-meter, wire-guided sprint race. Student teams are provided with kits ($10) that include a motor and a photovolaic panel. The chassis, wheels and transmission are made from other materials.

Beginning in 1990 as a pilot program, it expanded to 10 regional competitions in 1991 and 83 competitions in 1996, involving 100,000 students and 15,000 teachers. The program was designed to generate enthusiasm for science and engineering among middle/junior high school students, improve students' knowledge of science, engineering, and renewable energy concepts, and encourage students to consider technical careers.

Awards: The top performing car from each school advances to the host site competition. Awards are given for the five fastest cars and for the five best design vehicles including technical merit, craftsmanship, and innovation. Actual awards are not specified; host sites may determine and provide them.

Evaluation: Sample program evaluation forms are provided on the website by NREL, but actual data are not. No evaluations have been done since 1992, and these data are not available. Participant surveys were discontinued because the response rates of students and teachers during the summer (contest is in the late spring) were too low.

Contact Information: Jennifer Wieth, Education Programs Administrator, Education Office, NREL, 1617 Cole Boulevard, MS 1741, Golden, Colorado 80401, 1-800-639-3649, jennifer_wieth@nrel.gov

Reference: http://www.nrel.gov/business/education/SprintWeb

Program Name: McDonald's Science Fair

Sponsors: Partnerships in Education Network (electronic non-profit network, schools, business, and community) McDonald's

Funding Sources: Local businesses, PIE members, unclear which ones. PIE members include: Oregon Museum of Science and Industry, Environmental Information Center, Clark County Parks, Clark County School Employees Credit Union, Clark Public Utilities, Columbia River Education and Workforce Council, Hewlett Packard - Vancouver Site, International Air Academy, Southwest Washington Medical Center, US Army Recruiting, City of Vancouver Parks and Recreation and Water Resources Education Center, C-TRAN.

Scope: Local/district

Grade Level: Elementary

Cycle: Annual

Description: Partnerships in Education is a network in Vancouver, WA composed of 16 schools and 13 local businesses and government agencies. The science fair is for elementary students, but is planned by high school students as part of a service learning project. The high school students organize the fair, help the younger students with the science, and judge the entries along with community members. In 1998, a total of 2,685 elementary students participated at the school level, and 265 participated at the mall fair. The 135 judges are science teachers, employees from sponsoring organizations, high school students, and district staff

The goals of the competition are to encourage the study of science as a lifelong process, to encourage young people to think about earth's environment, to teach the use of the processes of science, to train youth in organization and completion of tasks, and to promote the enjoyment of science.

Awards: McDonald's provides ribbons and a coupon for free lunch for all students (K-12). Sponsors donate books and microscopes. Winning entries are displayed at the local mall.

Evaluation: Student and teacher questionnaires are collected. In 1998 school coordinators were interviewed in an effort to improve the fair for 1999; summary information was provided.

Contact Information: Phyllis Goldhammer, phyllis.goldhammer@esd112.k12.wa.us, 360.750.7500 x315

Reference: http://pie.wednet.edu/pie/scifair/, personal communication

Program Name: NASA Student Involvement Program (NSIP), formerly Space Science Student Involvement Program (SSIP)

Sponsors: National Aeronautics and Space Administration (NASA)

Funding Sources: NASA

Scope: State, regional, national

Grade Level: U.S. students grade 3-12 (public or private schools), individuals or teams of 3-4

Cycle: Annual

Description: With the goal of encouraging students to incorporate science, math, technology and art into science exploration, NSTA and NASA have sponsored this program since 1980. In 1997 nearly 10,000 students submitted 8,000 entries. It was designed to be used within the context of existing curricula, serving as authentic assessments and part of portfolios. The competition format are aligned with national standards in science, mathematics, social studies, and arts.

Students compete in five multidimensional program elements:
--Future Aircraft/Spacecraft Design Team Competition (illustration and description), grades 3-5 teams
--Mission to Planet Earth Team Project (plan analyzing environmental problem), grades 6-8 teams
--Mars Scientific Experiment Proposal (plan for experiment on Mars), grades 9-12
--Aerospace Internships (experimental proposals), grades 9-12
--Intergalactic Art Competition (illustration and narrative), grades 3-12

These catagories for entry are in the process of being revised, and the new categories will cover the full K-12 range. The proposed categories are:
--Exploring the Universe
--"Try It/Fly It" Flight Ready Experimental Opportunities
--Understanding Our Changing Planet
--How Things Work, Creative Arts and Communication/Multimedia.

Awards: This competition is unique in that it recognizes the teachers of winning students as well as the students. Twenty-seven national winners and their teachers receive an all-expense paid trip to Washington DC for National Space Science Symposium, where the students present their projects and tour the city and their congressional offices. The 82 regional semifinalists met with NASA mentors to receive feedback before revising their papers. Other awards included trips to NASA centers, internships with NASA scientists, Space Camp scholarships, medals, ribbons, and certificates.

Evaluation: A program evaluation is required of all teachers in order to receive their students' certificates. Information is collected by a survey of teachers regarding demographics, how the program was used in the classroom, how it aligned with the curriculum, how valuable the experience was, and the extent to which the interest of teachers and students in science was improved. The report is not available.

In 1997 a major program review was undertaken in order to keep the program current with education reform efforts, NASA missions and current technology. The review was conducted through a national workshop with current and previous participants, educators, and NASA program and education personnel.

The program review resulted in the name change and proposed changes in activities and structures, one being a more rigorous program evaluation process. NASA is currently seeking a contractor to run the new programs and design an annual evaluation component consistent with NASA's evaluation standards.

Contact Information: Tyson Brown, National Science Teachers Association, 1840 Wilson Blvd., Arlington, VA 22201-3000, 703/243-7100

Reference: http://www.nsta.org/programs/ssip.shtml

Program Name: National American Indian Science and Engineering Fair

Sponsors: American Indian Science and Engineering Society

Funding Sources: National Action Council for Minorities in Engineering, National Agriculture Statistics Service and U.S. Department of Agriculture.

Scope: National

Grade Level: American Indian students in grades 5-12.

Cycle: Annual

Description: Students compete in one of four grade divisions: 5-6; 7-8; 9-10; and 11-12. The student's research project is entered into one of the following categories: Behavioral and Social Sciences; Biochemistry/Microbiology; Botany; Chemistry; Earth and Space Sciences; Engineering/Computer Science/Mathematics; Environmental Sciences; Medicine and Health; Physics; Zoology; Life Sciences (Team); and Physical Sciences (Team). The Mathematical Association of America sponsors an on-site mathematics competition for teams of 2-3 students in each grade division.

As an affiliate of the International Science and Engineering Fair (ISEF), the National Science Fair follows the current ISEF rules and regulations. There are project fees associated with the NAISEF which begin at $25 per project entered.

In 1988, the National American Indian Science and Engineering Fair was established with funding support provided by National Action Council for Minorities in Engineering, National Agriculture Statistics Service and U.S. Department of Agriculture. Since 1992, over 3,500 elementary, middle and high school American Indian students representing numerous tribes and states across the nation and Canada have attended. Projects that are consistent with traditional American Indian learning - the concepts of balance, interdependence and wholeness as represented by the Medicine Wheel which is a major traditional symbol common to many tribes - are encouraged. Relationships of the physical to the emotional, mental and spiritual aspects of life are stressed.

Awards: Awards for first through third place for each category's grade division are given. The Grand Awards sponsors the top twenty 9-12 students to the International Science and Engineering Fair. Special Awards are presented by science fair sponsors who determine their own category and criteria. Traditional Awards are presented by Indian community representatives to students at each grade level who have developed a project that is consistent with traditional American Indian learning and culture.

Evaluation: No response.

Contact Information: American Indian Science & Engineering Society, 5661 Airport Blvd., Boulder, CO 80301-2339, (303) 939-0023 and Fax (303) 939-8150, Suzanne Benally, AISESpc@Spot.Colorado.EDU

Reference: http://www.colorado.edu/AISES/sciencf.htm

Program Name: National Association of Rocketry Annual Meet

Sponsors: National Association of Rocketry

Funding Sources: A large number of businesses

Scope: National

Grade Level: Pre-high school, high school, post-high school

Cycle: Annual

Description: Established in 1959 this contest is comprised of numerous separate events at five levels ranging from regional to sectional. Contestants must be members of the National Association of Rocketry and present their National Association of Rocketry Sporting License upon entering; several hundred participate. Special emphasis is placed on adhering to official safety codes and regulations. All levels of the competition fall within the contest year, July 1–June 30. Contestants earn points throughout the year based on the level of competition, the difficulty of the event, the rank of contestants in that event. Contestants progress throught local, regional, and sectional events to the national event. Events are held in five categories: altitude, payload, duration, craftsmanship, and miscellaneous events, which includes a research and development competition where contestants present research in which model rocketry plays a primary part. Judges are selected by the club that is hosting the event; judges are typically industry professionals.

Awards: Trophies

Evaluation: No evaluations conducted.

Contact Information: Maria Stumpe, Headquarters Manager, National Association of Rocketry, 1311 Edgewood Dr., Altoona, WI 54720, 715/832-1946.

Reference: NSTA Science and Math Events, 1990.

Program Name: National Chemistry Olympiad

Sponsors: American Chemical Society

Funding Sources: American Chemical Society, US Air Force Academy

Scope: National

Grade Level: Age under 21

Cycle: Annual

Description: From an original group of over 10,000 contenders, 4 students are selected to represent the United States in the International Chemistry Olympiad. After local competitions, 900 students take a 4.5 hour, 3 part national exam. Selection occurs through a series of tests, including multiple choice, problem-solving, and essay questions, and a 10-day study camp for the National Team. At the study camp, students are assisted by paid mentors who commit for a 3-year term and serve as a member of the international jury at the international competition. The aims of the contest are to stimulate students to achieve excellence in chemistry, recognize outstanding students, encourage additional learning, recognize the achievements of students' teachers and the importance of the school environment, promote contact between local sections, schools, and professional chemists, and foster cross-cultural experiences.

The United States joined the international competition, which started in 1968, in 1974 and has competed all over western and eastern Europe.

Awards: The top 20 contestants win a two-week expenses-paid trip to the chemistry study camp in Colorado. The top 4 also travel to the city where the international competition is held, where they are eligible to win bronze, silver, and gold medals. All participants receive certificates. Although students go to the Olympiad as a team, they win medals on their own through a 5-hour theoretical written exam and a 5-hour practical lab exam.

Evaluation: No evaluation conducted. Contact indicated that they haven't had any need for an evaluation.

Contact Information: Martha Turckes, Education Division, The American Chemical Society, 1155 16th Street, NW, Washington, DC 20036, 202/872-4382.

Reference: NSTA Science and Math Events, 1990, http://www.acs.org/education/studprog/olympiad.

Program Name: National Engineering Design Challenge

Sponsors: Junior Engineering Technical Society

Funding Sources: Alfred P. Sloan Foundation, American Intellectual Property Law Association, American Institute of Aeronautics and Astronautics, Law Offices of Kenyon and Kenyon, National Institute of Standards and Technology, National Society of Professional Engineers, Society of Manufacturing Engineers, and VIDAR Systems Corporate Engineers.

Scope: National

Grade Level: 9-12

Cycle: Annual

Description: NEDC challenges high school students to work in teams to design, build, demonstrate, and defend solutions to a defined problem. To increase student interest and social understanding, the projects normally are consumer product-based and emphasize universal design. Students must design their solution, build and demonstrate it in a formal presentation before a panel of engineers. A key feature of the NEDC is that the students must plan and organize themselves and are completely responsible for all aspects of the engineering process. Teacher coaches and advising engineers may provide guidance during the effort but may not help design or construct the solution. In past years, students have designed a replacement for a highway flagperson, a page turner for disabled persons, a retriever-grabber mechanism, a device to move grocery bags up stairs with only 6 pounds of force, and a medicine dispenser.

Teams compete on a regional level, with local winners advancing to a national competition in Washington, DC. Regional competitions are held between late November and early January. The national finals are held during National Engineers Week in February.

Awards: Regional awards are determined by regional NEDC hosts. National finalist schools each receive $1,000 and a trophy. The first place school receives $1,000; the second place school $500; the third place school $250; and each also receives a trophy and a set of brain teasers and puzzles.

Evaluation: A participant survey is conducted, but findings are not available.

Contact Information: Michael Peralta, Executive Director, 1420 King Street, Suite 405, Alexandria, VA 22314-2794, 703/548-5387.

Reference: http://www.jets.org

Program Name: National FFA Organization Agriscience Fair

Sponsors: National FFA Foundation

Funding Sources: Ford Motor Company

Scope: National

Grade Level: 7-12 in four divisions: individual 7-9, team 7-9, individual 10-12, team 10-12.

Cycle: Annual

Description: This contest began in 1997 and is open to middle and high school members of the National FFA Organization who are studying the application of scientific principles and emerging technologies in an agricultural enterprise. Students may enter projects in five divisions: biochemistry/microbiology/food science, environments science, zoology, botany, or engineering. Participants progress through local and state levels before competing at the National FFA convention in November.

Judging criteria include creative ability, scientific thought and engineering goals, thoroughness, skill, clarity, teamwork, commuication skills, a display, and an interview. Judges evaluate how well the scientific method was followed, the detail and accuracy of the project books, and whether tools and equipment were used in the best possible way.

Awards: The winner at the chapter level may be awarded a medal. Winners may be chosen at the state level for each category in all for divisions, and each state may forward ten winners to the national competition. All national participants are recognized with individual medals. Additional cash awards and scholarships are available as funded by special project sponsors.

Evaluation: The National FFA Organization has an award program review cycle but the process and findings were not specified.

Contact Information: Becky Meyer, Teacher Services Specialist, National FFA Organization, 6060 FFA Drive, P.O. Box 68960, Indianapolis, IN 46268-0960.

Reference: Personal communication

Program Name: National FFA Agriscience Student Recognition Program

Sponsors: National FFA Foundation

Funding Sources: Monsanto Agricultural Company of St. Louis, Missouri

Scope: National

Grade Level: Juniors or seniors in high school, or FFA members enrolled in or recently graduated from an agriculture/agribusiness program.

Cycle: Annual

Description: Begun in 1988 this contest is open to members of the National FFA who are studying the the application of scientific principles and emerging technologies in an agricultural enterprise. Students are encouraged to conduct agricultural research projects related to course material. Participants progress through state and regional levels before the national competition at the NFFA convention in Kansas City, MO in November. (Convention moves to Louisville, KY in 1999.)

Judging criteria include agriscience project summary (50%), agriscience summary (35%), and academic achievement and school/community activities. At the regional and national levels, a panel of judges selects the finalists.

Awards: The winner at the chapter level is awarded a certificate and medal, and his or her application is forwarded for state competition. Winners at the state level receive a $500 scholarship, a plaque, and are eligible to compete at the national level. Eight national finalists are selected from the state winners and receive a $1,000 scholarship and plaque. Finalists exhibit their projects at the national convention. The national winner receives a $3,500 scholarship, and national runners up receive a $1,500 scholarship.

Evaluation: The National FFA Organization has an award program review cycle but the process and findings were not specified.

Contact Information: Becky Meyer, Teacher Services Specialist, National FFA Organization, 6060 FFA Drive, P.O. Box 68960, Indianapolis, IN 46268-0960.

Reference: Personal communication, NSTA Science and Math Events

Program Name: National Physics Olympiad

Sponsors: American Association of Physics Teachers

Funding Sources: Fundraising is run by the American Institute of Physics and comes from 13 scientific associations, 24 private businesses, and 2 universities

Scope: International

Grade Level: High School

Cycle: Annual

Description: The International Physics Olympiad began in Eastern Europe in 1967, and the US first fielded a team in 1986. The American Association of Physics Teachers sends applications to 5,700 high schools, and they estimate that 10,000 students receive contest information. Through a series of local selection processes and exams, 20 students are selected to attend a 10-day training camp as members of the US Physics Team. The camp's philosophy is first to bolster students' sense of self-worth and convince them that they could win the Olympiad, and second to teache them more physics. Five are selected from those to compete in the International Physics Olympiad.

Awards: Attendance at the physics training camp.

Evaluation: No response.

Contact Information: International Physics Olympiad, American Association of Physics Teachers, 5112 Berwyn Road, College Park, MD 20740, 301/345-4200.

Reference: NSTA Science and Math Events, 1990.

Program Name: National Science Bowl

Sponsors: U.S. Department of Energy, Bechtel Environmental, Texas Instruments, IBM, Xerox. Regional hosts include NASA Jet Propulsion Laboratory, Alabama School for Math Science, USDA Natural Resource Conservation Service, Minnesota Academy of Science, Los Angeles Department of Water and Power, North Carolina Central University, Clark Atlanta University

Funding Sources: U.S. Department of Energy, Bechtel Environmental, Texas Instruments, IBM, Xerox; local teams have their own sponsors for regional contest

Scope: Regional, national (33 states participate)

Grade Level: High school

Cycle: Annual

Description: Now in its eighth year, the National Science Bowl is an academic competition that focuses on principles of mathematics and science. Students answer questions in biology, chemistry, physics, astronomy, earth science, computer science, and mathematics in teams of four, in addition to an alternate and a coach/advisor. The tournament is designed to encourage high school students to excel in math and science, pursue careers in these fields, and to bring national attention to their academic excellence. Regional elimination tournaments are held in February and March, and the 48 winning teams compete in the national finals in Washington, D.C. The competition is a fast-paced, round-robin then double-elimination, question-and-answer tournament. DOE encourages the participation of young women and minorities.

In 1998, more than 8,000 students from 1,600 high schools competed in Regional Science Bowl competitions. Since its inception, over 50,000 students have competed.

Awards: Prizes include attending the two-week International School of Physics at the University of Sydney, Australia, the week-long meeting of the Committee of Nobel Laureates in Chemistry in Germany, and one-week science experiences sponsored by DOE facilities. Expenses, accommodations, and organized activities for regional winners attending the national competition are included.

Evaluation: No response.

Contact Information: Sue Ellen Walbridge, Office of Energy Research, U.S. Department of Energy, 1000 Independence Ave., SW, Washington, DC 20585, phone 202.586-7231.

Reference: http://www.er.doe.gov/sci_bowl/sci_bowl.htm

Program Name: OM School Program (formerly Odyssey of the Mind)

Sponsors: OM Association, Inc.

Funding Sources: School membership fees of $135

Scope: International

Grade Level: K-12

Cycle: Annual

Description: The OM Association, Inc., is a private, non-profit corporation headquartered in Glassboro, New Jersey, with over 14,000 schools and community programs in all 50 states and DC and over 14 countries. Under the direction of OM Association, Inc., chartered associations are authorized to run local regional, and state/provincial competitions. The chartered associations are authorized to receive logistical support, training materials, and financial aid from OM Association, Inc. Chartered associations' competitions culminate in the OM World Finals.

Working under the guidance of coaches, teams of five to seven students develop solutions to problems and are given the opportunity to test their creative solutions against those of other teams. New problems are designed each year and allow for competition in four divisions. Participation in Divisions I-III is determined by age (elementary through high school). Division IV is for participants in college.

Participants are judged by (1) effectiveness of the solution to the long-term problem, (2) the style of the solution and its overall effect, and (3) the solution to a spontaneous problem.

OM Association, Inc. estimates approximately 14,000 schools and community groups encompass the OM membership. Membership is drawn from the 50 states and a dozen foreign nations.

Awards: Stepping up from local through international divisions.

Evaluation: OM conducts survey evaluations of participants and teachers following competitions. Information from these informal surveys are used in structuring the program and may influence the strategic plan which is revised each year by the OM Board. Copies of the Strategic Plan and informal surveys are unavailable to non-members.

Contact Information: OM Association, Inc., P.O. Box 547, Glassboro, NJ 08028, Linda Foster, (609)881-1603.

Reference: http://www.odyssey.org/odyssey/

Program Name: Science Olympiad

Sponsors: DuPont, Boeing-McDonnell Douglas, Combined Federal Campaign (CFC), National Aeronautics and Space Administration (NASA), PITSCO, Glencoe Publishing, Midwest Products.

Funding Sources: Entry fees, same as above

Scope: Local, state, feeds to national

Grade Level: K-12

Cycle: Annual

Description: Created in 1983 to increase the interest in science and as an alternative to traditional science fairs and single-discipline tournaments, the Science Olympiad has 13,500 active school members in all 50 states and Canada. Secondary teams of 15 students prepare throughout the year for 32 team and individual events in biology, earth science, chemistry, physics, problem-solving, and technology. Events focus on science concepts, science processes, and science applications. Teamwork is emphasized. Goals include improving the quality of science education, increasing student interest in science, providing recognition for outstanding achievement in science education for students and teachers, and bringing academic competition to the same level of recognition and praise normally reserved for athletic competitions.

Tournaments include team events that follow the format of board games, television shows, and athletic games. Biology, earth science, chemistry, physics, computers, and technology are included. Secondary school events may include the Bio-Process Lab, a Bridge-Building Contest, a Physics Lab, Surfing the Net, Propellar Propulsion, a Pentathalon with physical and academic obstacles, Polymer Detectives, Science Crimebusters, and the Sounds of Music where students design, build and play musical instruments.

The competition is based upon that National Science Education Standards.

Awards: Trophies, ribbons

Evaluation: Emory University has a proposal pending with NSF to evaluate the Georgia Science Olympiad. The three year evaluation will assess the impact of the program on students, teachers/coaches, other school personnel, curriculum, and parents and other community members. The evaluation will address project implementation and impact, case studies, creativity and problem solving, student attitudes toward science, and student, parent, coach and community perspectives.

Auburn University, the U.S. Army, and U.S. Honda Foundation is also conducting a study. National Science Standards highlight Science Olympiad as a model for performance testing and integrating science into the curriculum.

Small study form school district, 95% of students had mastered 95% of state science standards

Contact Information: Science Olympiad, 5955 Little Pine Lane, Rochester, MI 48306, 810/651-4013, FAX: 810/651-7835

Reference: http://www.geocities.com/CapeCanaveral/Lab/9699/, http://www.macomb.k12.mi.us/science/

olympiad.htm

Program Name: New York City Science, Mathematics and Technology Expo

Sponsors: The Board of Education, New York Academy of Sciences, Polytechnic University, and CUNY

Funding Sources: New York City Board of Education; Sumitomo Electric, USA; New York University College of Arts and Science; American Association for Clinical Chemistry; American Academy for Professional Law Enforcement; American Meteorological Society; Association of Biology Teachers; City College of New York Engineering; Eastman-Kodak; Environmental Education Advisory Council; Esther Hoffman Beller; Environmental Quest; Humane Education Committee; IEEE Communications Society; Society of Indo-American Architects and Engineers; Intel; Iota Sigma Pi; JETS; Marcelo Camacha Ayala; Medical Society of the County of Queens; Metropolitan Engineering Society Council; New York City Association for Computing Machinery; NAACP/ACT-SO; Navin Patel; New York City Department of Environmental Protection; New York City Detectives Endowment Association; New York Times; Robert Kaunitz; Richmond County Medical Society; Robert Sacks; Francine Salom; Edwin Schlossberg; Society of Women Engineers; U.S. Army; U.S. Air Force; U.S. Navy; Victor DeLeon; Society of Women Geoscientists; and Yale University.

Scope: New York City

Grade Level: High school

Cycle: Annual

Description: In 1999, the New York City Science, Mathematics and Technology Expo became a collaboration of three fairs—the New York Academy of Science's Expo, Polytechnic University's ISEF for engineering and physical and environmental sciences, and New York City Technical College's (CUNY) ISEF for the biological, biomedical, and social sciences. In this new model, the Academy's fair is a preliminary competition for all students. The other two fairs are final rounds designed to select students for the ISEF competition. A total of 12 students are selected for an all expenses paid trip to the week-long international competition.

Awards: Awards were both monetary and non-monetary. Nonmonetary awards included books, tours, calculators, and certificates of merit. Monetary awards ranged from $20 to $10,000 (the latter award underwritten by Sumitomo Electric, USA, Inc.) Monetary awards also included scholarships, the highest being a $20,000 renewable tuition scholarship from New York University.

Evaluation: None; contact noted that there is little concrete proof of the effectiveness of science fairs, besides anecdotal evidence.

Contact Information: New York Academy of Science, Education Department, 2 East 63rd Street, New York, NY 10021. Lori Skopp, lskopp@nyas.org

Reference: http://www.nyas.org/edwinter.htm#a12

Program Name: SuperQuest (inactive program)

Sponsors: Cornell Theory Center

Funding Sources: Cornell National Supercomputer Facility, National Science Foundation, Digital Equipment Corporation, IBM

Scope: National

Grade Level: High school

Cycle: Annual

Description: Conducted from 1989 to 1995, SuperQuest is the only super-computing competition in the US intended exclusively for high school students. Teams were composed of 3 to 4 full-time students and a teacher/coach who carried a full teaching load. Schools could sponsor more than one team, but students could only participate on one team, and winners could not compete in the year following their win. The purpose was to foster creativity in devising computational solutions to a scientific problem. In 1989 SuperQuest had 71 team entries.

The problems the students attempted to solve were be real science, and students were to demonstrate a better solution to an existing problem than was previously available. The computer application software was written in FORTRAN. To enter teams submitted a entry form and a 200-word abstract for each student's projct. Next, teams submitted a project report, including how the school would use the workstations. A review committee appointed by the Cornell National Supercomputer Facility evaluated each report.

Awards: The winning teams received either IBM or Digital workstation configurations for their school, one year of access to the Cornell Supercomputer Facility, and attendance at the SuperQuest Institute in Ithaca, NY, or one of several other supercomputer centers around the country, for which teacher/coaches received a $3,000 stipend and students received a $1,000 stipend. At the summer institutes students and their teachers worked with center staff and mentors to solve their problems. Awards for the best student paper were $1,500 for the winner and $1,000 for the runner-up. The winner of the best school competition received continued access for another year at the Cornell facility. The school authorized their participation and agreed to provide space for the workstation and to actively use the workstation and Cornell's supercomputers in its curriculum.

Evaluation: The evaluation of SuperQuest was conducted for the six years of the competition, 1989-1995, and used some data from all 66 participating schools and in-depth data from 14 schools. For each school, data were collected from teachers and students through written surveys, program documentation, telephone interviews, and electronic inquiries. Data were collected on teachers' experiences with the projects, prior and subsequent professional development, effectiveness of the summer institutes, perceived impacts on curriculum and teaching practices, factors and problems in implementing and sustaining the impacts, perceived impacts on students and the community, and teacher and school background and demographic information. Because the teachers were so heavily involved in both the application and implementation of the program in the school, it is possible to examine the impact of the program on the school. Student data were collected on processes in developing proposals and using supercomputers, continued work after the summer, perceived effects of their experiences, and demographic, academic and career information. The evaluation also includes several case studies of highly successful and less successful schools, teachers, and students. Data were collected from 50 percent of teachers and 35 percent of students.

Contact Information: Linda Callahan, Associate Director, Cornell Theory Center, Frank H.T. Rhodes Hall, Ithaca, NY 14853-3801, 607/254-8686, cal@tc.cornell.edu

Reference: NSTA Science and Math Events, http://www.tc.cornell.edu/er/sci93/dis16sq.html, personal communication

Program Name: Tests of Engineering Aptitude, Mathematics and Science

Sponsors: Junior Engineering Technical Society

Funding Sources: AT&T, The Elizabeth and Stephen Bechtel, Jr. Foundation, Intel, Lockheed Martin, NEC Foundation of America

Scope: National

Grade Level: 9-12

Cycle: Annual

Description: TEAMS introduces students to an engineering teamwork environment, where students work cooperatively in an open-book, open-discussion environment to solve objective and subjective engineering problems. TEAMS provides an opportunity for students to refine their academic abilities and build their problem-solving skills by working in groups of 4 to 8 students.

Regional competitions are held on college campuses. The exam is a 1-day, two-part competition. Part I consists of multiple-choice questions related to various engineering situations. Part II requires students to describe and defend their solutions to open-ended subjective questions related to problems they worked through on Part I. Subject matter includes mathematics, chemistry, physics, biology, visual interpretation of information, computer applications, and reading analysis and interpretation. Problems are designed to measure aptitude, not achievement and do not ask students to recite high school subject matter; rather, it challenges them to apply the subject matter to real-life problems.

Part I answers are scored on competition day and are used to determine local standings. JETS national headquarters announces state and national results. Based on state rankings and the number of schools competing in each division (varsity for grades 9-12, junior varsity for grades 9-11), eligible teams advance for national ranking and recognition. Those schools' Part II solutions are scored by a panel of engineers.

Awards: Regional awards are determined by regional TEAMS hosts. National finalists receive trophies and all entrants receive certificates.

Evaluation: A participant survey is conducted that gathers data mostly on how local programs are run and what improvements they suggest.

Contact Information: Michael Peralta, Executive Director, 1420 King Street, Suite 405, Alexandria, VA 22314-2794, 703/548-5387.

Reference: http://www.jets.org

Program Name: Technology Student Association Competitive Events

Sponsors: Technology Student Association

Funding Sources: Events funded separately by Pitsco, Inc., Versa Cad, Inc., Autodesk, Inc., Modern School Supply, among others

Scope: National

Grade Level: Middle and High school

Cycle: Annual

Description: Held at the Technology Student Association annual conference beginning in 1978, 27 events, of which 12 are science events for high school students, are held for members of the association. There are 3 tiers: school level, state level and national level, although students do not need to win to compete at the state and national levels. Participants may enter six events, with only one entry per event. Most events include Level I for students in grades 7-9 and Level II for students in grades 9-12, and there is a chapter (school-level) competition as well. Events include: Bridge Building, Computer-Aided Drafting/Design, Electricity/Electronics, Engineering Problems, Manufacturing Prototype, Metric 500, Radio Control Transportation, Research Paper, Technical Report Writing, Technology Bowl, and Technology Process Display. Most events also include an interview and written description of the product. In 1990, 3,300 students entered the competition. Students must pay their own travel expenses to the conference, as well as a $50 registration fee.

Awards: The first, second, and third place national winners in each event receive trophies. Several Level II event winners receive scholarships. All finalists receive a certificate.

Evaluation: No response.

Contact Information: Rosanne T. White, Executive Director, Technology Student Association, 1914 Association Drive, Reston, VA 22091, 703/860-9000 or 703/620-1060.

Reference: NSTA Science and Math Competitions, 1990.

Program Name: ThinkQuest, ThinkQuest Junior

Sponsors: Advanced Network & Services (non profit)

Funding Sources: IBM, Microsoft, Netscape, Proxima, Real Audio, VideoLabs, Adobe

Scope: International

Grade Level: Ages 12-19

Cycle: Annual

Description: Begun in 1996, ThinkQuest (and ThinkQuest Junior, a new program for younger students) is a competition where students create internet websites that help other students learn. ThinkQuest encourages students from schools with different levels of information technology to form teams to collaborate in their entries. Each team of two or three students submits an application describing the team, what entry is, and how they will implement it. Teams whose entries offer educational benefits to other students and demonstrate realistic plans for implementation are invited to develop and test their entries. Entries are place on the ThinkQuest web pages, are reviewed again for educational merit and compliance with the rules, and are then made available on the web. Judges select 35 teams as finalists who are invited to an awards event. At the awards event, judges discuss all aspects of the entry with team members and coaches. Awards are given in five categories: Arts and Literature, Science and Mathematics, Social Sciences, Sports and Health, and Interdisciplinary. Criteria are: 20% team collaboration (includes provisions for access to technology, language, gender, age that influenced collaboration), 15% uses of the entry, 25% education value of the entry, 15% likelihood of entry being highly used by other students, 25% technical quality and accuracy of information.

ThinkQuest Junior is designed for students in grades 4 through 6, including larger team sizes, proportionally larger teacher awards, and cash and network resources awards instead of scholarships.

Awards: All awards are scholarships to be used for college. Best of Contest: $25,000 per student, $5,000 per coach, $5,000 per school. First through fifth place awards are given in each category with awards ranging from $3,000 to $15,000 per student, $500 to $2,500 per coach and per school. Other awards include the $750 Collaboration Award (teams with the greatest dissimilarities in resources), the Gem Award, given to a team from a past competition who did not win an award, but whose entry has become broadly used on the internet (amount is somewhere between the Best of Contest and Second Place Award levels), and the Java Award, sponsored by Microsoft, for three teams whos entries have made the most innovative use of Java ($2,000-$3,000 per student, $400-$600 per coach and per school).

Evaluation: Conducted by Beta Resources, data and findings not available, but presumably through a web-based survey.

Contact Information: Advanced Network & Services 200 Business Park Drive in Armonk, New York, 10504, USA, 914/273-1700.

Reference: http://io.advanced.org/ThinkQuest

Program Name: Thomas Edison/Max McGraw Scholarship (inactive program)

Sponsors: National Science Education Leadership Association, National Science Supervisors Association

Funding Sources: Partial Contributors: Edison Electric Institute. U.S. Energy Association. the Max McGraw Foundation is the major funder with coordination by National Science Supervisors Association and NSELA, an affiliate of AAAS, NSTA, and the International Council of Associations for Science Education

Scope: International, private or parochial schools.

Grade Level: Grades 7-12

Cycle: Annual

Description: The stated purpose of the Thomas Edison/Max McGraw Scholarship Program is to motivate students to complete an experiment or a projected idea which deals with a practical application of a scientific law or principle in the field of science and/or engineering. Students enter in 2 divisions: junior and senior. Stated judging criteria are: creativity and ingenuity, practical application, and a letter of recommendation illustrating how the students used his/her ingenuity to solve problems on numerous occasions and demonstration inventiveness.

Awards: Grand Finalist, $5,000 scholarship; second finalist, $3,000 scholarship; finalists, $1,500 scholarship. Edison Electric Award, $1,000 scholarship; US Energy Association scholarships, $1,000.

Evaluation: not stated in available data.

Contact Information: Kenneth Roy, National Science Supervisors Association Leadership Institute for Science Education Center, Copernicus Hall, Room 227, Central Connecticut State University, 1615 Stanley Street, New Britain, CT 06050, 860/827-3200.

Reference: NSTA Science and Math Competitions, 1990.

Program Name: Toshiba/NSTA ExploraVision Awards Program

Sponsors: Toshiba, National Science Teachers Association (NSTA)

Funding Sources: Toshiba

Scope: U.S. or Canadian citizens or legal residents living within the U.S., U.S. territories, or Canada.

Grade Level: K-12. Divided into four categories (K-3, 4-6, 7-9, 10-12)

Cycle: Annual

Description: Stated objective: to encourage students to combine their imaginations with the tools of science and technology to create and explore a vision of the future.

Teams of 3-4 working with a teacher and optional community advisor. Teams select a technology, or an aspect of a technology, that is present in the home, school, and/or community. They are to explore what it does, how it works, and how, when, and why it was invented. The students are to project into the future what that technology could be like 20 years from now. They are asked to convey that vision to others through both a description and storyboard. Entry kits are provided to the teachers.

A regional judging committee, comprised of science educators, selects 48 teams as regional winners, one for each grade-level category from twelve regions in the country. Regional winners receive $500 to produce and submit a videotaped presentation of their project to be judged at the national level. Regional winners must create a prototype of their technology which must be used as a prop in their videotape. Twelve finalist teams are selected by a separate national judging committee.

Awards: Certificate of participation to all participants and an unspecified small gift. Student members of the four first-place teams each receive a $10,000. U.S. Saving Bond or Canada Saving Bond of comparable issue price. Student members of the eight second-place teams receive a $5,000. U.S. or Canada Savings Bond. Student members of the remaining 36 regional winning teams receive a $100 savings bond. The 12 finalist teacher advisors and schools receive unspecified Toshiba products. Schools of the 48 regional winning teams each receive Toshiba products. Finalist team members and their parents (or two other individuals), teacher advisors, and community advisors are given a trip to Washington, DC to attend an awards ceremony in June.

Evaluation: Follow-up surveys to selected entrants, but no specific information given.

Contact Information: Toshiba/NSTA ExploraVision Awards Program, 1840 Wilson Boulevard, Arlington, VA 22201-3000. phone: 800.EXPLOR-9, or 703/243-7100, exploravision@nsta.org

Reference: http://www.toshiba.com/tai/exploravision/index3.htm.

Program Name: USA Computing Olympiad (formerly International Computer Problem-Solving Contest)

Sponsors: USA Computing Olympiad, USENIX, Originally sponsored by the University of Wisconsin-Parkside

Funding Sources: USENIX, the technical assocation of UNIX users

Scope: International

Grade Level: High school

Cycle: Annual

Description: Started in 1977 this contest has changed and grown considerably as the nature of computer science has changed and programming in school shifted from writing programs to using programs already written to solve problems. The competition is now the feeder to the International Olympiad in Informatics. Over 250 coordinators distribute materials to 500 to 1,000 students. Upper level computer science students solve five problems in computation, simulation, graphic patterns, words and mind benders. The contest combines the art of problem solving with the skill of computer programming. The competition holds 3 contests over the internet, where students submit their solutions via email, and a national contest where the 500 to 1,000 students solve a 5-hour problem. The top 15 winners attend a week-long camp at the University of Wisconsin-Parkside to prepare for the international competition where the top 4 compete. The programs are judged by running them against the data given in the problem and increasingly more difficult test data and those programs that solve the problem the most efficiently and quickly win. 100% of the winners are boys.

Awards: The national winner receives a plaque and the opportunity, along with 14 others, to compete for the national team.

Evaluation: No formal evaluations have been conducted, but at the end of each summer session, participants debrief on their experiences and suggest ways to improve the program

Contact Information: Donald T. Piele, USA Computing Olympiad, PO Box 085664, Racine, WI 53408, 414/634-0868.

Reference: http://usaco.uwp.edu. Older competition: NSTA Science and Math Events, 1990.

Program Name: USA Mathematical Olympiad

Sponsors: American Mathematics Competitions

Funding Sources: Army Research Office, Office of Naval Research, University of Nebraska at Lincoln, Matilda R. Wilson Foundation, Microsoft

Scope: International

Grade Level: High School

Cycle: Annual

Description: The USAMO provides a means of identifying and encouraging the most creative secondary math students in the country who may become leaders in the mathematical sciences. The 160 top-scoring students on the USA Mathematical Olympiad on the basis of an indexed score of both the American High School Mathematics Examination and the American Invitational Mathematics Examination are selected to take the USAMO exam, a 6-hour, 6-question essay/proof exam. Thirty of the top scorers attend a month-long training session, and 4 are selected as team members based on a battery of International Olympiad-type exam. The summer program is designed to insure their interest in math, broaden their view of math, better prepare them for the international competition, provide the best example of how math should be taught, and achieve an atmosphere of comradship and cooperation. All of the math can be done with pre-calculus skills.

Awards: The top 8 scorers on the USAMO are invited to attend an awards ceremony in Washington, DCTop scorers attend a week-long training at West Point or Annapolis before competing in the international competition.

Evaluation: None conducted.

Contact Information: Walter Mientka, Executive Director, American Mathematics Competitions, Department of Mathematics and Statistics, University of Nebraska, Lincoln, NE 68588-0322, 402/472-2257, walter@amc.unl.edu.

Reference: NSTA Science and Math Events, 1990. http://www.unl.edu/amc