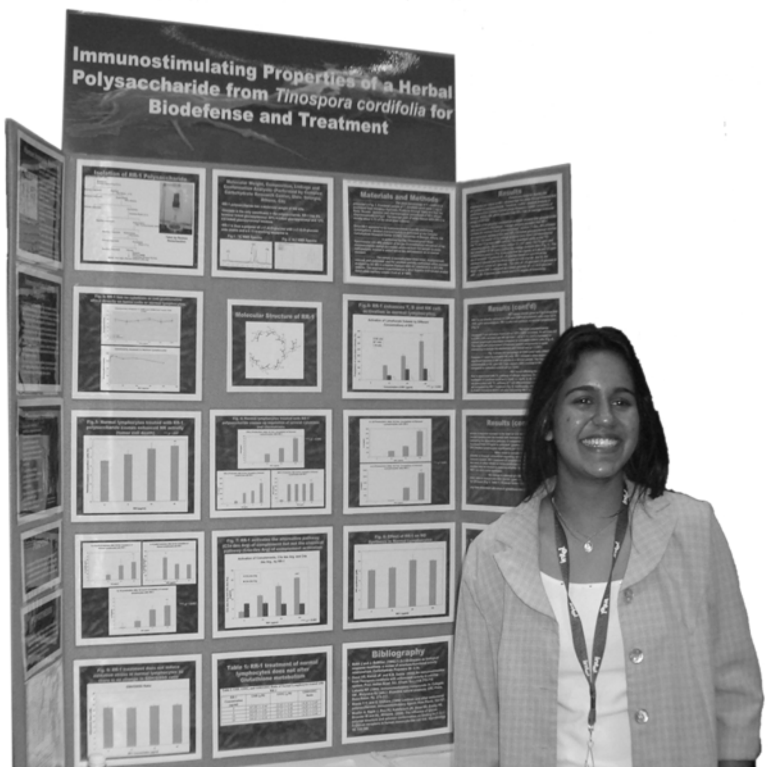
Intel International Science and Engineering Fair 2005

Evaluation Report



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August 22, 2005

EXECUTIVE SUMMARY

A team of Arizona State University tenured faculty in the College of Teacher Education and Leadership conducted a program evaluation of the 2005 Intel International Science and Engineering Fair (ISEF). On the surface, Intel ISEF is a world-class event with impressive participation and projects from students in the United States and other countries of the world. The three goals of Intel ISEF are: (1) to encourage and reward excellence in student-based research; (2) to motivate students to pursue science, math and engineering careers; and (3) to promote inquiry and project-based science teaching and learning in the schools. Probing deeper into the perspectives and experiences of students, teachers, judges, and regional fair directors adds to the luster of the program.

Evaluating Goal Achievement

The evidence suggests that all three goals are being met. Of the goals, the first two appear to have the most powerful supporting evidence. While a variety of data sources all point to the same conclusion, the support of goal one can best be illustrated from the online teacher questionnaire, where 98.5% of the respondents agreed or strongly agreed that, "Intel ISEF and its affiliated fairs encourage students to pursue excellence in science, mathematics, and technology" and 97.2% indicated that Intel ISEF rewards their students for excellence in science, mathematics, and technology. On the judges' survey, 95.7% of the respondents agreed or strongly agreed that the projects were of excellent quality.

The evidence also suggests that Intel ISEF motivates students to pursue science, math, and engineering careers. About 97% of the teachers agreed or strongly agreed with this statement. In the student questionnaire, more than three-quarters of the students agreed or strongly agreed with the following items that their work leading to Intel ISEF made them (a) more interested in pursuing a career in science, mathematics, engineering, or technology (88.1%), and (b) more interested in pursuing an occupation that requires inquiry (89.1%). Of the finalist respondents 75.0% percent indicated that they were interested in pursuing a STEM career (including medical) with 22.9% choosing Medical as a career choice, 22.1% Engineering, 21.7% Science, 5.6% Technology, and 2.7% Math.

The third goal also appears to have been met. The projects on display are a testimony to inquiry and project-based science. On the judges' survey, 91.3 % of the respondents agreed or strongly agreed that the projects were inquiry based. These projects were typically part of a class or school requirement or program. In the online survey 91.6% of the teacher respondents agreed or strongly agreed that Intel ISEF promoted inquiry in their schools and 89.1% agreed or strongly agreed that it promoted project-based science at their schools.

School and Classroom Impact

Moving past the stated goals for Intel ISEF, we also explored whether Intel ISEF was influencing what happens in classrooms. About two-thirds of the teacher respondents agreed or strongly agreed that their involvement with Intel ISEF had changed the way they teach and 89.1% agreed or strongly agreed that external competitions had a positive impact on their teaching. At a school wide level, however, the effects are not as strong. When faced with the possibility of removing Intel ISEF but not the affiliated fairs, 47.5% agreed or strongly agreed that it would affect science or mathematics programs at their school. When asked if all science fairs were gone, 63% agreed or strongly agreed that it would change their school's programs.

Yet, in the survey of high school students, 50.9% indicated that their school had a science research class or science club. These data suggest that Intel ISEF is influencing what happens in the classrooms of participating teachers and some programs at their schools. Whether that impact spreads beyond participating teachers should be investigated further. Just less than half of the teachers strongly agreed or agreed that Intel ISEF had affected how other teachers in their school teach science or math.

Successful Students

When asked about what it takes to be an Intel ISEF finalist, most finalists answered hard work, dedication, and a willingness to give up other activities to work on the project. Finalists felt supported by both their friends and other people at their schools—students, faculty, and administrators. However, that support seemed to be in the form of congratulations after winning recognition for their projects. It is unclear how people, other than those directly involved with a student and their project, supported the finalists during the creation of their projects.

When teachers were asked which factors influenced the success of Intel ISEF, the top four factors listed with the greatest percentage of strongly agrees were (1) work ethic (SA= 86.3%; x=3.87), (2) critical thinking ability (SA= 72.6%; x= 3.71), (3) parental support (SA= 71.1%; x=3.68), (4) communication abilities (SA= 69.5%; x=3.51), and (5) science or mathematics teachers (SA= 59.9%; x=3.51). Both teachers and students put the emphasis on hard work.

Recommendations

From the 2004 student questionnaire the "love of a chosen field" was rated as the most important factor in choosing a career. The data in 2004 and 2005 suggest that the Intel ISEF experience does help students develop a desire to pursue STEM careers. Part of the success may be that students love the work they are doing in their projects.

Immersing ourselves into the Intel ISEF experience for two consecutive years, talking to a variety of participants, and analyzing data from online surveys, it became clear that Intel ISEF has a culture of excellence. Conversations with teachers, students, judges, and regional fair directors revealed very positive, hard working, and intelligent people who are enthusiastic about their pursuits and passions related to the Intel ISEF experience. This report, with its quotes, numbers, and analyses, cannot completely convey the power of the Intel ISEF experience.

Regional and High School Fairs

An important question to ask is to what extent is the power of Intel ISEF leveraged for the greatest good? How many students in the U.S. and worldwide put tremendous effort and energy into their projects in the hopes of qualifying for a trip to Intel ISEF? How many fail but resolve to do better next year for the chance to be a finalist? Unfortunately data like these are difficult to gather.

Data could, with relative ease, be collected, on how many students participated at regional fairs. This data might exist but in our request for data from Science Service they were not provided. We would recommend that the exact number of students at each regional fair be collected from year to year. Analyzing the trends will give some indication of the impact of Intel ISEF and whether it is waxing, waning, or remaining constant. As part of this data collection, it may be a good idea to collect names of the students and addresses of the students who participated in case Intel wants to communicate with the students to encourage them or obtain data about the regional fairs.

We believe that a strong positive about Intel ISEF is that the finalists, whether they win an award or not at Intel ISEF, view themselves as winners for just becoming a finalist. In a sense, the trip and the experience is the award. It would be good to explore attitudes and perceptions at the regional level. Do the students feel special for having competed at a regional or school fair? How do the majority of students who are not selected to go to Intel ISEF feel? Are some so disappointed that they decide not to pursue STEM careers? We suggest that that Intel look a little deeper into the regional fairs to help inform the program. Regional fairs not only affect far more students directly than Intel ISEF does, but also the regional fairs have the ability to expand far easier than Intel ISEF does.

A more challenging venture would be to collect data below the regional fair level. How many projects were done in schools or feeder fairs that send their top projects to the regional fair? The mechanism for this data collection would be more complex than just determining exact numbers for the regional fair. It would, however, yield valuable information about the deeper impact of Intel ISEF. Perhaps some states or non-US countries have a data collection technique that can be emulated.

Separate Judging for Research Lab Projects

There are two recommendations that had strong support in the 2004 and 2005 teacher online survey. The first is that judging and awards should differentiate between projects that were conducted in "outside of school laboratories" and those that were more student-centered projects. We have concocted two fictional accounts to illustrate the concern.

George's father has a friend, Dr. Jones, at the local university who agrees to let George work in his biochemistry laboratory. Dr. Jones and his laboratory are investigating the transport of magnesium across the Q-channels in the cell membrane of yeast. For insurance and safety reasons, George is not allowed to manipulate most of the equipment, but Dr. Jones does find things for him to do that contribute to the work of the team during his paid summer internship. Dr. Jones shares some of the data they collect with George. George does lots of reading on his topic and creates a display board with his father and mother's help and wins his regional fair.

Although some teachers questioned the educational appropriateness of this type of experience, there does seem to be benefits for George. He sees aspects of a research laboratory in action, he gets to participate in some simple lab activities, he has a paid internship, he learns a lot about an area he would have never pursued on his own, and he becomes an Intel ISEF finalist, having a wonderful week in Phoenix, and giving his college application more clout.

Yet, another student in his region Martha used her own creativity in coming up with a research problem. She used very simple measuring tools, a ruler and a scale, as she explored an aspect of plant growth. Her methodology, through several iterations where she realized slightly different approaches would be better, became flawless. In Martha's year of research she found significant differences. The problem selected and the results were not appropriate to be published in a scientific journal but they were interesting. Martha was disappointed when her research project only won a second place ribbon. All the projects that scored higher were conducted in research laboratories.

It does seem difficult to compare George and Martha's work. What they did are both valuable experiences for the students. George's data would be more impressive to a botanist judge but that is because the problem and data collection were all initiated by a professional scientist. This is one of the reasons why so many teachers recommended separate judging for projects done in research laboratories versus those done at home or school.

Paperwork

The second teacher recommendation with strong support dealt with paperwork issues. It is our recommendation that a taskforce be created with the mission of reducing and streamlining the paperwork and then creating a system to facilitate its completion. For the Likert-item asking teachers to identify problems that students have, 22.1% indicated that paperwork was a very difficult problem.

Sharing of Expertise

There is considerable expertise within the Intel ISEF system on how to help students do inquiry projects, find laboratories, run regional fairs, and find financial support. We recommend finding ways of sharing the expertise. There is no evidence that the expertise is spreading down the same school hall of the successful Intel ISEF teachers, most with considerable expertise in helping students do inquiry projects. Most of the teachers disagreed that, "Other teachers at my school have changed the way they teach science or mathematics because of Intel ISEF and its affiliated fairs." The majority also disagreed that, "Most science teachers in my school could effectively teach a science research class." Effective ways to get successful teachers to share with other teachers and successful regional fair directors to share with other regional fair directors should be developed.

There might even be online courses offered for teachers to give them the skills to help students doing research. The two biggest problems that teachers identified in students are statistical analyses and choosing a problem. The judges suggested that to improve the projects students should focus on methodology, such as having a bigger sample or doing more repetitions. Perhaps courses could be initially developed that focus on areas of need as seen by teachers and judges.

The Decision Making Process

Many of the people we spoke with, in both heaping praise and suggesting improvements, spoke in terms of "Intel should …." These people tended to view Intel as not only the financial backer but also the decision maker and the executer of local logistics. This was even true of a judge who was an Intel employee in a complaint about the judging process. To be sure the association of Intel with ISEF is a strong positive for Intel and ISEF, but the view that Intel controls the logistics and decisions does at times present the possibility of negative views.

It was very clear that Intel employees were very active working to make Intel ISEF Phoenix a successful fair, especially in working with the local host committee. We wonder, however, if there are mechanisms to create change? In many ways, Intel ISEF seems to have the momentum of a very large cruise ship—with years of tradition built in—it could be very hard to change its direction. Indeed many within the system might be threatened by any changes to the status quo. To be sure, if Intel felt strongly about a change they could use their clout as a major funder to potentially influence the change. However, it would be more productive to view change as something that should be considered on a regular basis and establish a change process that involves constituents including representatives from Intel, Science Service, judges, teachers, and regional fair directors. A "board of directors" type structure would help Intel ISEF to evolve so it stays pertinent and responsive to the needs of all the constituents.

Conclusions

The Intel ISEF program is a world-class event that encourages and rewards excellence in science, engineering, technology, and mathematics. It is a truly impressive event that will be one of the highlights of the students' lives. Gathering information from the constituents throughout the system, and having mechanisms to make decisions, will help the program to evolve to continually meet the needs of the students.

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The Intel International Science and Engineering Fair Evaluation Report

This is an evaluation of the Intel International Science and Engineering Fair (ISEF). The evaluation was guided by the goals of Intel for the program and information was sought that would be useful to countries, regions, and schools seeking to implement or improve their participation in Intel ISEF. The evaluation plan was submitted and approved in January of 2005.

The three principal investigators for the evaluation are Peter Rillero, Nancy Haas, and Ron Zambo all are from the College of Teacher Education and Leadership at Arizona State University at the West Campus. This same team conducted the 2004 Intel ISEF evaluation, the 2004 Middle School Outreach Evaluation, and the 2005 Middle School Outreach Evaluation. Rillero's expertise is in science education. He has experience as a science research teacher in the borough of Bronx, NY and was a volunteer at Cleveland Intel ISEF. Haas is chairperson of the secondary education department and has experience in international evaluations. Zambo has expertise in mathematics education. As a team we designed all the instruments, collected data, and interpreted the data. Jon Price, of Intel Corporation and Heather Bowen, a preservice teacher, also participated in interviews. As in the 2004 evaluation, Gary Lewallan did the technical work of getting the survey online, ensuring its professional look, proper functioning, and data collection.

This document is divided into three major sections. The Executive Summary is a succinct overview for the evaluation. The Methods, Results, and Recommendations section describes the evaluation in detail. This major section is divided into Part A: Student Perspectives, Part B: Teacher Perspectives, Part C: Regional Fair Director Perspectives, Part D: Judges Perspectives and Part E: Conclusions and Recommendations. The final section is the CD-ROM attachment, which contains the instruments used and data from the online surveys.

Methods, Results, and Recommendations

Intel's three objectives related to the Intel ISEF program are: to encourage and reward excellence in student-based research; to motivate students to pursue science, math and engineering careers; and to promote inquiry and project-based science teaching and learning in the schools. As with the 2004 evaluation, data was sought to evaluate the achievement of these goals. Additionally, data was sought that could improve the program and help domestic and international participants start or improve their programs.

Data was obtained from five distinct groups of important participants in Intel ISEF: teachers, students, regional fair directors, and judges. Interviews at Intel ISEF were conducted with teachers, students, and regional fair directors. A focus group was held with a group of judges. Online surveys were used to collect data from teachers, students, and judges. A summary of the data collection is shown in the table below.

Data Source	Survey	Interviews	Focus Group
Students	X	X	
Teachers	X	X	
Judges	X		X
Regional Fair Director		X	

Part A: Student Perspectives

Finalists completed an online questionnaire regarding the following: their motivation for participation in science fairs; sources of knowledge and skills required to create a quality science fair project; the benefits of science fair participation; information pertaining to mentors; and general demographic information. In addition to the online questionnaires, we conducted structured interviews with a small sample of ISEF finalists to gather additional data that might more clearly define the benefit of mentors and internships in the production of Intel ISEF quality projects, as well as validate responses to selected items on the online questionnaire.

The results of the online questionnaire are presented in four sub-sections. Sub-section 1 addresses descriptive data regarding the finalists, their projects, and their activities leading up to Intel ISEF. Sub-section 2 deals with career choice, including general factors and the effect of Intel ISEF on career choice. Sub-section 3 deals with science fair participation, including people and other factors that motivate students to participate. Sub-section 4 deals with the benefits of science fair participation, including the knowledge and skills attained and the sources of that knowledge and skills.

After the online survey data are presented, the information from the student interviews is presented, including the qualities needed to be a finalist and programs in school and out of school that helped in regard to science fair projects.

Finalist Online Questionnaire

The evaluation team developed an online questionnaire to collect data from the finalists. Initially, the questionnaire was made accessible to finalists as a link on the finalists' registration site. This approach did not obtain what was considered an adequate number of responses with only about 220 finalists completing the questionnaire. Subsequently, the survey was made available to finalists during Intel ISEF on computers in the e-lounge. Members of the evaluation team promoted participation with signs and verbal encouragement. This approach added an additional 191 finalists for a total of four hundred, eleven finalists, which was 28.4 percent of all finalists competing at Intel ISEF.

1. The Finalists

Of the 411 finalists who successfully completed the questionnaire:

- 169 (41.1%) were female and 235 (57.2%) were male.

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- Natural Science and Engineering were the categories in which the majority of projects were entered.

- 327 (79.6%) of the finalists were from the United States and 81 (19.7%) were from 1 of 29 other countries.

- Of the 327 who were from the United States, 199 (60.9%) were White, 62 (19.0%) were Asian, 18 (5.5%) were Hispanic or Latino, 13 (4.0%) were Black or African American, and 9 (2.8%) were American Indian or Native Alaskan.
- Of the 407 finalists who reported a country of origin, 71 (17.4%) were from countries other than the United States and Canada. Grouping those countries by Intel geographic area descriptions, 30 were from Asia, 22 were from Europe, and 19 were from Latin America.

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- Overall, 297 (75.0%) percent indicated that they were interested in pursuing a STEM career (including medical) with 94 (22.9%) choosing Medical as a career choice, 91 (22.1%) Engineering, 89 (21.7%) Science, 23 (5.6%) Technology, and 11 (2.7%) Math. Only 37 (9.0%) indicated that they were undecided about a career.

- 125 (30.4%) were from Urban areas, 153 (37.2%) were from Suburban areas, and 124 (30.2%) were from Rural areas.

- The largest number of finalists 284 (69.1%) came from public schools, 68 (16.5%) came from private schools, and 35 (8.5%) came from magnet schools. Others types of schools with lower representation were Charter, Home, and Technical.

- 209 (50.9%) of the finalists participated in a class and/or after school science fair program.

    - Of those 209, 129 (31.4%) participated in an after school research program, 145 (35.3%) took a research class, and 65 (15.8%) took both.

- 296 (72.0%) reported having a Mentor who helped on the research part of their project.

    - Of the 296 that reported having Mentors, 78 (26.4%) of the mentors were their current teachers, 72 (24.3%) were college professors, and (69) 23.3% were science researchers.
    - 129 (43.6%) of the mentors were from Universities and 83 (28.0%) were from K-12 schools.

- 55 (13.4%) participated in an internship.

    - Of those 55, 36 (65.5%) of the internships were at universities.

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- 391 (81.8%) came from households in which a family member had a college degree (119 Doctorates, 108 Masters, and 109 Bachelors.)

- 316 (65.5%) were 15-16 years of age.

- 297 (72.3%) were first year participants.

- On average the students spent 276 hours doing the research for their projects and 59 hours working on the displays.

Addition analyses were conducted to refine the view of finalists from countries other than the United States.

The Crosstabs function and Chi-square tests in SPSS were used to explore differences by geographic group related to: participation in research classes and after school programs; having a mentor or an internship, community of origin (rural, suburban, or urban), and gender. In each category, finalists who did not respond were excluded from the analysis.

Finalists' participation in research classes, after school programs, work with a mentor, and internships are shown below by geographic area.

	Asia	Europe	Latin America	USA or Canada
Took a research Class	40.0%(12)	23.8%(5)	35.3%(6)	35.8%(142)
Participated in an After School Program *	55.2%(16)	45.5%(10)	41.2%(7)	28.4%(95)
Had a Mentor	89.3%(25)	61.9%(13)	61.1%(11)	72.6%(244)
Had an Internship	7.1%(2)	4.8%(1)	28.6%(4)	14.1%(47)

* Significant at the .01 level.

There were similarities in the data across geographic group. For example, having a mentor was the most common for all and internships was the least common for all. There were also substantial differences in the percent of finalists involved with each of the activities listed above. A higher percent of finalists from Asia reported taking a research class, participating in an after school program, and having a mentor than finalists from other areas. More finalists from Latin America reported having an internship. However, the only significant difference was participation in an after school program ($p < .01$).

Chi-Square tests were performed to determine if the proportion of finalists involved with research classes, after school programs, mentors, and internships varied by type of community (rural, suburban, urban). A significant difference occurred for Internships ($p < .05$). Finalists from Suburban and Urban areas were more likely to have an internship than those in Rural areas. Although there were no significant differences for research classes, after school programs, and mentors, they are included in the table below.

Type of Support	Percent and (Number) of Finalists Participating Rural	Suburban	Urban
Research Class	29.8% (36)	42.5% (65)	33.9% (42)
After School Program	28.2% (35)	27.6% (42)	39.8% (49)
Mentor	67.7% (84)	77.0% (117)	71.5% (88)
Internship *	7.6% (9)	18.2% (27)	16.8% (19)

The following table shows the percentage of finalists from rural, suburban, and urban areas. These proportions from each of the three classifications by geographic area of origin were significantly different at the .01 level. A large proportion of the finalist from Asia and Europe came from urban areas. The predominance of urban origins is less pronounced for the finalists from Latin American. Those from the USA or Canada were more likely to be from suburban and rural areas.

	Asia	Europe	Latin America	USA or Canada
Rural	16.7%(5)	5.3%(1)	29.4%(5)	33.9%(113)
Suburban	16.7%(5)	21.1%(4)	23.5%(4)	37.6%(150)
Urban	66.7%(20)	73.7%(14)	47.1%(8)	24.9%(83)

The data below indicates that finalists from USA and Canada were more likely to be female ($p<.02$).

	Asia	Europe	Latin America	USA or Canada
Percent Female	33.3%(10)	13.6%(3)	33.3%(6)	44.9%(150)

2. Career Choice

Students were asked to pick a career choice from a list. The top three career choices for all students were Medical, Science, and Engineering. A Chi-square test, performed using SPSS, indicated significant differences of Career Choice dependent on the type of project submitted. As expected, those who entered an engineering project were most interested in engineering careers and those entering math projects were more likely to have a math career preference and so forth. Finalists interested in a medical career tended to enter Natural Science projects. The top career choice categories for each of the project types are shown in the following table.

Top Career Choices		Project Type: Engineering	Mathematics	Natural Science	Social Science
22.9%	Medical	4	2	77	7
22.1%	Engineering	52	7	27	3
21.7%	Science	8	6	67	3
5.6%	Technology	14	3	4	0
2.9%	Business	4	1	6	1
2.7%	Math	2	4	5	0

A Chi-Square test also found a significant difference between the proportions of females and males choosing specific careers. Those significant differences are summarized in the table below. The choices are given as percents to accommodate the difference in the numbers of females and males. The numbers of females and males choosing each career are included as a gauge of magnitude.

Career Choice	Percent and (Number) Choosing: Females	Males
Engineering	14.2% (24)	28.1% (66)
Medical	30.2% (51)	17.4% (41)
Science	28.4% (48)	17.0% (40)
Technology	1.2% (2)	8.5% (20)

Females are more likely than males to choose careers in Medical or Science; whereas, males are more likely than females to choose careers in Engineering and Technology. The under representation of females in Engineering and Technology may be the result of the persistence of the inappropriate stereotype that those careers are the domain of males. That stereotype may affect the attitudes females have about careers in engineering and technology and deter them from pursuing those fields.

The Effect of Intel ISEF and Science Fairs on Career Choice

Students were asked to rate their agreement with three statements related to Intel ISEF, science fairs, and their career choices. The possible responses were 4=Strongly Agree, 3=Agree, 2=Disagree, and 1=Strongly Disagree. The table below shows for each statement: the mean and standard deviation, the percent marking Strongly Agree, and the percent marking either Strongly Agree or Agree. The statements are listed in rank order by their means.

Item	Mean (SD)	Strongly Agree	Strongly Agree or Agree
My work leading to Intel ISEF has made me more interested in pursuing a career that requires inquiry.	3.42 (.68)	52.1%	89.1%
My work leading to Intel ISEF has made me more interested in pursuing a career in Science, Math, Engineering, or Technology.	3.50 (.69)	58.2%	88.1%
(Doing science fairs) helped me to decide to pursue a career in Science, Technology, Engineering, or Mathematics.	3.33 (.76)	48.4%	84.2%

Analysis of Variance (ANOVA) was performed using SPSS to determine if any of 10 potentially important factors had a significant influence on finalists responses to the three items listed above. The ten factors were: type of project (team or individual), years participating in Intel ISEF (1-4), years of science fair participation (less than five *or* five or more), participation in a research class (yes or no), participation in an after school program (yes or no), having a mentor (yes or no), serving an internship (yes or no), type of community of origin (urban, suburban, rural), gender (female or male), and geographic area of origin (Asia, Europe, Latin America, or United States of America).

ANOVA found significant effects for two of those ten factors on the items related to career choice. 1) Finalists who entered individual projects responded more positively than those who entered team projects. Their work leading to Intel ISEF made them more interested in a career in inquiry and that doing science fairs helped them to decide to pursue a career in Science, Technology, Engineering or Mathematics. 2) Finalists who attended after school programs responded more positively that their work leading to Intel ISEF made them more interested in a career that requires inquiry.

The responses to these items indicate that the students' involvement in the science activities leading to their participation in Intel ISEF was a powerful motivator in promoting students to seek careers in science, engineering, and mathematics across all categories of students. Participation in an after school program and working on projects as an individual increases that effect. The Intel ISEF seems to be meeting its objective of motivating students to pursue science, math and engineering careers. Increasing participation in Intel ISEF and its affiliated fairs would have a positive impact on the numbers of students choosing these careers.

3. Science Fair Participation

The finalists in this year's fair indicated that science fair participation was a major influence on choosing a career in science, engineering, or math (See Section 2). This section addresses the question, what motivates students to initiate their participation in science fairs?

People as Motivators for Science Fair Participation

Finalists were asked about the importance of people in influencing them to participate in science fairs this year. Each category was rated as 4=Very Important, 3=Important, 2=Somewhat Important, or 1=Not Important. The table below shows the mean, standard deviation (SD), percent marking very important, and the percent marking either very important or important for each of the top five rated factors: The factors are listed in rank order by their means.

Factors	Mean (SD)	Very Important	Very Important or Important
Parents or Guardians	3.11 (1.02)	46.2%	73.0%
Current Teachers	2.99 (1.18)	48.9%	66.9%
Mentors	2.83 (1.23)	42.6%	63.3%
Past Teachers	2.47 (1.16)	25.5%	48.4%
Adult researchers	2.43 (1.23)	27.5%	48.4%

Parents/guardians and teachers were the top ranked people influencing science fair participation. To increase participation in Intel ISEF affiliate fairs, Intel might consider strategies for increasing and/or improving the dissemination of information about science fairs to teachers. Intel might also consider increasing/improving outreach to parents/guardians informing them of the benefits afforded to their children through science fair participation.

Mentors, past teachers, and adult researchers ranked 3^{rd}, $4^{th,}$ and 5^{th} in level of importance for influencing science fair participation. To increase participation in Intel ISEF and its affiliated fairs, Intel might consider ways to increase the number of connections between students and mentors or adult researchers.

An ANOVA found significant effects for 6 of the 10 investigated factors. Finalists who took either a research class (1) or an after school program (2) considered current teachers, mentors, and adult researchers more important than those who did not participate in any of those activities. Finalists who had a mentor (3) or an internship (4) rated mentors and adult researchers as more important than those who did not have mentors or internships. 5) Finalists from rural areas rated past teachers as more important than finalists from urban and suburban areas. 6) Female finalists considered parents/guardians as more important than males did.

Although they were not ranked in the top five, counselors (Mean = 1.57, SD = .93) and school principals (Mean = 1.68, SD = 1.01) were of interest because of the statistically significant effect ($p < .01$) of geographic area of origin. Finalists in Asia, Europe, and Latin America rated counselors and principals as more important than finalists from the United States of America.

Other Factors as Motivators for Science Fair Participation

Students were asked about the importance of other selected factors that influenced them to participate in science fairs this year. Each category was rated as 4=Very Important, 3=Important, 2=Somewhat Important, or 1=Not Important. The table below shows the mean, standard deviation (SD), percent marking very important, and the percent marking either very important or important for each of the top five rated factors: The factors are listed in rank order by their means.

Factors	Mean (SD)	Very Important	Very Important or Important
Enjoyment of science	3.59 (.66)	66.9%	92.0%
Future career opportunities	3.47 (.79)	60.3%	87.1%
Potential to win scholarships and awards	3.36 (.82)	53.3%	84.9%
Opportunity to attend Intel ISEF	3.35 (.96)	61.3%	80.8%
Improvement of my college application	3.25 (.96)	52.8%	78.3%

The finalists' enjoyment of science has the highest rated importance for participating in Intel ISEF, but the finalists also recognize that there are other potential external benefits to participation. The opportunities to win scholarships and rewards and to attend Intel ISEF were ranked 3rd and 4th of all the listed factors, outranked only by enjoyment of science and future career opportunities. This indicates that the rewards provided through Intel ISEF, both as scholarships and honors bestowed at the fair and the reward of being able to attend such a prestigious affair are powerful motivators to participate.

An ANOVA found significant effects for two factors. 1) Finalists who were in after school programs rated the opportunity to attend Intel ISEF and the enjoyment of science as more important than those that did not. 2) Finalists from rural communities rated the improvement of a college application as more important than those from urban and suburban communities.

4. Benefits of Science Fair Participation

Intel has the goal of promoting inquiry and project-based science teaching and learning in the schools. The following section looks at the effect of science fairs on students learning about inquiry and project-based learning.

<u>Knowledge and Skills Acquired Through Science Fair Participation</u>

A goal of Intel ISEF is to promote scientific inquiry in teaching and learning in the schools. In regard to that objective, students were asked to indicate their agreement with statements about what knowledge and skills were gained by participating in Intel ISEF and its affiliated fairs. The possible responses were 4=Strongly Agree, 3=Agree, 2=Disagree, and 1=Strongly Disagree. The table below shows the mean, standard deviation (SD), percent marking strongly agree, and the percent marking either strongly agree or agree for each of the six top rated factors: The factors are listed in rank order by their means.

Statements	Mean (SD)	Strongly Agree	Strongly Agree or Agree

I increased my knowledge of science.	3.76 (.48)	76.4%	95.6%
I increased my understanding of inquiry.	3.68 (.50)	68.9%	97.1%
I increased my ability to conduct inquiry.	3.67 (.51)	67.6%	95.8%
It helped me become a better communicator.	3.58 (.63)	63.0%	92.0%
It increased my overall confidence.	3.50 (.62)	57.2%	90.8%
It increased my knowledge of mathematics.	3.15 (.81)	37.5%	78.9%

The top ranked benefits all relate to increasing knowledge or ability regarding inquiry and science. These results indicate that Intel ISEF and its affiliated fairs are a powerful influence on learning about inquiry and project based science. In addition, the finalists also feel strongly that science fair participation makes them better communicators and more confident overall. Lastly, although only 7.5% of the finalists entered a mathematics project and only 2.7% are interested in a mathematics career; they agree that science fair participation has increased their mathematics skills.

An ANOVA found significant effects for four factors. 1) Finalists who took a science research class more strongly agreed that they increased their understanding of inquiry and that they increased their knowledge of science, than those who did not take a research class. 2) Finalists who had mentors were more likely to agree that they increased their understanding of inquiry and their ability to conduct inquiry. 3) Female finalists more strongly agreed that they had increased their understanding of science whereas male finalists more strongly agree that it increased their understanding of math. 4) Finalists from Asia more strongly agreed that they became better communicators and finalists from Europe less strongly agreed.

Sources of Knowledge and Skills Needed for Science Fair Success

Students were asked how important specific factors were in developing the skills and knowledge necessary to create an Intel ISEF Quality project. Each factor was rated 4=Very Important, 3=Important, 2=Somewhat Important, or 1=Not Important. The table below shows the mean, standard deviation (SD), percent marking very important, and the percent marking either very important or important for each of the top two rated factors. The factors are listed in rank order by their means.

Factors	Mean (SD)	Very Important	Very Important or Important
Science Classes	3.00 (1.02)	40.6%	68.8%
Family Members	2.84 (1.12)	37.2%	63.2%

Not surprisingly, Science Classes and Family Members were the top ranked categories. Teachers and parents are the people who encourage science fair participation and they are also the people who facilitate the acquisition of the necessary knowledge to succeed.

An ANOVA determined that there was a significant effect for gender with female finalists agreeing more strongly, than male finalists that family members were helpful in developing the skills they needed to make an Intel ISEF quality project.

Although they were not in the top ranked factors, science fair websites (Mean = 2.09, SD = 1.11) and science fair books (Mean = 1.93, SD = 1.11) are of interest because of the statistically significant effect ($p < .01$) of geographic area of origin. Finalists in Asia rated those two sources of information much higher than finalists from other geographic areas.

Other factors regarding the sources of the skills and knowledge necessary to complete an Intel ISEF quality project had the response option "Not Applicable", reasoning that these options would not be available for all students. The table below shows the mean, standard deviation (SD), percent marking very important, and the percent marking either very important or important for each of the top three rated factors for students who DID NOT mark NOT APPLICABLE. The factors are listed in rank order by their means.

Factors	Mean	Very Important	Very Important or Important
Mentor	3.64 (.67)	73.5%	94.7%
Research program at school	3.10 (1.00)	45.6%	73.8%
Internship	3.04 (1.11)	44.3%	72.1%

The data indicate that mentors are considered important factors in the development of the skills and knowledge of the finalists. Research programs at school were also listed in the top three. Increasing the accessibility of mentors and research programs in schools would further the goal of promoting inquiry and project based learning. An ANOVA indicated significant effects for one factor. Finalists who reported having an internship rated internship as more important than those who did not.

Finalists were asked to rate their agreement with statements related to Intel ISEF and their interest in science and inquiry. The possible responses were 4=Strongly Agree, 3=Agree, 2=Disagree, and 1=Strongly Disagree. The table below shows for the top five rated items: the mean and standard deviation, the percent marking Strongly Agee, and the percent marking either Strongly Agree or Agree. The factors are listed in rank order by their means.

Statements	Mean (SD)	Strongly Agree	Strongly Agree or Agree
Science fair participation has had a major positive influence on my interest in science.	3.68 (.57)	71.8%	93.7%
My work leading to Intel ISEF has made me more interested in inquiry.	3.53(.58)	56.2%	93.7%
Science fair participation has increased my technology skills	3.35 (.71)	47.2%	86.6%
I had access to experts to help me with my research.	3.12 (.94)	41.6%	76.6%
Science fair participation has had a major positive influence on my interest in math.	2.89 (.82)	25.1%	65.2%

These data show, once again, that science fair participation has a strong influence on interest is science and interest in inquiry. The promoting of participating in the scientific inquiry-based projects of science fairs could have a major impact on the level of students' interest in science. A positive influence on math was rated low relative to those factors related to science. Few projects are submitted in the math category, but most projects require the mathematics of statistics for data analysis.

An ANOVA determined significant effects for five factors. (1) Finalists who entered individual projects agreed more strongly, than those that entered team projects, that science fair participation has had a major positive influence on their interest in science. Finalists who took a research class (2) had a mentor (3) or had an internship (4) agreed more strongly than those who did not that they had access to expert to help them with their projects. (5) Male finalists agreed more strongly than female finalists that science fair participation has had a major positive influence on their interest in math.

Student Interviews

During Intel ISEF 60 finalists were interviewed using a structured interview protocol. In most cases, the interviews were audiotaped as the interviewer recorded major ideas on the interview form. The audiotapes were transcribed with the notes providing support to the transcriber in the event of garbled or inaudible words. The transcribed interviews were then analyzed for key components and those components synthesized into general statements of finalists' beliefs. Of the 60 interview conducted, 9 were with finalists from Asia, 9 were from Europe, 8 were from Latin American, and 34 were from the United States.

The Road to Intel ISEF

Finalists were asked how many science fairs lead to their participation in Intel ISEF. The mode of the responses was two with most students from foreign countries participating in a school and then a National Science Fair. Students from the United States typically competed in a school fair and then a regional fair, although variations occurred for both foreign and US students. Most finalists reported that their project for the current year was the same as, or at least on the same topic, as the previous year's project.

Regardless of the number of preliminary fairs, the finalists felt that participation in them helped them improve their science project in two ways. First, they received suggestions that enabled them to improve the project overall and second they had the opportunity to improve their presentation skills and the defense of their ideas. Finalist thought that other people's ideas helped them to narrow the focus of their projects and make them more concise. No one reported switching to a new project as the result of feedback, only improving on his or her current project. The finalists stayed with their initial vision but strove for higher quality.

Sixty-two percent of the finalists that were interviewed reported having mentors. This was 10 percentage points lower than the reported number on the questionnaire. The variation may be due to the lack of clarity regarding the definition of a mentor. Some of the interviewees mentioned that their teacher gave them all the help they needed and they did not need a mentor; whereas on the questionnaire, many students responded that they had a mentor who was their teacher. An alternative explanation is that there was a difference between the sample of students who responded to the questionnaire and those that were approached for the interviews.

A mentor could be a teacher, a friend or colleague of their teacher, a parent, or a coworker of a parent. Most finalists reported that they enjoyed working with the mentors and felt that the mentors helped them to learn the methodology and how to work equipment. Most finalists were quick to point out that it was still their project and although the mentor helped direct, the finalist did the work

Twenty-two of the interviewees did some work in a laboratory outside of their school. Ninety-one percent (20) of those 22 also had a mentor who either worked in the laboratory or had an acquaintance/colleague that worked there. The work completed in the laboratory varied greatly from working extended periods of time on a government run farm, to spending three hours to make some measurements, to having technicians at the lab test for antigens.

Finalists were asked about what made their project better than others. Many felt that the potential of their project to be helpful and valuable to others made it better that others. Others thought the uniqueness or new methods made it better. Others felt that their high level of knowledge about a project, that they had completed themselves, was the element that made their project better than the others. Others did not believe that their project was better than the others.

During the course of the interviews, 35% of finalists mentioned that their research could help other people and/or their countries. Finalists from every geographical group were included in the 35%. Variation between groups was relatively small with the percent of finalists from Asia saying their project helped people and/or their countries was 33%, finalists from Europe-44%, finalists from Latin America—38% and finalists from the United States—32%.

Motivation

The finalists were asked about the people and things that motivated them to participate in science fairs. The most common responses were family members, teachers, love of science, and opportunities that science fairs afforded them, especially Intel ISEF. These results are consistent with responses obtained on the questionnaire. In many cases finalists pursued topics related to the interests of their parents; considered their teachers motivators to enter the science fair; felt that work on their science fair projects, which was said to require much hard work and dedication, was related to their love of science in general or their project in particular; and that participating in Intel ISEF was a wonderful and enjoyable experience that allowed them to meet peers from around the world.

Finalists were asked about the benefits to be gained from participating in science fairs. Although Intel ISEF was not specifically mentioned in this question, responses seemed to refer to participation in Intel ISEF. Finalists saw the opportunity for travel, meeting students from other cultures, the possibility of scholarships and prize money, and overall having an enjoyable time.

Support

When asked about what it takes to be a finalist, most answered hard work, dedication, and a willingness to give up other activities to work on the project. Finalists felt supported by both their friends and other people at their schools, both students and faculty including administrators. However, that support seemed to be in the form of congratulations after winning recognition for their projects. It is unclear how people, other than those directly involved with a student and their project, supported the finalists during the creation of their projects.

Student Conclusions

Students see many benefits to Intel ISEF and are motivated by many factors to compete. However, the perseverance and level of commitment needed to create an excellent project may not be a natural occurrence for many. Teachers and parents need to capture the imagination of students to promote their curiosity, which may lead to an interest powerful enough to induce the commitment needed for success.

Part B: Teacher Perspectives

This section describes the Intel ISEF data collected from teachers. The first section discusses the Teacher Online Survey, which teachers answered after they returned from the Intel ISEF. The second section discusses the teacher interviews conducted at Intel ISEF.

Teacher Online Survey Likert Items

The evaluation team developed an online survey to collect data about the main goals of the Intel ISEF, other possible benefits of Intel ISEF, and recommendations for improving the program. Science Services sent an e-mail message to teachers who had students at Intel ISEF and the number of instant rejections was counted. The e-mail was sent to 913 e-mail addresses, of which, 78 bounced back, and with two who replied stating that they were mentors and not teachers. It was not possible to verify how many of these working addresses were actively used. There were 394 surveys completed, yielding a response rate of 47.3%, as compared to 46.7% in 2004.

Teacher Age Distribution		
20-25	9	**2.3%**
26-30	37	**9.4%**
31-35	39	**9.9%**
36-40	32	**8.1%**
41-45	65	**16.5%**
46-50	70	**17.8%**
51-55	65	**16.5%**
56-60	53	**13.5%**
61-65	18	**4.6%**
66-70	2	**0.5%**
71-75	0	**0.0%**
76-80	1	**0.3%**

Who are the Teachers?

Using the data collected and reported below, we have constructed a composite of the Intel ISEF teacher respondents, that we call Mrs. Jones, using averages and/or modes for the responses to the questions.

Mrs. Jones teaches in a suburban area in the United States. She has been teaching for 17 years and she appears to be in her upper 40s. She considers her ethnicity to be white. She is a certified biology teacher and she has a master's degree. She recently received professional development training on general teaching methods.

School Setting		
Urban	123	**31.2%**
Suburban	142	**36.0%**
Rural	113	**28.7%**
Not Reported	16	**4.1%**

Mrs. Jones has a strong interest in Intel ISEF and is proud of her finalist, and although she did not do any science fairs in her youth, she sees the value of participation as a teacher. This is her tenth year of doing science fairs. Her school does not have a special science research class, but it has a club, that she runs. At the regional fair where her students competed there were about 150 students.

Program Effects

Section 1 of the survey asked teachers for their opinions about Intel ISEF and the ways in which it affected their students and their teaching. Three items stand out because nearly all respondents answered them with strongly agree or agree. These items are presented below with the item's percentage of respondents strongly agreeing or agreeing, the mean, and the standard deviation. For comparison purposes, the results from the 2004 evaluation are included here and with other items of this section.

- Intel ISEF and its affiliated fairs encourage my students to pursue excellence in science, mathematics, and/or engineering (2005: 98.5%, x=3.75, SD=0.46 and 2004: 98.5%, x=3.72, SD=0.48).

- Intel ISEF and its affiliated fairs reward my students for excellence in science, mathematics, and/or engineering (2005: 97.2%, x=3.64, SD=0.52 and 2004: 98.2%, x=3.69, SD=0.50).

- Intel ISEF and its affiliated fairs motivate students to pursue careers in Science, Technology, Engineering, or Mathematics. (2005: 96.7%, x=3.50, SD=0.55 and 2004: 97.2%, x=3.58, SD=0.56).

These items are also significant because they address two of the three main goals of the Intel ISEF program. These goals are to: (1) encourage and reward excellence in student based research and (2) motivate students to pursue science, math, and engineering careers. From the respondents' perspectives, these goals are being met. These three items also had the most respondents answering strongly agree.

Two other items also had above 90% of the teachers agreeing or strongly agreeing and are:

- Intel ISEF and its affiliated fairs promote scientific inquiry in my school. (2005: x=3.50, SD=0.64 and 2004: x=3.44, SD=0.69).

- The administration in my school is supportive of my science fair related efforts. (2005: x=3.42, SD=0.69, 2004: x=3.36, SD=0.71).

Promoting inquiry is part of the third goal of Intel ISEF. The teacher respondents overwhelmingly (91.6%) agree that this is being achieved. Of the respondents, 90.6% of the teachers agreed that their work in science fairs is supported by their administration. This data can be important to inform other schools that wish to develop programs.

The next three items placed sixth to eighth in a ranking of percentage of respondents answering agree and strongly agree. A majority of respondents strongly agreed with each item.

- Because of the way I teach my classes, most of my students have the knowledge and skills to complete a satisfactory science fair project (2005: x=3.32, SD=0.66, 2004: x=3.36, SD=61).

- Intel ISEF and its affiliated fairs promote project-based science in my school (2005: x=3.41, SD=0.68 and 2004: x=3.39, SD=0.75).

- External competitions have had a positive effect on my teaching (2005: x=3.34, SD=0.69 and x=3.39, SD=0.64).

All three of these items relate to the third goal of Intel ISEF, which is to promote inquiry and project-based science teaching and learning in the schools. This goal is the most difficult to assess directly but these items present evidence that Intel ISEF may be serving a dual purpose of not only affecting the students who participate in science fairs, but also affecting the way teachers teach, thus providing a much larger impact for all students.

The next item with the most responses of agree and strongly agree relates to students working in an outside research lab.

- Students who work in an outside research lab have a competitive advantage over other students in Intel ISEF and its affiliated fairs. (2005: x=3.41, SD=0.68 and x=3.41, SD=0.77)

A large percentage of teachers strongly agreed with this item (56.3%). On the surface it appears to be a straightforward and intuitive conclusion that working in an outside research laboratory would help students. There is, however, the underlying issue from the 2004 evaluation, that some students, such as those in rural areas, do not have access to outside research laboratories, and these students therefore are at a competitive disadvantage.

It is also useful to consider the only items where the majority of teachers either strongly disagreed or disagreed, and these three items are presented below.

- Other teachers at my school have changed the way they teach science or mathematics because of Intel ISEF and its affiliated fairs (2005: x=2.40, SD=0.81; 2004: x=2.52, SD=0.79).

- Most science teachers in my school could effectively teach a science research class (2005: x=2.43, SD=0.86; 2004: x=2.48, SD=0.83).

- If there was no longer an Intel ISEF, but its affiliated science fairs continued, things would change in my school's science or mathematics programs. (2005: x=2.49, SD=0.88; 2004: x=2.60, SD=0.86).

A slight majority of the teachers disagreed that their Intel ISEF involvement affected other teachers at their school. This is an area that may warrant attention if the program is desired to have a broader effect on students. If there is a teacher who uses inquiry and project methods at a school with great success, what can be done to help other teachers, especially those not directly involved with Intel ISEF, learn different approaches to teaching?

A majority of the teachers also disagreed that most other science teachers could effectively teach a science research class. We make the assumption that these teachers believe they are capable of teaching this class. Part of this assumption is based on their success in having finalists; and from the data, in the next section, it suggests that they do believe they can help students prepare science fair projects. (It would, however, be useful to have this as an item next year to test this assumption.) We can only hypothesize where their level of expertise might have come from; areas such as work in previous careers, education, and/or the average of ten years of science fair involvement. It would be instructive to find out, where their expertise distilled from and to understand where they believe other teachers are lacking.

The third item above offers an interesting perspective on the relative importance of the affiliated fairs and Intel ISEF. A slight majority of the teachers (51%) disagreed and 47.5% agreed to the statement that if there was no Intel ISEF, but the regional fairs continued, that it would affect their school's science or math programs. As an analogy, this could be similar to asking coaches if the state championship for their sport was cancelled but league play continued; would it affect their sports programs? In a purely speculative way, we would estimate that at least three-quarters of the coaches would say "no" as few teams or individuals probably compete at the state level. Yet for coaches who frequently have teams or individuals at the state championship, it might affect their programs. Clearly the Intel ISEF teachers currently have finalists and in the past many have had finalists, but most indicate it would not affect their school's programs and only 13.2% indicated that they strongly agree with the statement. This line of reasoning leads to the question, are the affiliate fairs the really important part of Intel ISEF?

Responses to item 1.12, "If there were no longer any external science fairs, things would change in my school's science or mathematics programs," provides another facet of this question. Approximately 63% of the respondents agreed or strongly agreed to this statement (x=2.86, SD=0.93). Interestingly 28.9% strongly agreed with the statement, which is more than twice the amount for the item that hypothetically removed Intel ISEF but left the regional fairs in place. These differences of approximately 15%, do not strongly suggest that teachers view Intel ISEF as unimportant. They do suggest that they tend to view what happens locally as most important. Therefore, future evaluations may explore activities at the regional level.

Success Factors

In section 2 of the survey, teachers were asked about factors that contributed to ISEF finalist success. The highest rated items that respondents strongly agreed with as important factors in a student's success in Intel ISEF and its affiliated fairs are students' (1) work ethic (2005: 86.3%, x=3.87, SD=0.36 and 2004: 87.2%, x=3.85), (2) critical thinking ability (2005: 72.6%, x= 3.71 SD= 0.51 and in 2004 was not an item), (3) parental support (2005: 71.1%, x=3.68, SD=0.54 and 2004: 68.3%, x=3.63, SD=0.59), (4) communication abilities (2005: 69.5%, x=3.51, SD=0.69 and 2004: 97.2%, x=3.67, SD=0.54), and (5) science or mathematics teachers (2005: 59.9%, x=3.51, SD=0.69 and 2004: 64.8%, x=3.59, SD=0.62).

Rounding out the top ten items that were most strongly agreed to are: (6) internship/mentorship outside of school (58.9%), (7) technology resources (58.6%), (8) scientific and technological literacy (54.8%), (9) willingness to take risks (51.3%), and (10) intelligence (48.5%).

It is noteworthy that of the 15 traits listed, intelligence was ranked 10^{th} in percentages of respondents listing it as very important. These data suggest that teachers view doing a high quality science project as something that most students can be educated to do if they have sufficient motivation and willingness to work hard. The evaluation team also found it interesting that, although, in the 2004 interviews students mentioned the necessity of dealing with ambiguity; and so therefore we included it on the 2005 survey, this item received the lowest percentage of very important ratings (27.7%) among the teacher respondents.

Contributing Factors

Section three was newly created for this survey. It seeks to find factors that contribute to science fair success. This type of data may be of use to both nascent and established science fair programs.

Teacher respondents tended to view teachers as essential in motivating students to participate in science fairs (x=3.64, SD=0.58). Yet, they also believe that successful science fair students tend to have a great deal of support from their parents (x=3.47, SD=0.65). They also tend to believe that the successful science fair students have mentors (x=3.37, SD=0.79). With less fervor, they indicated that most of the mentors for the students were schoolteachers (x=2.95, SD=0.89). It is important to realize that the term "mentor" may mean different things to different people. Many people may consider a mentor to be someone outside of schools, yet teachers obviously view mentors as mainly occurring in schools. Teachers were divided about out-of-school mentors being easy to find (x=2.08, SD=0.70) and not being a realistic possibility for their students (x=2.15, SD=0.81). They were also divided on the perceived ease of placement of students in out-of-school research labs.

The teachers overwhelmingly believed that science fair students excel in their regular science classes (x=3.44, SD=0.62). They tended to report the support of other teachers at the school in their science fair work (x=3.10, SD=0.78). They generally expressed confidence in their ability to assist students in the development of excellent projects (x=3.43, SD=0.62). Yet, despite their confidence they generally believed that they would benefit from training on how to help students create excellent science fair projects (x=3.28, SD=0.70). They generally agreed that science fairs help to address standards or a country's curriculum (x=3.17, SD=0.82) and a bit less strongly that participation helped prepare students for university entrance exams (x=2.89, SD=0.79).

Potential Problems Ranked by Percent Indicating Very Difficult

Task	Very Difficult
Statistical analyses	35.8%
Choosing a problem	32.2%
Completing paperwork	22.1%
Analyzing data	15.0%
Getting accurate measurements	9.6%
Consulting literature	9.4%
Obtaining adequate controls	7.4%
Forming conclusions	6.9%
Finishing the project	6.6%
Developing hypotheses	5.8%
Identifying variables	5.6%
Preparing to explain their projects to judges	5.6%
Collecting data	2.8%
Creating display boards	2.0%

Student Difficulties

The following question was asked, "Think about all your students that worked on science fair projects this year. Please indicate how difficult the following tasks were for those students as they did their science fair projects?" In response the six items with the largest means were (1) statistical analysis (x=3.20, SD=0.72), (2) choosing a problem (x=3.17, SD=0.70), (3) analyzing data (x=2.87, SD=0.69), (4) completing paperwork (x=2.90, SD=0.78; with a tie for the fifth position (5) consulting literature (x=2.72, SD=0.71) and (5) getting accurate measurements (x=2.72, SD=0.69). Interestingly, there was only one item that the majority of teachers rated as easy: creating display boards (x=2.12, SD=0.67).

Teacher Online Survey: Open-ended Item

There were 315 individual responses to the open-ended item on suggestions to improve Intel ISEF and its affiliated fairs (out of a total of 394 surveys completed). Many of the responses were not suggestions but words of praise and encouragement for Intel ISEF, such as "I was too awed by the whole experience to offer a critique. This was my first ISEF experience" and "I really don't have any suggestions—Intel ISEF is a marvelous event that students and teachers love just as it is." We placed suggestions that were common into one or more groups to help see trends in recommendations, which are presented in the following pages. In reading through the recommendations there are several specific and general prominent themes. These are explicated below.

The Top Five Specific Suggestions

These top five specific suggestions are based on the relative number of respondents giving the suggestion in the open-ended portion of the survey. They are ranked in order starting with the most frequently mentioned. For example, the recommendation to reduce the complexity and amount of the paperwork was made by 49 separate individuals and 40 teachers suggested that research lab mentored projects be judged separately from home/school projects. Since 394 teachers answered the survey, this is 12.4% and 10.1% of the responders, respectively.

1) Reduce both the paperwork complexity and amount.
2) Judge separately projects done in research labs from school and home projects.
3) Provide better publicity about Intel ISEF and its affiliated fairs.
4) Improve the judging at the national and regional levels.
5) Increase the number of awards and spread these over a greater number of students.

It is illustrative to read a few sample responses for the most recommended suggestions. These are presented below for the first three items above.

1) Reduce both the paperwork complexity and amount.

> The paperwork is in need of reorganization. The process is extremely frustrating for students, teachers, and parents. In the past 15 years the difficulty of completing the reams of paperwork has increased.

Many teachers at my school were overwhelmed and unfamiliar with the many forms. I feel more teachers would support the fairs if they were more informed with procedures.

Reduce the amount of paperwork—it so too ambiguous/confusing for teachers and parents.

2) Judge separately projects done in research labs from school and home projects. (In addition to these, there were 13 additional suggestions about ways to improve getting mentors.)

I would make the playing field equal. It is very difficult for our students to compete against other students whose parents/ friends have connections with huge universities or labs. Real down to earth science is becoming neglected at ISEF.

Differentiate between mentored projects and non-mentored projects. Schools that are not located in urban areas are at a disadvantage, because they do not have access or transportation to research facilities.

I would change allowing students to work in research labs and the sort. It has gotten to the point that one wonders how much is the student's original work as opposed to completing a portion of a current research project that a graduate student would.

3) Provide better publicity about Intel ISEF and its affiliated fairs.

More advertisement; making the public aware of how important these competitions are to raising student's standards for themselves

Promote the fairs on the state level on the television. Promote the winners and their specific projects to finally change the silly TV commercials and educate the public that science fair projects are experiments not displays like a volcano.

More local recognition for the International Science Fair winners- The El Paso Times never printed the local winners from the fair had in Phoenix this year and we had winners.

The Top Five General Themes

The general theme category is for issues related to a certain area but where there are numerous different suggestions about the area. Therefore, if the item made the list of top five specific recommendations, it was not eligible for the general list. Items on this list are complex and have many parameters for possible comment; therefore, the inclusion of a theme on this list present what may be problems but that have no clear solutions. These items, presented alphabetically are: communication, funding issues/cost concerns, Intel ISEF fair logistics and helping students locate mentors.

Other Specific Suggestions

Besides the top five specific suggestions there were hundreds of other suggestions. In this section we present suggestions that were made by at least five people and that we feel are worthy of deliberation. They are not presented in ranked order.

- Increased focus on teacher training, especially, at the regional level.
- Student training and provide students with better feedback about their projects.
- Develop better linkages between Intel ISEF and universities and professional organizations.
- Revisit the categories

New Ideas with Possible Merit

After reading and comparing the 2004 comments and this year's comments, there are two new ideas that were only mentioned by one (different) individual, but they may have possible merit. So that they do not get lost in the Appendix (where all the responses are presented), they are presented below without commentary.

> The length of the program creates a major problem for the student and the teacher coming at the end of the year as it is. If one day could be cut out and the program moved to a Sat-Wed format, it would decrease the amount of missed time for many.

> After the awards ceremony, I went back to look at the winning projects but could not remember which projects had won and at what level. It would have been good for me if someone could have indicated on the project that they had won and the level!

> I would like to implement the possibility to get a (video or text) record about the fair.

Teacher Interviews

The teacher interviews provided additional opportunities to explore, in an in-depth manner, the views, ideas, and practices of classroom teachers. The selection of the teachers was random; however, it is probably not a representative sample of all finalist teachers because the selection was done from the pool of finalist teachers that attended and had either student finalists or observers, at the Intel ISEF. Nevertheless, the views of these teachers, many with seasoned Intel ISEF experiences, can inform the program.

A total of 34 teachers were interviewed. These teachers that are at Intel ISEF are experienced teachers with experience in science fairs (the fewest years were two but the majority had many more, including two with more than 20 years of experience). They have very positive views of Intel ISEF; their teaching is very much influenced by the standards, and they typically assign several projects for students to do over the course of a semester.

Why do you do it?

During our conversations with teachers it became very clear that working with students on science fair projects is a very time consuming endeavor. For example, when we asked what advice a veteran teacher had for a teacher thinking about being involved, her response was, "They had better be dedicated, it is not something you can give minutes to, [you] have to have lasting power, willing to be give up time, the rewards are not in money, it is seeing the child being successful." For many students, teachers are a critical part of the science fair formula.

We asked teachers why they are involved and we received an assortment of motivations, such as a belief in the program, a love of science, and seeing the benefits on students. Here are several responses to the question, “Why are you involved?”

> When you look at the students that are participating; you are looking at the future. I think the future is worth investing in, because they may develop medication, or operate on you or be making some decisions that affect your future
>
> I believe in the hands on approach and individual discovery; in our school, athletics seems to get it all—so this is the scientist football game if you will call it that.
>
> Now it is for the opportunities that are afforded for these students. I started out with my principal saying, “You will have all honors students entire the regional fair,” so a principal mandate started it. Last year was my first Intel finalist’s project. In the first 2 or 3 years we won a specialty award here or there, and as I went back looking at the projects and asking questions of other teachers, I started educating myself about what it takes to improve the caliber of the projects, etc. and each year the students did better because I knew more to guide them. After about 5 years I had a good handle on what it takes, but then I had to have the kids willing to do it. So it was another 3 years before I had a student that would do what I advised them to do and they did it and we ended up here.
>
> I am a teacher and now I am a Ph.D. student. I love to teach to the earth science, in scientific method. I also learn how too—so I am student and also teacher. Students in Taiwan cannot do the scientific project very well because the education is always fill-in the blank and cannot choose and the student has difficulty, especially girls—my school is a girl’s school. I think it is difficult to teach girls involve in scientific- they love to do something like literature or something- few girls can do scientific things for a long time.
>
> I love science and I love to teach kids science, and so, if I can get them excited about participating in it, I get excited about it.
>
> I like science fair, I like the competition, I like what is does for the kids in their confidence and I have kids that have done science fair projects and some of them go into science related careers and some of them do not, but it establishes a sense of confidence in themselves to successfully complete a project
>
> When I was younger and I did my first science fair project and my parents didn’t know how to do science fair projects, so they didn’t know how to help me and my teachers weren’t very forthcoming with the information in time to get it done. So from that experience I decided to get involved with science fair. I have come back and I am looking at research and doing research and doing a master’s thesis, I realized that it is part of helping the students do research, so it started small and got bigger and sort of helped students understand that research is part that needs to be included.
>
> It opens doors for students, this is the only thing that I know of that exists on a HS level to the student at the level it does. Students who participate in science go on to be much better college students, they are prepared for research, and they are prepared to write and better prepared to talk. Time and time again I have students come back from college and thank me for having had that opportunity because they go into freshman classes knowing how to do research, how to write a report, how to talk about and how to present themselves in a confident manner and many times are able to excel in areas and be identified as college students in excellence.

In one of the quotes above, one of the teachers mentioned that she got involved because her principal mandated it in her first year. In the subsequent ten years, she gained knowledge and experience, along with a passion for helping her students. It would be interesting, in future evaluations, to understand why other teachers *first* became involved.

Benefits

Teachers frequently described benefits of science fairs in their answers for why they are involved with science fairs. They were also directly asked, to name what are the benefits of science fairs to students.

> They learn doing their science fair project and see real science being done. Often students think everything has already been discovered—they learn that science isn't all out of the book—there really are new things to be discovered and they are part of the discovery.

> They enjoy it, it is a tremendous opportunity to the students, to see what research is about and investigate their own interests. It's a different perspective—everything isn't "canned" and kind of compartmentalized…. This is what education is all about, they can step outside that traditional classroom, try to enrich the experience.

> They have the opportunity to exchange information and to increase their knowledge and to learn science and they also get to compare what other students are doing.

> Huge responsibility for them, they have to do a lot of it on their own, they have to learn to organize, manage their time wisely and gives research abilities when they move on to college.

Skills for the 21st Century

The teachers were asked, in addition to general benefits, "How do science fairs prepare your students to be productive in the 21st Century?" Most of the teachers mentioned several ways, and as a group they described 22 categories, which shows that the idea of "skills for the 21st Century" is a general rather than specific construct. The most mentioned item, with eight teachers mentioning it, were skills or understandings specific to the study of science.

> By exposing them to the realities of research. It's pretty frustrating. Also, what the demands are, the amount of effort and time required, that sort of thing. Things they don't really learn at the high school level. Successful science is not instantaneous; it takes a little time.

The second most common response (6 teachers) was problem solving ability. A quote to illustrate this is presented below. In addition to this, two teachers mentioned creativity two others critical thinking, and one decision-making.

> It gives them such a huge problem solving ability and they go and have that question and go through the scientific method and solve any problem if they use it.

Another common response (5 teachers) was gaining skills in and an appreciation of technology.

> You really need to be comfortable with technology. Now working with science fairs, you need to type a paper, make a graph, use emails to contact your mentors, being able to fax things. When they get out of school these are skills that they are will need to be able to handle

> Science fairs are going to help in many ways, not only they learning new technology. Like a new graphing program—graphical analysis, just for their project. So now they are more familiar with another program. So now technology is available to them, especially when they go to college and the are faced with classes that they are required to do a graphing program and now they are more familiar with it.

Five teachers also mentioned communication ability. Most of these comments related to communicating their work to judges. Two teachers also mentioned the idea of developing the ability to defend your ideas and work. The quote below illustrates the idea of communication but it also is an example of a teacher's full response to this item.

> Gives them a boost of confidence because they can stand in front of a total stranger and convince that stranger that they know what they are doing and that it is their own work and not someone else's and the ability to problem solve and think on their feet, the creative thinking that has to go into designing, resourcefulness, how do I get the money for it, how to modify it, how to make it work, how to finance it. Perseverance. Commitment.

Resources to Succeed

We asked teachers what resources they have to help them succeed. The most common response, stated by 14 teachers, was access to a university. This connection was often for mentors, sometimes for questions of professors, and use of university facilities.

> We have some connections with the university and there are some mentors for kids who want to do research there. We have a library connection, internet connection is linked to the Minnesota State University library and they can go directly.

The second most common response (11 teachers) was access to mentors. It seems as though universities were the leading places to get mentors but they also came from industry and hospitals.

> I try to hook them up with some type of mentor in industry or college We are rural but we have a small college north of us and then we have state regional campus south of us and they both been helpful working with kids.

The third most common response was equipment (8 teachers) was access to computers. These teachers either specifically said computers or the internet or both. Another category that overlaps with the internet is access to Information Sources, such as the internet, database, or periodicals. Seven teachers described this as a resource to succeed. Seven teachers also mentioned the importance of science and laboratory equipment.

> Computer access, Internet access as well as getting to see the ISEF projects for the year- I provide them a list of ISEF projects that would catch the students attention in that branch of science

> Got a grant from Intel and Intel helped buy a lot of equipment that we needed for these kids to do their project and help fund the projects they were doing, We have a science club.

The Problem of Choosing Problems

The full inquiry experience is at the heart of the national and state standards. In a full-inquiry activity students choose the problem, design and conduct the investigation, and report the results. The selection of good problems is important for a student's success in science fairs, as well as a scientist's career. We asked teachers, "What process do you use to help students choose the problems they investigate?"

While, one teacher gave the response, "It just happens. I leave it up to them, it is not a formal process", others discussed ways of helping students to arrive at a problem. The most mentioned strategy was to get students to think about areas that they are interested in, such as hobbies, and then pursue some aspect of that for their projects. The following responses illustrate this approach.

> They have to come up with their own ideas, but the guidance I give them is: find something you are interested, investigate a hobby, investigate something you are familiar and relates to your world, sometimes not totally connected to any of those but something you want to know about

> That is the toughest part; I start this from the very first day of class. I say you are going to be working on this project the entire school year you had better pick a subject area you like. So they have to write down what they are interested in. I tell them science is in absolutely in everything, so don't try to look only in biology or chemistry. What is it, period, that you are interested in? Because you are going to find some science behind it, right? That is the homework assignment for the first day of school: list all the things you are interested in. Then we find an area to research in and choose an area—depending if they are working in a group or alone—and they narrow it down to a question that they are interested in. Then I take them down to the U of A and have them research that area; focus it as much as you can.

> Go through a process where they are asked to write down their hobbies and their interests, what they like to do in their free time. Then I ask them what do you want to know more about that hobby/interest? And how would you get the answer to that, and usually that leads them to questions…. Sometimes I give suggestions and there is a lot of modification for about a month

Frequently, to help students find something they are interested in, teachers would have them start exploring science in news, journals, and on the internet.

> Search science news and publications for current ideas. That is probably the source for the best ideas. You have books, the library for the kids that aren't as motivated as the ones that end up here. Pretty much the kids come up with their own ideas.

> Looking through current media and research and professional journals; picking up the scientific method, skim literature and what appeals to the kids- it is their curiosity, there is more to science than it would just be fun to do. It has to have significance. We spend 2-5 weeks investigating the ideas that they would be interested.

> Our school prepares an abstract book at the end of the year, I have a whole collection of them, I tell the students to read them. While at ISEF I will walk around and collect abstracts from these students, I have another book I put those in, I have several subscriptions to readable scientific magazines- Scientific American, Discover. I clip articles and put them in a big binder, give them that to read, if we ever win any money I buy books, so I have a core collection of books. We can also do Google searches.

One teacher described a peer-helping-peer approach to helping students find a good problem to investigate.

> I interview all my students, I have about 150 students and I find out how many have done science fairs, and some have never had, I have them interact and if they have had successes then I put the other kids with the successful students My goal is to get kids thinking outside of the box and outside of the textbook and then we do practice labs and give them a feel for if they would like it and that might be the direction that they might like to go

As many of the above quotes illustrate, it is obvious that the teachers would often help students modify their ideas for projects to become successful projects.

> I might reject the project if it is not feasible. A kid may say they want to study cancer in various families in New Mexico and unless they have some idea of what a database is and some idea of who to talk to then I say you probably can't do that. Or some kids might want to find out how fast you can heal after you cut yourself; and I will say I am sorry you can't do that but lets look at regeneration in what areas. You can redirect usually, otherwise it is the same old, same old ideas.

We purposefully asked the teachers if they ever just gave the problems to the students to work on. Out of all the responses that were clear, as no and yes, 39.2% of the responses were no and 60.8% were yes. A few teachers went on to clarify their answer.

> I did that this year, first time, because we had kids that weren't traditionally honors students. We have a lot of Hispanic kids that don't necessarily feel that they fit in. There were two girls who couldn't come up with an idea, so I gave them a project that I told them I wanted to see done, and they came in first for the regional team projects.
>
> Sometimes that happens, but you know, I am okay with that because what is important is that once they get the problem. Sometimes somebody can't think of something original and they need that extra boost, and that is fine because they are still going to do science and that is what is important.
>
> I always have project in reserve.

One teacher explained her "no" response.

> They don't always give you the high research methodology that you look for but I have never had kids, when you approach it like that, that we can't come up with something, I have had kid do all kinds of topics.

Successful Schools

We asked the teachers, "What is it that makes schools successful in producing Intel ISEF finalists?" The answers ranged from administration support, a culture for success, parental involvement, to having science research classes. Fifteen of the teachers mentioned the importance of teachers in a successful school. Aspects of this were that the teachers had to be willing to "go the extra mile," that had to be able to motivate the students, and that had to be knowledgeable about science fairs.

> The school has to have certain teachers, a teacher that believes in and takes ownership of it because some teachers are oblivious and go along with it but not totally involved but they are there to help the student the whole way

Ten of the teachers commented about the importance of a school's support for this venture. Many of these comments described the importance of the school's administration in this support. Others comments mentioned the importance of a school's culture and the support of other teachers. .

> First of all supportive administration- it isn't easy getting someone to support you, you need support School has to believe that it is important

Six of the teachers commented on the students. These responses included the ideas that students have to be willing to work hard, they have to be well trained in science, it helps if they can see top projects, and they have to have initiative

> Kids that want to work more than the average Joe, there are very few people that I have found that want to go to the higher levels

Five of the teachers commented about the importance of having mentors for the students. In one case a teacher spoke of herself as a mentor, however, in most cases, it seemed as though the teachers were referring to out of school mentors.

> We have had finalists for the last 4 years- Mentors make the difference, you when you have a mentor you have access to a lab and make better projects

Four teachers comment on the importance of parents. These comments focused on parents as motivators, rather than as mentors or givers of information. Four teachers also mentioned the value of having science research classes.

> The schools that have a science research class and tend to produce the best projects- [with] guidance on daily basis. The biggest factor is the science research class and proximity to a university. [And] teachers who know what is required and are willing to put in the time and effort to facilitate the projects.

Science Research Class

The last question, teachers were asked, was to explain the differences between what they do in their regular classes and what they do in their science research class or what they might do in a research class if they had one. The following answers are from teachers who did not have a research class.

> If I had a science research class I would be meeting individually with students and hearing a whole lot more from them, I would be giving them the freedom to do their own experiments. I would be working as a coach and not as an instructor and have a whole lot more fun.
>
> Each individual student would be doing his own project, still hooking up with some mentoring situation. I don't have the background and knowledge to help the kids with all that they would need.

> If I had a science fair research class I would have 10 kids here, right now. They [the students with her] are just coming out of the regular Ed classes. In a research class you could do so much more research.

The following answers are presented because they are detailed responses from teachers with research programs.

> Our research class is totally linked to science fair, we pick the topic, we research the topic, we do the outline and focus on the project together and then I supervise the project so at the end of the project that proves the hypothesis. In my other classes I don't have the one on one.
>
> In regular classes there is a specific topic so I can prepare a lesson on genetics for the entire class and I can do activities that the whole class can do. A regular class is about 15-20 students. I can design an activity that all those students interact with. In a research class you can't do that because each student is looking at a different topic. So I can't plan a lesson for those. In those classes, I am more a facilitator of: where are we at, what are we to do, what research do we need. To begin the year I do some classes in lab, so this week we are going to investigate what happens and how you write up the research background, how do you formulate your hypothesis, how do you support your hypothesis, how to you graph and analyze that?

Teacher Data Summary

The data obtained from the online survey and interviews, from teachers of finalists, reveal strong, positive feelings towards the Intel ISEF program. In the respondents' view the program does encourage and reward excellence in science, mathematics, and/or engineering, and it motivates students to pursue careers in these areas. The responses of the teachers indicated that students' work ethic, critical thinking ability, and levels of parental support were key factors in their success. The three biggest problems that students have with their projects are the statistical analysis, choosing a problem, and analyzing the data. In the open-ended section on suggestions the three most common specific suggestions were to: (1) reduce the paperwork complexity and amount, (2) judge projects done in research labs from school and home projects, and (3) provide better publicity about Intel ISEF and its affiliated fairs.

The teacher interviews gave more information about the teachers themselves and about their programs. The teachers are involved for various reasons that are related to a love of science and seeing the beneficial effects of the program on the students. The benefits ranged from really understanding how science works; to seeing other students' research; to the development of confidence and communication abilities.

Several ideas emerged from the interviews about why some schools are successful at producing Intel ISEF finalists. The schools have administrations and teachers that are supportive of doing science fair work. Having a science research class can really help advance the cause. Teachers who had a science research class were able to have students work on projects everyday and provide in-depth one-on-one guidance.

Part C: Regional Fair Directors' Perspectives

The purpose of the Regional Fair Director Interviews was twofold: (a) gather opinions and thoughts about Intel ISEF and (b) provide data to structure a Regional Fair Director Online Survey for future Intel ISEF evaluations. There were 21 Regional Fair Director interviews conducted, 87% were from the US and the remaining from Asia (1) and South America (2). In describing their regions, six indicated it was rural, four urban, one suburban, and 12 indicated it was a mixed region.

The Regional Fair Directors (RFDs) generally have a broader perspective about Intel ISEF than teachers or students. RFDs involvement may be connected with their occupation, but in general their participation is voluntary. Data suggests that this group has very positive attitudes about the Intel ISEF program. When probed for the benefits of Intel ISEF, RFDs focused on a broad range of topics, as reflected in the following two responses:

> Marvelous way for students to investigate aspects of science that maybe they just touched on in a regular classroom setting, so they can go more in depth on things and really provides them an opportunity to learn the scientific method and carry through on things they could study about if there had really been an opportunity to really do study on it, The opportunity to come to a large city, to meet students from other states as well as other nations, is a fantastic opportunity. We have two students that are with our group that have never flown on a plane before—it is a real leaning opportunity and really helps them mature as individuals, gain confidence.

> It is such an opportunity; I can't really put it into words. It really lets the students showcase their skills, but *the interaction* is just incalculable. They get to meet other students like themselves as well as the opportunity to see other scientists. The interaction with the judges is great. Then the panels that they have; last year they had a whole stage of Nobel Prize winners, even non-scientists like me, it gives us goose bumps. The students really see the possibilities. Having Sally Ride speak, one of my students wants to be an astronaut, so that was great.

Who were the Regional Fair Directors that were interviewed?

The regional fair directors came mostly from the United States with a sampling from other countries. They had occupations from four categories: (1) University/College Professors or staff (45%); (2) active or retired high school teachers (30%); (3) government or district non-teaching employees (15%); and (4) private industry (10%).

Levels of Student Participation

The RFDs seemed specific and comfortable providing estimates of how many students qualified for Intel ISEF and how many competed at the regional fair. However, the details on how many fairs a student had to compete in; how many schools were in the region; and how many students were in the region, were often unclear. It follows that the focus of the fair directors was probably on their own fairs, and not on how many students were in their region or how many students were doing science research projects in their region.

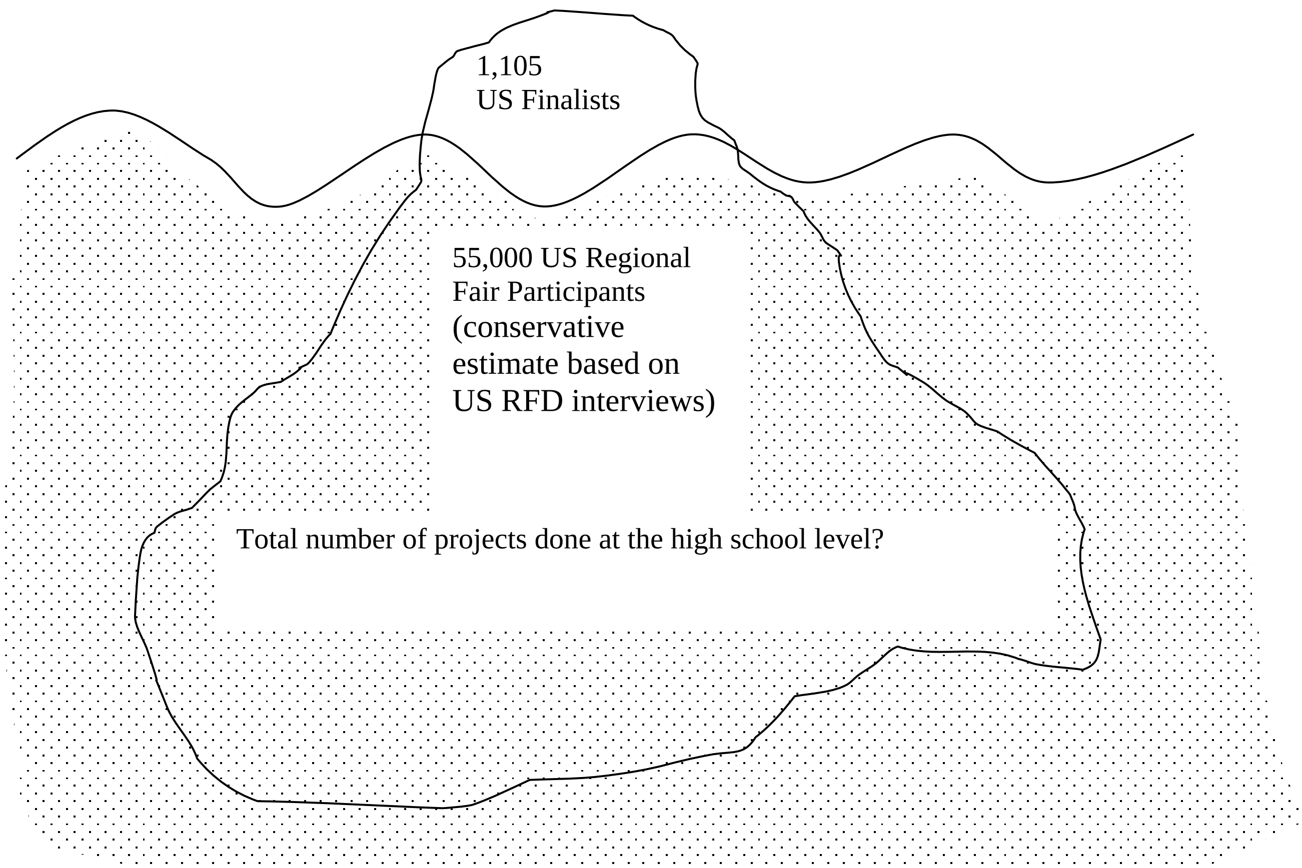
One U.S. RFD from a mixed urban/ rural region reported 250 students participated in his/her regional fair, but also clarified that only 50 of these students were at the high school level. There were thirty high schools in this region, with two finalists coming to Intel ISEF from it; which represents four percent of the regional fair participants. Delving deeper than the *crème de la crème*, it is worth knowing how many students were involved in doing science fair projects for possible entry into Intel ISEF. Even for this single case, this information cannot be directly derived from this data since it was not required that students participate in a school fair to enter the regional fair. In addition, the RFD did not know how many students were in the 30 high schools. In view of the fact that it was not required that students even enter or do well in a school fair, it is possible that the number of students (50) that entered the regional fair is the same as the total number of students who did science fair projects. While that is possible, several teachers reported that science fairs were required in their classes and some students doing projects might choose to not enter theirs into the regional science fair. So if we estimate that for every project entered, two were done, then in this region 100 projects were completed. If 100 students did projects out of 30 schools with a population estimated to be 1,000, that would mean that one third of 1% of the students were involved.

Similar numbers were reported by another RFD from an urban region with 12 public high schools and 12 charter schools. Again, students did not have to participate in a school fair to enter the regional fair. Their regional fair had 165 students, of which 125 were from the junior category. Assuming 1,500 students (a greater number because it is an urban area, but this is still a conservative estimate) per high school and 100 students doing projects, this means that yet again just less than one third of 1% participated (or 0.27%). Another RFD reported 200 schools in his/her region, but stated that only 10% of the schools participated in the regional science fair.

One international fair director had more precise numbers. He reported that there were 20,000-30,000 projects entered at the school level, where there are 6,000 high schools in the country; 10,000-15,000 at the division level; and at the regional/national level there were 100-150 projects with approximately 100-250 students. Ten individual projects and 6-8 teams, from the country, came to Intel ISEF. A different international fair director did not have that type of precise data. Three regional fairs were held that, through television advertisements had attracted 450 students. He was unaware of how many high schools that there were in the region.

Previous data suggests that Intel ISEF does both reward and motivate talented students to pursue work in science and mathematics. The tip of the iceberg is evident at Intel ISEF, where approximately 1,300 finalists gather. From our student survey 80% were from the U.S., so that would make 1,105 U.S. finalists. Inferring from our limited U.S. data it seems reasonable to suggest that for each finalist there were at least 50 students competing in a regional fair. (A typical fair sends 2 individual projects and one two-person project, and we are using an estimate of 200 high school students in the regional fair. The average size regional fair in the Teachers Survey was 150 students.) If this is true, the iceberg widens to an estimated 55,250 US students. (This number is a conservative estimate and does not take into account large US regional fairs that may exist and it does not take into account the large international numbers in the “iceberg.” For example, a recent article on China estimated that they alone had one million science fair participants.) Below this point, however, it is not possible with our data to estimate how many more students were involved. How many students did projects and presented them at school fairs? How many students did projects but never presented them beyond their classrooms? Obtaining this data would be extremely useful for evaluating the impact of Intel ISEF and for advertising and promoting that impact on communities across the U.S. and in the world.

If you consider activity at the junior high level as a function in preparation for the Intel ISEF, then the impact would be even larger. For RFDs disaggregating numbers for junior and high school divisions, the junior divisions were always far larger. For example, at a suburban/urban very large region there were 500 in the junior division and 186 in the high school division. (Incidentally, this combined fair also had 2,000 elementary school projects in this large region of 15 school districts



Iceberg Analogy: The US finalists are the tip of the iceberg in terms of the impact of Intel ISEF. Better data collection at the regional level would help Intel realize and communicate this broader impact.

Recommendations

Perhaps it is a reflection of their satisfaction with the program as there were very few RFD recommendations about changing the Intel ISEF program, beyond local logistics issues, such as housing for students. Three RFDS suggested paperwork as a problem, with one first-year director requesting more coaching on what to expect from the judging process. The following were each suggested by only one RFD: more visibility for the program in areas with high proportions of minority children, more encouragement for students to participate, and bring back the parade of flags at the beginning of the ceremony. One director suggested changing the judging categories and perhaps create different levels (AAA, AA, or A) to reflect the economic status and access to resources of different divisions. One RFD expressed concern about a judge belittling a student's work. Other suggestions were to do something to limit the costs for families; that the national organization should give assistance to local organizations, especially those starting out; and to give project approval prior to Intel ISEF. An international fair director suggested having an information binder for reference and improved website to assist in communication,

In response to the question asked on where the best place to live to qualify for Intel ISEF was, the answers did not suggest evidence that the regional fair directors were unhappy about the inequity of it being easier to qualify in some regions than others; and in fact, most did not state this. Some respondents commented that it does not matter where you live as long as you have an interest, and some commented that it is best to live near a university making it easier to get a mentor's support. Many interpreted the question as "what is the best place to live to win an award at Intel ISEF?", rather than focusing on getting *to* Intel ISEF and those directors holding this interpretation of the question generally indicated a few states, such as New York and Florida, as the best place to live.

A few regional fair directors commented that living in a rural area would yield the best chances as demonstrated in the following quote: "Some tiny little region where there is not a lot of passion for what they are doing and where their project, because it is creative and different, can come to the very top. I have seen paper towels come in from Montana—I don't mean to pick on Montana—it is just sparse and very spread out and you don't have 400 kids in a region." However, none of these directors seemed to have resentment for other areas, as they all seemed to be more focused on what occurs in their own regions.

The Role of Mentorships

The average percentage of students at the regional fairs that were thought to have worked in an outside research lab was 24.3%, with a standard deviation of 30.7. There is a wide range in these percentages as the standard deviation suggests. Two RFDs reported 100% and 95%, while two others reported 0% and 1%. This difference could result from unequal access to outside research labs or different philosophies on science fairs. When asked if working in an outside laboratory gives students an advantage, 68.7% thought it did; although, most of the responses classified as "no" were of the variety, "not necessarily."

Regional Fair Director Summary

The RFDs that we interviewed had strong positive views about Intel ISEF. They described student benefits from many different perspectives such as the chance to do inquiry, learn about science, interact with other students, and build confidence. The group did not provide many suggestions for changing Intel ISEF, which perhaps is another indicator of their satisfaction with the system as it is.

The results also suggest a powerful university link in the Intel ISEF system. Of the regional fair directors we spoke with, 45% had a university/college affiliation. Further the mentoring process, from the RFD viewpoint, seemed to be most often associated with universities.

Part D: Judges' Perspectives

To gather information from the Intel ISEF judges that might inform teachers and fair directors about factors that could improve student projects, judges were asked to complete an online survey. The online questionnaire consisted of Likert-type items as well as three open-ended questions. In addition to the questionnaire a small group of judges also participated in a panel discussion for teachers and a focus group. This section of the reports will be presented in two separate sections. Section 1 will address the online questionnaire and section 2 will address the panel and focus group.

Preview

Imagine an Intel ISEF judge talking to a group of High School teachers about how they can help their students produce high quality science fair projects. Based on the online survey, panel, and focus groups, the composite judge would be a male, still working in his profession (most likely in industry), after judging one year of Intel ISEF. The judge might be saying something similar to this: A scientific way of thinking is the most vital element to the creation of a high quality project. Critical thinking skills are necessary for scientific thinking and the creation of a successful project. Students need to clearly define the problem that is the focus of their research. They need to design a carefully planned experiment that will answer their question. After data analyses, critical thinking is about asking what was learned. Even a failed experiment can result in uncovering the next question to ask. A failed experiment is not a failure but a great learning experience and a springboard for asking another question or looking at the problem from another angle. Critical thinking is more than trying to find solutions; it is about finding ways to apply knowledge to similar situations, not being afraid of failure, thirsting for a deep understanding of how things work and a willingness to admit that learning is a continual process and not an end state. The most successful science fair projects are those in which the participants demonstrate these critical thinking skills; this is what makes scientists and engineers unique.

Passion and desire are also crucial elements. To create a winning project, the student needs to have curiosity, passion, desire and creativity. Projects created without passion and a person's unique creativity is often mediocre at best. When there is love and passion for a topic or project there is a creative energy that emanates and flows. The judges can sense this in the interview process.

The finalist must have ownership of and final responsibility for their research. A project must be the creation of the designer and as such, it is important that one takes ownership. Anything that is handed to another pre-packaged loses something. When one owns their project they nurture and cultivate it because of feelings of responsibility. It takes maturity and insight to realize this and most winners are more mature and insightful.

The Survey

An email, containing a request for participation and the web-link to the judges' questionnaire, was sent to 1,164 judges by Science Service. Ten emails were returned undeliverable. Of the 1,154 judges who presumably received the email, 715 (62.0 percent) responded.

Description of the Judges

Of those 715:

- 71.2% were male and 26.6% were female.
- 11.2 % are retired and 84.1% are still working in their careers.
- 75.9% were judging their first year.
- They judged a variety of categories and came from a variety of workplaces.
- 78.5% of the judges reported that they judged projects for one category only.

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Quality of the Projects

Judges were asked to respond to three items indicating their level of agreement with statements about the quality of the projects they judged at Intel ISEF with 4=Strongly Agree, 3= Agree, 2=Disagree, and 1=Strongly Disagree. Those statements ranked by the mean response are shown in the table below with the mean, standard deviation (SD), the percent that strongly agreed and the percent that strongly agreed or agreed listed for each item.

Statements	Mean (SD)	Strongly Agree	Strongly Agree or Agree
In general, the projects I judged were of excellent quality.	3.42 (.57)	45.2%	95.7%
There was a wide variation in quality between the top-tier and bottom-tier projects.	3.29 (.70)	42.9%	85.3%
In general, the projects I judges were inquiry based.	3.11 (.50)	18.0%	91.3%

A large majority of judges, 85% or higher, agreed to all three statements including that there was a wide variation in the quality of projects. However, the level of strong agreement between the first and last statements was somewhat striking. Whereas 45.2 percent strongly agreed that the projects were excellent, only 18.0 percent strongly agreed that the projects were inquiry based. This might be partially explained by the relatively large number of judges from engineering (24.3%). Engineering projects often take the form of a problem solving process in contrast to the scientific method of projects in other areas.

Differentiating Factors

The judges were asked to rate the importance of 16 factors in differentiating the top projects from the others with 4=Very Important, 3=Important, 2=Somewhat Important, and 1= Not Important. Those factors are presented in four separate subsets. In each group the factors are presented in rank order by the mean response accompanied by the mean, standard deviation (SD), the percent that considered them very important and the percent that considered them very important or important listed of each item.

Subset 1. Seven of the 16 factors corresponded to aspects of the scientific method and the quality of the data collected.

Factor	Mean (SD)	Very Important	Very Important or Important
Methodology	3.49 (.61)	53.8%	93.8%
Quality of Data	3.43 (.63)	49.7%	91.5%
Data Analysis	3.37 (.66)	45.7%	89.9%
Hypothesis	3.17 (.74)	35.4%	81.8%
Problem Selected	3.09 (.80)	33.1%	77.6%
Theoretical Framework	2.94 (.72)	20.8%	73.7%
Literature Review	2.73 (.77)	15.2%	60.2%

The methods (which include the collection of data), the quality of data, and the analysis of data are ranked as the top three factors in differentiating the best projects from the rest. This result can be interpreted in multiple ways. For example, because Literature Review was ranked as the least important, we might assume that the literature reviews in general are of equal quality between the best and the rest. Or, we might assume that when the judges are ranking the projects, they give more emphasis to the factors related to data and less to the others.

Subset 2. Two of those 16 factors related to the use of the research beyond the project.

Factor	Mean (SD)	Very Important	Very Important or Important
Findings expanded scientific knowledge	3.03 (.83)	32.0%	73.1%
Potential of results to be used by others.	2.82 (.92)	27.1%	61.6%

The utility of the project to others and the expansion of scientific knowledge were not rated as highly as the factors from Subset 1 related to data. Although the usefulness of the results of inquiry is an accepted concern, it does not rank highly in the process of differentiating the best projects for the others.

Subset 3. Four of those 16 factors related to the presentation of the project.

Factor	Mean (SD)	Very Important	Very Important or Important
Oral Presentation	3.18 (.76)	37.6%	80.3%
Visual Display	2.65 (.77)	12.9%	56.7%
Written Report	2.60 (.82)	12.2%	56.5%
English Language Skills	2.14 (.91)	7.0%	34.4%

The oral presentation was ranked far higher than the other factors in this group. The oral presentation provides the finalists the opportunity to demonstrate their knowledge relates to the projects and provides the judges with the opportunity to obtain information that may not be apparent on the visual display.

Subset 4. Three of the 16 factors related to the availability of outside assistance.

Factor	Mean (SD)	Very Important	Very Important or Important
Access to outside mentors	2.41 (.90)	11.2%	46.3%
Access to outside research labs	2.30 (.94)	11.3%	40.7%
One of more parents working in scientific or technical fields.	1.85 (.92)	5.0%	25.1%

The group of factors related to the availability of outside assistance proved to be the least important in differentiating the best projects from others. However having an outside mentor or working in an outside research lab was considered important or very important by more than 40 percent of judges. The interpretation of these data is difficult. It is not clear if the judges were aware that outside mentors were involved with the projects.

Quality of Judging

Judges were asked to respond to three items indicating their level of agreement with statements related to the quality of judging at Intel ISEF with 4=Strongly Agree, 3= Agree, 2=Disagree, and 1=Strongly Disagree. Those statements are shown in the table below with the Mean, Standard Deviation, the percent that strongly agreed and the percent that strongly agreed or agreed listed of each item.

Statements	Mean (SD)	Strongly Agree	Strongly Agree or Agree
Intel recruited high quality judges.	3.38 (.56)	40.3%	94.1%
I agree with my group's selection of the top project.	3.40 (.65)	47.6%	91.2%
I would judge for Intel ISEF again.	3.67 (.56)	70.6%	95.1%

The judges evaluated themselves and their colleagues high with widespread agreement that they were quality judges and that there was some consistency in the judges' opinions about the selection of the top projects. The Intel ISEF experience must be very rewarding for judges, 95% agreed that they would like to judge for Intel again.

Judges were asked to respond to three items indicating their level of agreement with statements related to the quality of judging at Intel ISEF with 4=Strongly Agree, 3= Agree, 2=Disagree, and 1=Strongly Disagree. Those statements are shown in the table below rank ordered by means with the Mean, Standard Deviation, the percent that strongly agreed and the percent that strongly agreed or agreed listed of each item.

Statements	Mean (SD)	Strongly Agree	Strongly Agree or Agree
Students with access to outside research labs generally had better projects than other finalists	3.04 (.76)	29.4%	73.3 %
It was easy to determine if students had an out of school mentor.	2.94 (.71)	20.7%	74.1%
It was easy to determine how much work was done by the student.	2.84 (.65)	13.1%	70.7%

About three-fourths of the judges agreed that students with access to outside research labs generally had better projects than other finalists, and that it was easy to determine if a finalist had a mentor and how much work was done by the mentor.

In their focus group, judges commented that they asked questions of the finalist to be sure that they understood their projects and were not reporting the results from a mentor or lab.

Attributes for Success

The judges were asked to rate the importance of seven finalist attributes for being successful at Intel ISEF with 4=Very Important, 3=Important, 2=Somewhat Important, and 1=Not Important.

Factor	Mean (SD)	Very Important	Very Important or Important
Critical Thinking	3.72 (.51)	73.3%	96.1%
Creativity	3.63 (.56)	66.6%	95.0%
Curiosity	3.63 (.58)	67.0%	94.1%
Perseverance	3.60 (.58)	64.1%	94.7%
Intelligence	3.29 (.61)	36.5%	92.0%
Communication Skills	3.20 (.71)	35.9%	83.0%
In-depth Knowledge	3.07 (.71)	28.0%	77.8%

All of the factors were rated of relatively high importance. The judges perceive that in-depth knowledge is not as important as critical thinking. This may be an indication that creating an inquiry project goes beyond basic knowing and involves the higher order thinking skills.

Open-ended Items

The judges' questionnaire also included three open-ended items. As the items were read, categories of responses were identified and the responses were then sorted into those categories and counted. The top categories for each of the open-ended items will be reported here.

Open-ended Item 1

Judges were asked to complete the following statement: "Most Intel ISEF finalists could make their projects better by…" The table lists the nine categories resulting from the analysis and the percent of judges with a response in each category.

Category of Response	Percent of Judges in Category
Methodology/Critical thinking	**35.2%**
Content clarity of the presentation	**26.2%**
Communication and presentation skills	**10.3%**
Practical Applications	6.4%
Innovative topics/Creativity/ /passion for topic	5.5%
Categorization	4.8%
Other/ General/Don't know/Great job	4.3%
Mentors/ outside resources	3.9%
Expectations for quality projects	3.2%

The top category in this group related to the methodology and critical thinking. Judges responses in this category referred to: thoroughness of the methodology, lab notes, analysis of the results (e.g., does it conform to current theory), and making the process used apparent on the display. Over one third of the judges had a suggestion that fit this category.

The second category of responses was labeled, "Content clarity of the presentation". Judges initial introduction to a project is through the display. Judges' responses in this category referred to: making displays complete, organized, clear, and concise without a large amount of unneeded information. The judges seemed to think that the backboards needed to be easier to read and focused on the important aspects of the project. Their comments referred to spelling and grammatical typos, overly fancy or too small fonts that were difficult to read, titles that were creative (cute) but that did not convey the essence of the project, overly complicated visual displays (tables and graphs) that were difficult to follow, and poorly presented data analysis results. Some judges also thought that the displays did not always convey the complexity, or lack of complexity, of the project. One judge said that the results of their prejudging had to be thrown out after talking to the students and learning about their research.

The third category of responses was titled, “Communication and presentation skills”. Judges suggested that “canned” oral presentations were not what they were interested in. They would prefer that the finalists provide a brief overview of their projects and then have time for the judges to ask questions. Some said that some finalists were unable to deviate from their planned speech and were not prepared to answer the judges’ questions.

For the students to be able to answer questions about the project, the judges suggested that they need to understand the broader context of their projects, understand the basic underlying scientific principles, and know what research has been done before and how their project fits into it. The judges thought that this lack of the underlying principles was evident when questioning students about their project. They might have thoroughly understood what they had done, but had little if any knowledge about the big picture in which their project fit.

Judges also thought that the finalists did not understand or use the correct data analysis procedures for their projects. Finalists were able to state the results of the analysis but were unable to explain the why a particular analysis was used.

Open-ended Item 2

Judges were asked to respond to the prompt: “The one thing that separates the best projects from the others is…” The table below lists the ten categories resulting from the analysis and the percent of judges with a response in each category.

Category of Response	Percent of Judges in Category
Scientific method and in depth understanding	**31.3%**
Unique topic / approach to topic/creativity	**14.5%**
Student Initiated/ originality/curiosity/passion for project	**13.1%**
Quality of student’s research/ work / research based	9.0%
Practicality/ real world applications/	8.1%
Clarity / thoroughness/ effort and time	8.1%
Access to resources/access to mentors/advisors	5.1%
Maturity level of student/ skills of the student	1.6%
Other/Don’t know/ no one answer	2.1%
Communication/Presentation	6.4%

The top category for these responses was “Scientific method and in depth understanding”. In depth understanding of the topic allows finalists to better understand their own projects. Only a shallow understanding of a problem is possible without an understanding of the larger context. A deeper understanding of past research provides a basis for critical analysis and focused problems. This would also help the finalist to understand how their project is adding to what is already known. A thorough review of the literature would be one source of background knowledge.

Judges commented on data analysis techniques and the amount of data that was collected. They felt that some finalists used an inappropriate data analysis procedure or that they did not collect enough data. They felt that additional rounds of data collection would increase the validity of their findings.

The second category of responses was unique topic/approach to topic/creativity. Judges thought that the best projects were innovative and creative. The best projects tend to focus on something that has not been tried before or that is a creative extension of previous work. Some judges felt that some projects were the same old thing adding nothing knew to what is already known. They recommended that an adequate literature review would help finalists put their projects into a context of what is already known and where research needs to lead.

The third category of responses was "Student Initiated-originality-curiosity-passion for project". Judges were impressed with finalists who exhibited a high level of personal excitement about a project. Those finalists might tend to be those who had designed a project in which they were personally interested, rather than doing a project suggested by another. Some judges felt that students who worked on their own with little outside help were more likely to develop enthusiasm for their projects. Their passion drove their efforts for the research and was in turned fueled by those efforts.

Open-ended Item 3

Judges were asked to respond to the prompt: "Intel ISEF could be improved by…" The table lists the nine categories resulting from the analysis and the percent of judges with a response in each category.

Category of Response	Percent of Judges in Category
Judging and scoring issues	**31.1%**
Time Constraints/scheduling issues	**14.4%**
Other/ great job/nothing	**13.7%**
Categorizes/sub-categories	**12.6%**
Set up/organization/procedures	11.3%
PR/promotion of science fair/outside mentors & promotion	7.7 %
Chairs/seating/comfort/ food services	5.5 %
Other services/interpreters	3.3%
Multiple dissatisfaction/rude staff/ facilities	.2%

The top category of responses dealt with the scoring process and other issues related specifically to the selection of the top projects. There were concerns about the "new scoring spreadsheet" not working out well, being somewhat confusing, and needing large fonts to be readable. Judges also said that there was some confusion about the caucusing activities.

Some judges voiced a need for setting up better review procedures to possibly avoid misunderstanding in the judging process. For example, when judges divided into multiple groups to do an initial survey of the projects, some finished much more quickly than others and some did not understand the process they were following. Other judges, who have judged in more than one category, stated that different groups used different processes and that making all of the evaluation processes the same would be fairer. Some judges suggested that they could be better prepared to judge the projects if they were provided with the abstracts, possibly on a website, so that they could be reviewed before the event.

The second ranked category dealt with "Time/Scheduling Issues". Two main concerns were the short time allowed to thoroughly evaluate the projects. Suggestions related to that were to lengthen the interviews to 20 minutes and to allow the judges extra time to look over the projects prior to the commencement of the formal judging.

Others suggested that judges needed to have a tighter schedule with less dead time. They suggested optimizing check-in and training so there was less waiting between activities. They thought that their time should be spent reviewing projects, interacting with the participants, and discussing results. Any other time should be absolutely minimized.

A number of people commented on how hard it was to read the judges' schedule. They suggested that a schedule that clearly indicates what is mandatory and what is optional for each separate kind of judge (Special vs. Grand) would be helpful.

The third ranked category dealt with the great job that was done this year. Judges praised the organization of the overall fair, the logistics of their activities, the Thursday evening photo sessions, and the food. These judges tended to have no comments for improvement, just praise.

The fourth ranked category dealt with the categorization of the projects. Some judges thought that project categories were too wide to effectively judge the projects. For example, when a category has over 100 projects in it, it is impossible to comprehend them in depth and judgments are made on superficial knowledge of the projects. One judge questioned why there were 13 categories for science and only one category for engineering, when it was a science and engineering fair.

Judges also suggested having two tiers of projects, those completed entirely by the finalist and those completed with the help of mentor working in the field of science. Projects completed without outside mentoring or laboratory help did not shine compared to cutting edge research conducted with the help of a scientist. Other judges recommended that all students need to have outside help in the form of a mentor, someone they could talk to about their projects and who might provide some of the underlying scientific knowledge and data analysis recommendations.

Judge's Panel and Focus Group

During Intel ISEF, four experienced judges conducted an open panel discussion attended by teachers and others attending the fair. Immediately after the panel discussion, those judges participated in a focus group during a luncheon buffet. The conditions of the focus group were the best that could be arranged in the busy schedule of the judges. This section will provide brief summaries of the main points judges made in answering questions from both the panel and the focus group.

Judges were asked about any trends that were apparent in projects over the years. They thought that:

- The quality of projects was going up and the projects were much better.
- Projects are becoming more sophisticated; some seem to be at the Ph.D., not the High School level.
- Every so often there is an unbelievable project that amazes and humbles the judges.
- There were more projects being conducted at major universities in the US, Europe, and Asia than in past years.
- In the health and medicine category there were more projects dealing with alternative, non-western medicine.

Judges were asked how projects at regional fairs compare to projects at Intel ISEF.

- The quality of the projects at Intel ISEF is much, much higher.
- These are the top projects from fairs around the world. The higher quality is very, very obvious.

Judges were asked how they weigh students' work when there is a disparity between those with access to considerable resources and those who do not.

- Working in a laboratory does not insure that a project will win; methods and so forth must be good.
- Work completed in a bigger laboratory probably does have an advantage.

Judges were asked if a finalist has worked in a laboratory, how do they distinguish what the student has done and what others have done.

- Understanding the project is most important. When you are talking to a student and they do not understand what an apparatus they used can do or give clear descriptions of the process, you can assume that they did not do the work themselves.
- Sometimes students working in university labs are part of a team and are not the scientist who comes up with a great idea of interest to them. That usually comes out in the interviews.

Judges were asked about the importance of the verbal presentation.

- Many presentations sound canned and they seem like they have been coached. A conversation between the judge and the finalist is better. You get to hear about their ideas, things that worked and those that did not, how they made sense of the results, and so forth.

The judges were asked if they were ever surprised or disappointed when interviewing a student after they had reviewed their display and paperwork.

- Sometimes the abstract leads you to believe it is not a very good study and then you go and talk to the students and realize it is much more that you had thought.
- We do not get fooled by abstracts anymore. They are full of wonderful words like "treatment for cancer". We go right to the methodology to look for the value of the project.

Judges were asked what advice they would give to teachers to improve the overall quality of their students' projects.

- Have a well thought our and clear hypothesis and problem statement.
- Make sure they do what they were trying to do and make the explanation of those two things very clear.

Summary Related to Student Projects

Critical thinking skills are vital to doing research. A focus on inquiry and the scientific process should be the context for learning those skills. Science fair classes need to provide not only the time and resources to create projects but should also guide students in applying their critical thinking to their research.

Ideally, students should be working on projects of their own imagination and curiosity. A project assigned by a teacher or conceived by a mentor is not likely to ignite the passion needed to maintain the persistence to complete a high quality project.

Students need to have a solid understanding of the topic of their research. Without that knowledge, the student if not likely to have the deep understanding that will guide the methodology of the research and inform the results.

Part E: Conclusions and Recommendations

On the surface, Intel ISEF is a world-class event with impressive participation and projects from students in the United States and other countries of the world. Probing deeper into the perspectives and experiences of students, teachers, judges, and regional fair directors reveals more of the magnitude of the program.

Achieving Goals

Intel's three Intel ISEF goals are (1) to encourage and reward excellence in student-based research; (2) to motivate students to pursue science, math, and engineering careers; and (3) to promote inquiry and project-based science teaching and learning in the schools. The evidence from this evaluation suggests that all three goals are being met. Of the goals, the first two appear to have the most powerful supporting evidence. While a variety of data sources all point to the same conclusion, the support of goal one can best be illustrated from the online teacher questionnaire, where 98.5% of the respondents agreed or strongly agreed with the item, "Intel ISEF and its affiliated fairs encourages students to pursue excellence in science, mathematics, and technology." On the judges' survey, 95.7% of the respondents agreed or strongly agreed that the projects were of excellent quality.

The evidence also suggests that Intel ISEF motivates students to pursue science, math, and engineering careers. About 97% of the teachers agreed or strongly agreed with this statement, "Intel ISEF and its affiliated fairs encourage my students to pursue excellence in science, mathematics, and/or engineering."

In the student questionnaire, more than three-quarters of the students agreed or strongly agreed with the following items that their work leading to Intel ISEF made them (a) more interested in pursuing a career in science, mathematics, engineering, or technology (88.1%), and (b) more interested in pursuing an occupation that requires inquiry (89.1%). Of the finalist respondents 75.0% percent indicated that they were interested in pursuing a STEM career (including medical) with 22.9% choosing Medical as a career choice, 22.1% Engineering, 21.7% Science, 5.6% Technology, and 2.7% Math. Only 9.0% indicated that they were undecided about a career.

The third goal also appears to have been met. The projects on display are a testimony to inquiry and project-based science being done. On the judges' survey, 91.3 % of the respondents agreed or strongly agreed that the projects were inquiry based. These projects were typically part of a class or school requirement or program. In the online survey 91.6% of the teacher respondents agreed or strongly agreed that Intel ISEF promoted inquiry in their schools and 89.1% agreed or strongly agreed that it promoted project-based science at their schools.

Impact on Teaching and Learning

Moving past the stated goals for Intel ISEF, we also explored whether Intel ISEF was influencing what happens in classrooms. About two-thirds of the teacher respondents agreed or strongly agreed that their involvement with Intel ISEF had changed the way they teach and 89.1% agreed or strongly agreed that external competitions had a positive impact on their teaching. At a school wide level, however, the effects are not as strong.

When faced with the possibility of removing Intel ISEF but not the affiliated fairs, 47.5% agreed or strongly agreed that it would affect science or mathematics programs at their school. When asked if all science fairs were gone, 63% agreed or strongly agreed that it would change their school's programs.

Yet, in the survey of high school students, 50.9% indicated that their school had a science research class or science club. These data suggest that Intel ISEF is influencing what happens in the classrooms of participating teachers and some programs at their schools. Whether that impact spreads beyond participating teachers should be investigated further. Just less than half of the teachers strongly agreed or agreed that Intel ISEF had affected how other teachers in their school teach science or math.

Factors in Success

When asked about what it takes to be an Intel ISEF finalist, most finalists answered hard work, dedication, and a willingness to give up other activities to work on the project. Finalists felt supported by both their friends and other people at their schools—students, faculty, and administrators. However, that support seemed to be in the form of congratulations after winning recognition for their projects. It is unclear how people, other than those directly involved with a student and their project, supported the finalists during the creation of their projects.

When teachers were asked which factors influenced the success of Intel ISEF, the top four factors listed with the greatest percentage of strongly agrees were (1) work ethic (SA= 86.3%; x=3.87), (2) critical thinking ability (SA= 72.6%; x= 3.71), (3) parental support (SA= 71.1%; x=3.68), (4) communication abilities (SA= 69.5%; x=3.51), and (5) science or mathematics teachers (SA= 59.9%; x=3.51). Both teachers and students put the emphasis on hard work.

Recommendations

From the 2004 student questionnaire the "love of a chosen field" was rated as the most important factor in choosing a career. The data in 2004 and 2005 suggest that the Intel ISEF experience does help students develop a desire to pursue STEM careers. Part of the success may be that students love the work they are doing in their projects.

Immersing ourselves into the Intel ISEF experience for two consecutive years, talking to a variety of participants, and analyzing data from online surveys, it became clear that Intel ISEF has a culture of excellence. Conversations with teachers, students, judges, and regional fair directors revealed very positive, hard working, and intelligent people who are enthusiastic about their pursuits and passions related to the Intel ISEF experience. This report, with its quotes, numbers, and analyses, cannot completely convey the power of the Intel ISEF experience.

Regional and High School Fairs

An important question to ask is to what extent is the power of Intel ISEF leveraged for the greatest good? How many students in the U.S. and worldwide put tremendous effort and energy into their projects in the hopes of qualifying for a trip to Intel ISEF? How many fail but resolve to do better next year for the chance to be a finalist? Unfortunately data like these are difficult to gather.

Data should be collected on how many students participated at regional fairs. This data might exist but in our request for data from Science Service they were not provided. We would recommend that the exact number of students at each regional fair be collected from year to year. Analyzing the trends will give some indication of the impact of Intel ISEF and whether it is waxing, waning, or remaining constant. As part of this data collection it may be a good idea to collect names of the students and addresses of the students who participated in case Intel wants to communicate with the students to encourage them or obtain data about the regional fairs.

We believe that a strong positive about Intel ISEF is that the finalists, whether they win an award or not at Intel ISEF, view themselves as winners for just becoming a finalist. In a sense, the trip and the experience is the award. It would be good to explore attitudes and perceptions at the regional level. Do the students feel special for having competed at a regional or school fair? How do the majority of students who are not selected to go to Intel ISEF feel? Are some so disappointed that they decide not to pursue STEM careers? We suggest that that Intel look a little deeper into the regional fairs to help inform the program. Regional fairs not only affect far more students directly than Intel ISEF does, but also the regional fairs have the ability to expand far easier than Intel ISEF does.

A more challenging venture would be to collect data below the regional fair level. How many projects were done in schools or feeder fairs that send their top projects to the regional fair? The mechanism for this data collection would be more complex than just determining exact numbers for the regional fair. It would, however, yield valuable information about the deeper impact of Intel ISEF. Perhaps some states or non-US countries have a data collection technique that can be emulated.

Separate Judging for Research Lab Projects

There are two recommendations that had strong support in the 2004 and 2005 teacher online survey. The first is that judging and awards should differentiate between projects that were conducted in "outside of school laboratories" and those that were more student-centered projects. We have concocted two fictional accounts to illustrate the concern.

George's father has a friend, Dr. Jones, at the local university who agrees to let George work in his biochemistry laboratory. Dr. Jones and his laboratory are investigating the transport of magnesium across the Q-channels in the cell membrane of yeast. For insurance and safety reasons, George is not allowed to manipulate most of the equipment, but Dr. Jones does find things for him to do that contribute to the work of the team during his paid summer internship. Dr. Jones shares some of the data they collect with George. George does lots of reading on his topic and creates a display board with his father and mother's help and wins his regional fair.

Although some teachers questioned the educational appropriateness of this type of experience, there does seem to be benefits for George. He sees aspects of a research laboratory in action, he gets to participate in some simple lab activities, he has a paid internship, he learns a lot about an area he would have never pursued on his own, and he becomes an Intel ISEF finalist, having a wonderful week in Phoenix, and giving his college application more clout.

Yet, another student in his region Martha used her own creativity in coming up with a research problem. She used very simple measuring tools, a ruler and a scale, as she explored an aspect of plant growth. Her methodology, through several iterations where she realized slightly different approaches would be better, became flawless. In Martha's year of research she found significant differences. The problem selected and the results were not appropriate to be published in a scientific journal but they were interesting. Martha was disappointed when her research project only won a second place ribbon. All the projects that scored higher were conducted in research laboratories.

It does seem difficult to compare George and Martha's work. What they did are both valuable experiences for the students. George's data would be more impressive to a botanist judge but that is because the problem and data collection were all initiated by a professional scientist. This is one of the reasons why so many teachers recommended separate judging for projects done in research laboratories versus those done at home or school.

Paperwork

The second teacher recommendation with strong support dealt with paperwork issues. It is our recommendation that a taskforce be created with the mission of reducing and streamlining the paperwork and then creating a system to facilitate its completion. For the Likert-item asking teachers to identify problems that students have, 22.1% indicated that paperwork was a very difficult problem.

Sharing of Expertise

There is considerable expertise within the Intel ISEF system on how to help students do inquiry projects, find laboratories, run regional fairs, and find financial support. We recommend finding ways of sharing the expertise. There is no evidence that the expertise is spreading down the same school hall of the successful Intel ISEF teachers, most with considerable expertise in helping students do inquiry projects. Most of the teachers disagreed that, "Other teachers at my school have changed the way they teach science or mathematics because of Intel ISEF and its affiliated fairs." The majority also disagreed that, "Most science teachers in my school could effectively teach a science research class." Effective ways to get successful teachers to share with other teachers and successful regional fair directors to share with other regional fair directors should be developed.

There might even be online courses offered for teachers to give them the skills to help students doing research. The two biggest problems that teachers identified in students are statistical analyses and choosing a problem. The judges suggested that to improve the projects students should focus on methodology, such as having a bigger sample or doing more repetitions. Perhaps courses could be initially developed that focus on areas of need as seen by teachers and judges.

The Decision Making Process

Many of the people we spoke with, in both heaping praise and suggesting improvements, spoke in terms of "Intel should …." These people tended to view Intel as not only the financial backer but also the decision maker and the executer of local logistics. This was even true of a judge who was an Intel employee in a complaint about the judging process. To be sure the association of Intel with ISEF is a strong positive for Intel and ISEF, but the view that Intel controls the logistics and decisions does at times present the possibility of negative views.

It was very clear that Intel employees were very active working to make Intel ISEF Phoenix a successful fair, especially in working with the local host committee. We wonder, however, if there are mechanisms to create change? In many ways, Intel ISEF seems to have the momentum of a very large cruise ship—with years of tradition built in—it could be very hard to change its direction. Indeed many within the system might be threatened by any changes to the status quo. To be sure, if Intel felt strongly about a change they could use their clout as the major sponsor to attempt change. However, it would be more productive to view change as something that should be considered on a regular basis and establish a change process that involves constituents including representatives from Intel, Science Service, judges, teachers, and regional fair directors. A "board of directors" type structure would help Intel ISEF to evolve so it stays pertinent and responsive to the needs of all the constituents.

Evaluation in 2006

Flexible suggestions are now proposed for an Intel ISEF 2006 evaluation. This flexibility is presented as a menu, where certain options that are logically clustered can be selected. The menu is grouped into three sections: (1) the Basic Evaluation, (2) Addendum A: Face-to-Face, and (3) Addendum B: Intel ISEF Online. Our suggestion is that the Basic Evaluation is the starting point. Then there is the option to select either or both Addendum A and Addendum B. Because the Basic Evaluation includes a focus on regional fairs, which occur well before Intel ISEF, the project will need to be started earlier than in previous years.

The Basic Evaluation. The suggestion for a basic evaluation of the 2006 Intel ISEF and its affiliated fairs includes three data collections from three different constituencies. New online questionnaires should be designed to uncover the thoughts and attitudes of participants and teachers involved in regional fairs. A revised Intel ISEF finalist online questionnaire should be merged with awards information.

This basic package should include the development of the online questionnaires, monitoring of data collection, analyses of the data, development of recommendations, and a final report.

1) To measure the impact of Intel ISEF through its affiliated regional fairs, we suggest an online questionnaire to collect data regarding the perceived benefits of, motivations for, feelings about, and resources that support participation in regional fairs. Separate data summaries should be prepared for each of the major Intel States.

2) To uncover the thoughts of teachers about their students and their efforts leading to affiliated fairs, we suggest an online questionnaire for the teachers of high school participants in regional fairs. Separate data summaries should be prepared for each of the major Intel States.

3) To determine potential differential beliefs and attitudes between the best at Intel ISEF and the rest, we suggest collecting data using a finalist online survey, merge awards data, and perform an analysis to look for variations in responses between groups on attitudes, availability of resources, and so forth.

Addendum A: Face-to-Face. In addition to the basis evaluation described earlier, there are two possible addenda. The first addendum includes the conduction of interviews at Intel ISEF in May of 2006. New focused interview protocols should be developed for finalists, teachers, and fair directors. The excitement and hectic pace of Intel ISEF makes it impractical to conduct long interviews. So we are suggesting shorter targeted interviews that would only focus on one topic that the interviewee is familiar with. These targeted interviews would last between ten to fifteen minutes.

For finalists the suggested targeted interview topics are as follows: (a) Outside research lab, (b) Mentors, (c) Science research class, (d) After school programs, (e) Science fairs and life in the 21st Century, (f) the roles of parents. Working with Intel personnel, we will narrow these to three foci.

To illustrate the focused interview protocol, the evaluation team would approach a person and ask, "Are you a finalist?" If they were a finalist, the evaluator would ask if they worked in a research laboratory. If they said no, the evaluator would ask if they had a mentor. If they said yes, the evaluator would ask a series of questions about the mentor-finalist interactions, such as: How did you find your mentor? What did your mentor do as a mentor? How was your mentor helpful? What problems did you have with your mentor? Why did your mentor do it?

Questions for the science research class could include the following: Why did you take the science research class? Please give us an overview of things that were presented in class? Please tell us what a typical day looked like? What were the benefits of being n the research class? How important is it to take a research class to do well in science fairs?

The goal is to get a minimum of 10 to 15 finalist interviews for *each* topic. During the Intel ISEF process the evaluation team would track our progress to ensure adequate levels of responses for all the topics.

The suggested targeted interview topics for the teachers are as follows: (a) administration support, (b) mentors, (c) science research class, (d) after school programs, (e) science fairs and life in the 21st Century, and (f) effects of not winning a science fair. Working with Intel personnel, we will narrow these to three foci. As with the finalist interviews, if they don't have experience with an area the evaluator will ask them about a different area. The goal is to get a minimum of 10 to 15 teacher interviews for *each* topic.

The suggested targeted interview topics for the regional fair directors are as follows: (a) biggest problem, (b) budgets, (c) motivation to be regional fair director, (d) budget, and (e) possibilities and methods to grow the regional fair. Because regional fair directors are harder to find and interview, we suggest having two focus areas. But both of these foci would be investigated during the same interview. The goal is to have a minimum of 10 to 15 regional fair director interviews.

Addendum B: Intel ISEF Online. Along with the basic evaluation described earlier, this is the second addendum. This portion consists of three online surveys for (a) teachers who have finalists at Intel ISEF, (b) Intel ISEF judges, and (c) regional fair directors.

The teacher questionnaire would continue to allow the collection of data about the impact of Intel ISEF and several items would be repeated from the 2004 and 2005 evaluations. New items that match the regional fair teachers interview should also be incorporated, so that a current year comparison could be made between teachers with regional fair students and those with Intel ISEF finalists.

The judges' online survey was first implemented in 2005, and it provided revealing and powerful data. We suggest this instrument be modified and again used to collect data from the judges in 2006.

In 2006, interviews were conducted with regional fair directors. These people offer a unique vantage point with both general and specific views of events at the regional level and those at the national level. We suggest using the interview data as a starting point to develop an online regional fair director survey.

Conclusions

The Intel ISEF program is a world-class event that encourages and rewards excellence in science, engineering, technology, and mathematics. It is a truly impressive event that will be one of the highlights of the students' lives. Gathering information from the constituents throughout the system, and having mechanisms to make decisions, will help the program to evolve to continually meet the needs of the students.

List of CD-ROM Attachments

Attachment A: Approved Evaluation Plan
Attachment B: Intel ISEF Teacher Online Questionnaire
Attachment C: Intel ISEF Teacher Online Questionnaire Results
Attachment D: Intel ISEF Teacher Interview Protocol
Attachment E: Intel ISEF Finalist Online Questionnaire
Attachment F: Intel ISEF Finalist Online Questionnaire Results
Attachment G: Intel ISEF Finalist Interview Protocol
Attachment H: Regional Fair Director Interview Protocol
Attachment I: Judges Online Questionnaire
Attachment J: Judges Online Results
Attachment K: Digital Copy of this Report

2005 Intel International Science and Engineering Fair Student Finalist Survey

Congratulations on being selected to attend the Intel International Science and Engineering Fair (Intel ISEF). We are a team of researchers at Arizona State University working with Intel to collect information about participants in this year's Intel ISEF. Please take a moment to answer some important questions that will help Intel to better understand the effects of their efforts. There are 8 sections to the survey and it should take less than 10 minutes to complete. Your responses will remain confidential and therefore cannot and will not be used in judging your project. In appreciation of your participation, as you finish the survey you will have the opportunity to enter a contest to win a Dell™ Axim™ Pocket PC.

Read this notice if you completed this survey before May 4.

Official Contest Rules

Privacy Statement

Section 1		
1.1	Is this your first year attending the Intel ISEF?	◯ Yes ◯ No
1.2	Counting this year, how many years have you participated in the Intel ISEF?	-
1.3	Counting this year, how many years have you participated in a science or math fair at any level (elementary, middle, or high school)?	-
1.4	How old were you when you participated in your first science fair?	-
1.5	What is the major focus of your project?	-- -- -- -- --
1.6	Did you submit your project as an individual or a team?	◯ Individual ◯ Team
1.7	About how many hours did you work on the research part of your project?	Hours (use numbers only)
1.8	About how many hours did you work on the display and presentation part of your project?	Hours (use numbers only)
1.9	Did you participate in an optional science research class?	◯ Yes ◯ No
1.10	Did you participate in an after school science fair club/program?	◯ Yes ◯ No
1.11	How would you characterize your community?	◯ Urban ◯ Suburban ◯ Rural
1.12	How would you characterize your school?	-- -- -- -- -- --
1.13	What career area do you think you will pursue?	- - -

--next section--

Section 2

	How important were the following factors in your decision to compete in a science fair this year? Please rate each of the following factors in regard to their importance.	Very Important	Important	Somewhat Important	Not Important
2.1	Opportunity to attend Intel ISEF	○	○	○	○
2.2	Enjoyment of science	○	○	○	○
2.3	Enjoyment of mathematics	○	○	○	○
2.4	Enjoyment of technology	○	○	○	○
2.5	Enjoyment of engineering	○	○	○	○
2.6	Recognition/prestige	○	○	○	○
2.7	Enjoyment of working with my peers	○	○	○	○
2.8	Opportunity to work with adult experts	○	○	○	○
2.9	Potential to win scholarships and awards	○	○	○	○
2.10	Future career opportunities	○	○	○	○
2.11	Improvement of my college application	○	○	○	○
2.12	Family tradition	○	○	○	○
2.13	Other:	○	○	○	○

--next section--

Section 3

For this survey, please consider a mentor as a person who worked one-on-one with you (or your team) on the research part of your project that was beyond normal classroom interactions.

3.1	Did you have a mentor for the research part of your project?	○ Yes ○ No
	If yes, please answer these additional questions. If no, please skip to question 3.2	
	3.1.1 Who was this mentor?	-- -- -- -- -- --
	3.1.1.1 Other	
	3.1.2 If your mentor was your parent or your teacher, please skip this question. Who gave you the greatest assistance in finding your mentor?	-- -- -- -- -- --
	3.1.2.1 Other	
	3.1.3 Where does your mentor work?	-- -- -- -- -- --
	3.1.3.1 Other	
	3.1.4 About how long have you worked with your mentor?	-- -- -- -- -- --
3.2	Did you participate in an internship related to your project?	○ Yes ○ No
	3.2.1 If yes, where was your internship?	-- -- -- -- -- --
	3.2.1.1 Other	

--next section--

Section 4

	How important were the following people in your decision to compete in a science fair this year? Please rate each of the following in regard to their importance.	Very Important	Important	Somewhat Important	Not Important
4.1	Current Teachers				
4.2	Past Teachers				
4.3	Counselors				
4.4	Parents or Guardians				
4.5	Brothers/Sisters				
4.6	Grandparents				
4.7	Peers/Friends				
4.8	Mentors				
4.9	Adult researchers				
4.10	School Principal				

--next section--

Section 5

	Think about the skills and knowledge you used to make an Intel ISEF Quality Project. Please rate the following on their helpfulness in developing those skills and knowledge.	Very Important	Important	Somewhat Important	Not Important	Not Applicable
5.1	Mentor					
5.2	Internship					
5.3	After school clubs/programs					
5.4	Research program at school					
5.5	Science classes					
5.6	Math classes					
5.7	Science Fair Books					
5.8	Science Fair Websites					
5.9	Family members					
5.10	Other:					

--next section--

Section 6

	We are interested in your thoughts about the benefits of doing science/math fair projects. Think about the benefits you experience as you respond to the following statements.	Strongly Agree	Agree	Disagree	Strongly Disagree
6.1	I increased my understanding of inquiry.				
6.2	I increased my ability to conduct inquiry.				
6.3	I increased my knowledge of science.				

6.4	I increased my knowledge of mathematics.	◯	◯	◯	◯
6.5	It helped me decide to pursue a career in Science, Technology, Engineering or Mathematics.	◯	◯	◯	◯
6.6	It increased my overall confidence.	◯	◯	◯	◯
6.7	It helped me to become a better communicator.	◯	◯	◯	◯

--next section--

Section 7

Indicate your agreement or disagreement with the following statements.		Strongly Agree	Agree	Disagree	Strongly Disagree
7.1	Science fair participation has had a major positive influence on my interest in science.	◯	◯	◯	◯
7.2	Science fair participation has had a major positive influence on my interest in math	◯	◯	◯	◯
7.3	Science fair participation has increased my technology skills.	◯	◯	◯	◯
7.4	My work leading to Intel ISEF has made me more interested in inquiry.	◯	◯	◯	◯
7.5	My work leading to Intel ISEF has made me more interested in pursuing a career that requires inquiry.	◯	◯	◯	◯
7.6	My work leading to Intel ISEF has made me more interested in pursuing a career in Science, Math, Engineering, or Technology.	◯	◯	◯	◯
7.7	I had access to experts to help me with my research.	◯	◯	◯	◯

--next section--

Section 8

Age	- -
Gender	◯ Male ◯ Female
Country	United States Canada Mexico Afghanistan Åland Islands Albania
	If you live in the United States, please tell us your ethnic heritage: -
Education level	Among the adults in your current household, what is the highest completed educational level? -- -- -- -- -- --
Previous survey	Did you answer the previous version of this survey before Tuesday, May 3, 2005? *(It was part of the online registration that some finalists saw, but many overlooked.)* ◯ Yes ◯ No

To enter a contest for a Dell™ Axim™ Pocket PC, please complete the survey above then supply your Project ID, full name, and email address below.
NOTE: Your name and email address will not be associated with your previous answers when the data is analyzed nor will it be used for any other purpose except administering this contest. Resubmitting your survey answers WILL NOT increase your chances of winning the contest. View the full contest rules here. View the privacy statement here.

Project ID	

number	
Your Full Name	(optional)
Your Email Address	
Confirm your Email Address	

Submit

2005 Intel International Science and Engineering Fair Teacher Survey

We are a team of researchers at Arizona State University. We are working with Intel to collect information about the Intel International Science and Engineering Fair and its influence on your teaching. Please take 5 minutes to answer some important questions that will help Intel understand the impact of their efforts. In appreciation of your time, after completing the survey, you can enter a contest for a **Dell™ Axim™ X30 Pocket PC.**

Official Contest Rules

Privacy Statement

Section 1

	Please indicate your agreement with each of the following statements.	Strongly Agree	Agree	Disagree	Strongly Disagree
1.1	Intel ISEF and its affiliated fairs encourage my students to pursue excellence in science, mathematics, and/or engineering.				
1.2	Intel ISEF and its affiliated fairs reward my students for excellence in science, mathematics, and/or engineering.				
1.3	Intel ISEF and its affiliated fairs promote scientific inquiry in my school.				
1.4	Intel ISEF and its affiliated fairs promote project-based science in my school.				
1.5	I have changed the way I teach because of Intel ISEF and its affiliated fairs.				
1.6	Other teachers at my school have changed the way they teach because of Intel ISEF and its affiliated fairs.				
1.7	Students who work in an outside research lab have a competitive advantage over other students in Intel ISEF and its affiliated fairs.				
1.8	Intel ISEF and its affiliated fairs motivate students to pursue careers in Science, Technology, Engineering, or Mathematics.				
1.9	External competitions have had a positive effect on my teaching.				
1.10	Because of the way I teach my classes, most of my students have the knowledge and skills to complete a satisfactory science fair project.				
1.11	If there was no longer an Intel ISEF, but its affiliated science fairs continued, things would change in my school's science or mathematics programs.				
1.12	If there were no longer any external science fairs, things would change in my school's science or mathematics programs.				
1.13	Intel ISEF and its affiliated fairs promote collaboration between different departments (example: math and language arts) in my school.				
1.14	Most science teachers in my school could effectively teach a science research class.				
1.15	The administration in my school is supportive of my science fair related efforts.				

--next section--

Section 2

Think about the students who have done well at Intel ISEF and its affiliated fairs. Indicate the importance of the following factors to their success.		Very Important	Important	Somewhat Important	Not Important
2.1	School environment	○	○	○	○
2.2	Classroom experiences	○	○	○	○
2.3	Internship/mentorships outside of school	○	○	○	○
2.4	Technology resources	○	○	○	○
2.5	Their Science/Mathematics teachers	○	○	○	○
2.6	Parental support	○	○	○	○
2.7	Their intelligence	○	○	○	○
2.8	Their work ethic	○	○	○	○
2.9	Their communication abilities	○	○	○	○
2.10	Their personal charm or charisma	○	○	○	○
2.11	Their ability to collaborate	○	○	○	○
2.12	Their willingness to take risks	○	○	○	○
2.13	Their tolerance for ambiguity	○	○	○	○
2.14	Their critical thinking skills	○	○	○	○
2.15	Their scientific and technological literacy	○	○	○	○

--next section--

Section 3

Please indicate your agreement with each of the following statements.		Strongly Agree	Agree	Disagree	Strongly Disagree
3.1	Most of the successful science fair students at our school have mentors.	○	○	○	○
3.2	Most mentored science fair students at our school are mentored by our school's teachers.	○	○	○	○
3.3	Out of school mentors are easy to find.	○	○	○	○
3.4	External mentors are not a realistic possibility for my students.	○	○	○	○
3.5	It is easy to place my students in out of school research labs.	○	○	○	○
3.6	Most successful science fair students at our school have a great deal of support from their parents.	○	○	○	○
3.7	Most of our successful science fair students have had middle school science fair experiences.	○	○	○	○
3.8	Teachers are essential in motivating students to participate in science fairs.	○	○	○	○
3.9	Most of our science fair students excel in their regular science classes.	○	○	○	○
3.10	I have the support of other teachers at my school in my science fair work.	○	○	○	○
3.11	I feel confident in my ability to assist students in the development of excellent science fair projects.	○	○	○	○
3.12	I would benefit in training about how to help students create excellent science fair projects.	○	○	○	○
3.13	Science Fair participation helps my students meet my state’s standards or country’s curriculum.	○	○	○	○
3.14	Science Fair participation prepares my students for university entrance exams.	○	○	○	○

--next section--

Section 4

Think about all your students that worked on science fair projects this year. Please indicate how difficult the following tasks were for those students as they did their science fair projects?		Very Difficult	Somewhat Difficult	Easy	Very Easy
4.1	Consulting literature	◯	◯	◯	◯
4.2	Choosing a problem	◯	◯	◯	◯
4.3	Identifying variables	◯	◯	◯	◯
4.4	Developing hypotheses	◯	◯	◯	◯
4.5	Collecting data	◯	◯	◯	◯
4.6	Getting accurate measurements	◯	◯	◯	◯
4.7	Statistical analyses (descriptive, inferential, multivariate)	◯	◯	◯	◯
4.8	Analyzing data	◯	◯	◯	◯
4.9	Obtaining adequate controls	◯	◯	◯	◯
4.10	Forming conclusions	◯	◯	◯	◯
4.11	Creating display boards	◯	◯	◯	◯
4.12	Preparing to explain their projects to judges	◯	◯	◯	◯
4.13	Finishing the project	◯	◯	◯	◯
4.14	Completing paperwork	◯	◯	◯	◯

--next section--

Section 5

5.1	What subject do you **primarily** teach?	-- -- -- -- -- -- --
5.2	How many years have you taught that subject?	years
5.3	How many years total have you been teaching?	years
5.4	How old are you?	-- -- -- -- -- -- --
5.5	What is the highest degree you hold?	-- -- -- -- -- --
5.6	Do you have a degree or certification in the primary subject you teach?	◯ Yes ◯ No
5.7	How many years as a teacher have you done science fairs?	years
5.8	In this academic year, how many competitions lead to your students' involvement with Intel ISEF?	-- -- --
5.9	Approximately how many students competed in your schools' science fair?	students
5.10	Approximately how many students competed in your regional science fair?	students
5.11	Please indicate in which of the last ten years you have had a finalist at Intel ISEF:	☐ 1996 ☐ 1997 ☐ 1998 ☐ 1999 ☐ 2000 ☐ 2001 ☐ 2002 ☐ 2003 ☐ 2004 ☐ 2005
5.12	Did you participate in science fairs as a student?	◯ Yes ◯ No
5.13	Did you participate in Intel ISEF as a student?	◯ Yes ◯ No

5.14	Does your school have special programs/clubs to help students succeed in science fairs?	◯ Yes ◯ No
5.15	Does your school offer research classes designed to help students succeed in science fairs?	◯ Yes ◯ No
5.16	Did you teach or facilitate a research class, club, or program this semester?	◯ Yes ◯ No
5.17	Over the past five years, please indicate your participation in professional development workshops that addressed these topics. **(Check all that apply.)**	☐ Project-based learning ☐ Problem-based learning ☐ Inquiry ☐ Problem solving ☐ Science fairs ☐ General teaching methods ☐ Classroom management ☐ Standards-based instruction
5.18	How would you characterize the relationship between the academic standards of your state or country and your students' science fair projects?	-- -- -- -- -- --
5.19	How would you characterize your school setting?	◯ Rural ◯ Urban ◯ Suburban
5.20	If you were in charge, what is the most important thing you would do to improve Intel-ISEF and its affiliated fairs? (maximum of 250 characters)	
5.21	Your gender	◯ Male ◯ Female
5.22	Your country	United States Canada Mexico Afghanistan Åland Islands Albania
5.23	If you live in the United States, please tell us your ethnic heritage:	- -

To enter a contest for a Dell™ Axim™ X30 Pocket PC, please supply your name and email address. **NOTE: Your name and email address will not be associated with your previous answers when the data are analyzed nor will it be used for any other purpose except administering this contest. Resubmitting your survey answers WILL NOT increase your chances of winning the contest. Click here for full contest rules. Click here to view the privacy statement.**

Name:	
Email Address	
Confirm email Address	

Submit

2005 Intel International Science and Engineering Fair Judges Survey

INTERNATIONAL SCIENCE AND ENGINEERING FAIR

We are a team of researchers at Arizona State University working with Intel to collect information from Judges in this year's Intel ISEF. Please take a moment to answer some important questions that will help Intel to better understand the effects of their efforts and what can be done to improve student performances. There are 5 sections to the survey and it should take less than 12 minutes to complete. In appreciation of your time completing the survey, you can enter a contest for a Dell™ Axim™ X30 Pocket PC.

Official Contest Rules

Privacy Statement

Section 1

1.1	How many years have you been a judge for Intel ISEF?	☐ years
1.2	What category did you judge? (Check all that apply.)	☐ Behavioral & Social Sciences ☐ Biochemistry ☐ Botany ☐ Chemistry ☐ Computer Science ☐ Earth Science ☐ Engineering ☐ Environmental Science ☐ Mathematics ☐ Medicine & Health ☐ Microbiology ☐ Physics ☐ Space Science ☐ Zoology
1.3	Are you active or retired from your career?	○ Active ○ Retired
1.4	Where do (or did) you work?	-- -- -- -- -- -- -- --
1.5	What is your gender?	○ Male ○ Female

--next section--

Section 2

	Please indicate your agreement with each of the following statements.	Strongly Agree	Agree	Disagree	Strongly Disagree
2.1	In general, the projects I judged at Intel ISEF were of excellent quality.	○	○	○	○
2.2	In general, the projects I judged at Intel ISEF were inquiry based.	○	○	○	○
2.3	Intel ISEF recruited high-quality judges.	○	○	○	○
2.4	I agree with my group's selection of the top projects.	○	○	○	○

2.5	I would judge for Intel ISEF again.				
2.6	It was easy to determine how much work was done by the student.				
2.7	It was easy to determine if students had an out of school mentor.				
2.8	Students with access to outside research labs generally had better projects than other finalists.				
2.9	There was a wide variation in quality between the top-tier and bottom-tier projects.				

--next section--

Section 3

	Please consider the following items and rate them for how important they were in differentiating the top projects from the others.	Very Important	Important	Somewhat Important	Not Important
3.1	Problem selected				
3.2	Methodology				
3.3	Hypothesis				
3.4	Quality of data				
3.5	Findings expanded scientific knowledge				
3.6	Theoretical framework				
3.7	Data analysis				
3.8	Literature review				
3.9	Potential of results to be used by others				
3.10	Visual display				
3.11	Oral presentation				
3.12	Written report				
3.13	Access to outside mentors				
3.14	Access to outside research labs				
3.15	One or more parents working in scientific or technical fields				
3.16	English language skills				
3.17	Other:				

--next section--

Section 4

	Please rate the following potential attributes for being successful at Intel ISEF.	Very Important	Important	Somewhat Important	Not Important
4.1	Intelligence				
4.2	Perseverance				
4.3	Creativity				
4.4	Curiosity				
4.5	Critical thinking				
4.6	In-depth knowledge				
4.7	Communication skills				

--next section--

Section 5

Please share your thoughts about the following items.

5.1 Most Intel ISEF Finalists could make their projects better by:
(maximum of 720 characters which is the size of this text box)

5.2 The one thing that separates the best projects from the others is:
(maximum of 720 characters which is the size of this text box)

5.3 Intel ISEF could be improved by:
(maximum of 720 characters which is the size of this text box)

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Name:	
Email Address	
Confirm email Address	

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