Testimony to the Subcommittee on Research

Of the House Committee on Science, Space, Technology

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Intel Corporation respectfully submits this testimony for the record in conjunction with the Committee's hearing on STEM education. The testimony will focus on three topics

- The importance of a highly skilled workforce to Intel's manufacturing and research investments in the United States
- The role of STEM education in fostering innovation to solve global challenges
- Intel's education programs and partnerships to create that workforce and foster innovation

Intel Corporation

Intel Corporation is the world's largest semiconductor chip maker, based on revenue. We develop advanced integrated digital technology, primarily integrated circuits, for industries such as computing and communications. Our goal is to be the preeminent computing solutions company that powers the worldwide digital economy. We are transforming from a company with a primary focus on the design and manufacture of semiconductor chips for PCs and servers to a computing company that delivers complete solutions in the form of hardware and software platforms and supporting services.

Intel was founded 45 years ago at the dawn of the digital age in Silicon Valley and our corporate headquarters is in Santa Clara, California. Our history is the history of the 20th century technology revolution and is still being written today. As of the end of 2012 Intel employed over 105,000 people worldwide and more than half of them, over 53,000, are here in the US.

At a time when the need for a revival of US manufacturing is a popular refrain, Intel stands as a unique example of a commitment to US manufacturing. Three-fourths of Intel's manufacturing is here in the United States. In the last two years Intel has broken ground on two large manufacturing facilities in Arizona and Oregon to add to the existing network of fabs in Arizona, Oregon, New Mexico and Massachusetts. According to the Progressive Policy Institute, Intel is the 5th largest capital investor in the United States[1]. In 2012 alone, Intel invested over $8.5B in capital in the United States.

But Intel's investment in the United States is not limited to manufacturing. Over three-fourths of Intel's research and development is also based here at home. Intel has major R&D facilities in Oregon, Arizona, Massachusetts, Texas, Colorado, Washington, California and South Carolina. Intel is an economic engine in our site communities and the fuel for that engine is our highly skilled workforce.

We understand the importance of Science, Technology, Engineering and Mathematics (STEM) skills because these are the skills we seek every day as we hire the best and the brightest engineers and scientists to operate our factories and conduct our research. At this moment Intel has over 1500 job openings in the United States. The majority of these positions require degrees in engineering disciplines. In 2012 alone, Intel hired 2491 engineers in the United States[2]. Intel employs 4445 PhD's in the US and faces a daunting challenge in finding qualified candidates each year.

We know that a chronic shortage of engineering students threatens America's role as the world's leading innovator and continues to impede our nation's fragile economic recovery. We believe having a vibrant economy sustained by quality education, a skilled workforce, and innovation is key to our Nation's success. Through our education initiatives and investments, Intel is helping communities build local capacity while preparing the next generation of innovators.

Intel's Education Strategy

For more than four decades, Intel has made education the primary focus of our strategic philanthropic activity. We invest more than $100 million annually in programs that promote STEM education, encourage women and girls to seek careers in technology, foster and celebrate innovation and entrepreneurship among the best and brightest young students in the world and help teachers to incorporate best practices in math, science and the effective use of technology in their work.

We work in coalitions with other high-tech companies to encourage the U.S. Congress and state legislatures to support technology access, development and implementation of more rigorous K-12 mathematics and science standards, as well as assessments to support initiatives that develop 21st century skills, such as critical thinking, collaboration and creativity. These are skills they need to be the innovators of tomorrow. We were among the first to call for more rigorous standards and assessments to ensure that US students are competitive with their peers in other

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[1] Dana G. Carew and Michael Mandel, "Investment Heroes: Who's Betting on America's Future," Progressive Policy Institute, Policy Brief, July 11, 2012.
[2] This number does not include interns and employees added as a result of acquisitions.

countries. We have been advocates for the Common Core State Standards since the initiative was first conceived and we continue to lend our voice as the implementation of the Common Core becomes a reality.

The statistics are well known to all of us. According to the most recent (2011) National Assessment of Educational Progress (NAEP), commonly referred to as "The Nation's Report Card," only 40 percent of U.S. 4th grade students and 35 percent of 8th grade students (note the trend) performed in mathematics at or above the "proficient" level. In the science assessment, only 32 percent of 8th grade students performed at or above the proficient level. Only 26 percent of 12th grader students scored at or above the proficient level in mathematics and only 21 percent did the same in science in 2009.

But the truth is that what really matters in the 21st century is how our children stack-up in comparison with their peers in other countries who will be seeking the same jobs in the commercial market and designing their own nation's military systems. The well-regarded Programme for International Student Assessment (PISA) assesses the performance of 15-year-olds in mathematics and science, from OECD (Organisation for Economic Co-operation and Development) countries and other countries. In 2009, the average scores of U.S. students in both mathematics and science were below the average of all OECD countries and also below some non-OECD countries. Specifically, U.S. students ranked 23rd in science and 31st in mathematics among the OECD member countries and total of 65 participating countries. And in the most fundamental educational skill of all—reading—our nation's children ranked 17th.

What drives and inspires Intel's commitment to education is both our need to secure a highly skilled workforce for every employer and our desire to ensure that this country remains the global leader in innovation and entrepreneurship.

Intel's Education Programs

Our science competitions are at the center of our education programs. Our goal in sponsoring the competitions is to identify and celebrate talented young scientists. Through them, we inspire younger students to follow in their footsteps and communities to invest in high quality science education.

Each year, more than 1,700 seniors attending American high schools conduct original research projects and present their work in the country's oldest, most prestigious pre-college science competition: the Intel Science Talent Search, a program of Society of Science & the Public. Forty of these young innovators are chosen as finalists and invited to participate in a nearly week-long event in Washington, D.C., where they compete for over $1.25 million in awards and scholarships. Intel STS alumni have achieved some of the world's most prestigious honors: Eleven have won MacArthur Foundation "Genius" grants, six have won the National Medal of Science and the National Medal of Technology, and seven have won the Nobel Prize. The event culminates with the Intel STS Gala in March, where the forty finalists are celebrated and the scholarships awarded at a black-tie event. This event represents how Intel believes the students should be recognized by the public, with as much respect, appreciation and praise as our most accomplished athletes.

The Intel International Science and Engineering Fair, also a program of Society for Science & the Public, is the world's largest pre-college science fair competition. Each year, approximately 7 million high school students around the globe develop original research projects and present their work at local science fairs with the hope of winning. Those who do win progress to regional, state, and national competitions. Ultimately, the select few, 1,500 promising young innovators, are invited to participate in Intel's ISEF in the US.

At this week-long celebration of science, technology, engineering, and math, students share ideas, showcase cutting-edge research, and compete for awards and scholarships. At Intel ISEF, awards are based on students' abilities to tackle challenging scientific questions, use authentic research practices, and create solutions for the problems of tomorrow.

The 2012 winner of Intel ISEF, Jack Andraka, is from Crownsville, Maryland, where at the age of 15 he surpassed what most adults achieve in a lifetime. His research discovered a way to detect pancreatic cancer at its earliest stages through a simple and low cost test using a slip of paper and a drop of blood. The implications of his research on early detection for a variety of cancers, including lung and ovarian cancers, are substantial. And he is just getting started.

Intel's programs to encourage students to seek careers in STEM fields are not limited to our large science competitions. In each of our sites in the US, Intel invests in local initiatives that support STEM education. Recently, Intel sponsored a conference near our site in Washington County, Oregon, which attracted over 120 Latina high school girls. The conference was designed to introduce the girls to careers in STEM fields. Intel's Latino employee group volunteered at the conference to provide mentoring for the students. The projects undertaken at the conference ranged from extracting DNA from strawberries to the science behind crime scene investigations. One young woman, quoted in media coverage of the conference, said: "I haven't seen many Hispanic women doing things like that. It inspired me because I feel like we could go far."[3]

Intel has a long history in supporting Project Lead the Way (PLTW) within all of our site communities, but one of our most successful and deepest relationships have built with PLTW is rooted in the state of California. About six years ago, Intel identified PLTW as a best known method for inspiring students to pursue STEM careers, while providing critical professional development to educators. The program was most effective in helping the teachers become comfortable with delivering instruction using a hands-on, project based course. Using the San Diego region's PLTW implementation template as a model, Intel partnered with Sacramento's economic and workforce development affiliate of their local chamber of commerce, Next Ed, to scale up PLTW to a multi-county, multi district approach. At the start of the implementation, PLTW was in two schools in the greater Sacramento region. The curriculum is now currently in over 40+ schools throughout the California Capital Region, serving over 6,000 students. Intel has led the effort, from starting the regional PLTW collaborative venture to investing nearly $500k to support classroom startup costs and training costs for every PLTW teacher within the Capital Region (nearly 150 teachers).

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[3] Andrea Castillo, "Latina high schoolers from Forest Grove, Hillsboro, Beaverton introduced to science, technology careers," The Oregonian, February 23, 2013.

Most recently, PLTW and Next Ed were chosen as recipients of a $5 million Department of Education I-3 grant to demonstrate success rates of high need/nontraditional students in STEM course work as well as their potential success in college and careers in STEM fields. Intel supported the grant by committing $50,000 towards the required 10% private sector match. Intel further helped by bringing other regional leaders to the table resulting in over 23% private matching funds, far exceeding the required amount. The grant will help PLTW expand to over 60 schools, reaching over 10,000 students in the Capitol Region.

Intel Educator Professional Development Programs

Intel does not focus solely on talented students. We also invest heavily in teacher professional development. We understand that behind every successful student regardless of the level is a teacher providing needed inspiration and guidance.

Intel Math

One of the most successful professional development programs developed and supported by our company is Intel Math. Mathematics, a subject not generally the strength of elementary school teachers, is the essential language of science, engineering and technology. Intel Math increases teachers' understanding of mathematics and confidence in teaching the subject, which makes a real and measurable difference in the time they spend on instructing students, the enthusiasm they show for the subject, and in what their students learn.

Intel Math is an 80-hour professional development course in mathematics content for K-8 teachers. The program was adapted from the Vermont Math Initiative developed by Dr. Ken Gross. The course is collaboratively taught by a practicing mathematician and a mathematics educator. One of the goals of Intel Math is that teacher participants deepen their own understanding of math through problem-solving.

Intel Math "is designed to close the gap between insufficient mathematics training of elementary school teachers and the demands of the contemporary mathematics classroom" (Kenneth Gross, on VMI), and places emphasis on deepening the teacher participants' understanding of core K-8 mathematics concepts. Studies showed that elementary school teachers were often uncomfortable in teaching math to their students. This problem stemmed from their own fundamental lack of knowledge of math concepts.   A recent study of the impact of the training on Arizona teachers showed that the students of Intel Math-trained teachers scored significantly higher on the AIMS (Arizona's Instrument to Measure Standards) test than the students of comparable elementary school teachers.

Eleven states are currently offering Intel Math. In 2012 the program reached over 1400 elementary school teachers. Intel is currently working with the University of Arizona, which is the national training agency for the program, to identify ways to scale the program at lower cost without compromising its impact and quality.

Intel Teach

Intel's signature program for teacher professional development is Intel Teach which has been offered for over 12 years in the United States and 70 countries worldwide. Intel Teach has trained over 500,000 teachers here in the U.S. The Intel Teach Program empowers teachers to achieve common core and state standards implementation while developing the students' problem solving, critical thinking, communication, and collaboration skills. These skills are essential for college and career-readiness in an information age.

Partnering with experts in online education and educational technology, Intel has redesigned its proven professional development as the basis for Intel Teach Elements, a series of interactive, multimedia courses designed specifically for online and blended use by educators. The courses under the Intel Teach Elements program include key areas of instruction deemed important by educators: Project-Based Approaches, Assessment of 21st Century Skills, Educational Leadership, Thinking Critically with Data, Collaboration, Science Inquiry, and Designing Blended Learning. The Intel Teach program is offered free of charge to including State and Regional agencies, districts, schools and other local institutions. Intel Teach is currently offered in 29 states.

An Intel Teach master trainer, Dyane Smokorowski, was recently named Kansas teacher of the year. Mrs. Smoke, as her students call her, is an eighth grade language arts teacher. She credits Intel Teach with helping her achieve the teacher of the year award because it helped her incorporate STEM concepts and critical thinking into her classroom lessons.

Intel Educator Academy

A third professional development opportunity, the Educator Academy, is provided in conjunction with our Intel ISEF science competition. This professional development program is targeted at administrators at the state and local level as well as those from universities. This program reaches a smaller number of teachers than Intel Math and Intel Teach, but is an effective way to leverage an existing education program to add a professional development component at modest cost. Every year at Intel ISEF, Intel invites select educators to participate in the Educator Academy with all expenses paid by Intel. The Academy focuses on improving science education and the scientific quality of science fair projects. The participants receive a "hands on" view of how Intel ISEF works and how to organize their own science fairs. They meet with the organizers and judges about judging and rules, and receive the benefit of insights from scientists of the highest caliber. The participants also benefit from exposure to educators from other countries and gain a view of the international competitive landscape. In 2102, 37 educators from the United States participated in the Educator Academy.

Teachers Engage

Intel provides a program for teachers who have participated in our professional development offerings to continue their development and expand their collaboration. The Teachers Engage program is an online community of educators that is offered free of charge to any teacher. This community is an extension of Intel's commitment to education and classroom transformation through technology. Transforming education to meet the needs of today's learners requires ongoing support for teachers as they implement new teaching practices. Intel connects educators

who integrate technology into the classrooms and promote student-centered approaches in the Teachers Engage online community. Teachers Engage offers 21st century classroom resources, online courses, and active dialogue within a global network. Participants gain a professional edge through collaborating and interacting with other educators, creating private learning spaces, and hosting or attending in live webinars. Approximately 18.000 educators are members of the Intel Engage community at www.engage.intel.com.

Over the past decade, Intel and the Intel Foundation have invested more than $1 billion to improve education around the world. Intel's investments in education expand opportunities for young people like Jack and teachers like Dyane while also benefiting the company. Education is the foundation of innovation, and as a technology company, Intel's success rests on the availability of skilled workers, a healthy technology ecosystem, and knowledgeable customers.

Additional Intel resources that support STEM education

Intel Labs

Although a number of Intel business groups support education through internships and volunteerism, one business group, Intel Labs, is unique in its programs that support STEM education. The mission of Intel Labs is to fuel Intel's growth by delivering breakthrough technologies that bring the benefits of the ongoing digital revolution to everyone. In order to achieve this mission, Intel labs must work closely with academia to foster innovation and technology breakthroughs as well as to feed the pipeline of researchers needed by Intel and all industries.

One of the programs of Intel Labs is the Intel PhD Fellowship program. The program's goal is to continuously improve Intel's access to hard-to-find PhD talent through funding and actively mentoring top PhD students working in line with Intel's technical areas of interest and emerging technical pipeline needs. The Intel PhD Fellowship Program works with selected university contacts to connect with student candidates that are working on specific areas of research of interest to Intel. The award is based on the academic calendar and is a one-year award. Each PhD Fellow is paired up with an Intel mentor to provide technical coaching and build a relationship between the student and Intel.

Intel Labs also supports the work of the Anita Borg Institute through grants and board service by Intel Corporation's Chief Technology Officer, Justin Rattner, and through grants for its work in promoting technology careers for women. The Anita Borg Institute recently announced that Intel Corporate was its 2013 Top Company for Technical Women award recipient. One of our recent collaborations with the Institute was sponsorship of the 2012 Grace Hooper Celebration. This conference is designed to bring the research and career interests of women in computing to the forefront. Presenters are leaders in their respective fields, representing industrial, academic and government communities. Leading researchers present their current work, while special sessions focus on the role of women in today's technology fields, including computer science, information technology, research and engineering.

In 2012, Intel Labs collaborated with the Intel Corporate Affairs Group to embark on a partnership with Maker Faire, a grassroots movement of entrepreneurs, inventors and tinkerers who seek to encourage STEM careers and a culture of innovation. Describes as the "Greatest Show and Tell in Earth," the Maker Faire creates an opportunity for students to experience first-hand the satisfaction and rewards of hands on work in fields such as computer coding and robotics. Unlike the science competitions sponsored by Intel, Maker Faires are not competitions. They are simply a way for young people to learn by doing. Intel chose to invest in the Maker Movement because Intel was built by makers who envisioned a world of possibilities and instilled in our culture a deep rooted connection to innovation. Maker Faire is an opportunity for Intel and our community of makers to engage and share with other innovators who share these values. In 2012 over 1200 elementary school students in the Silicon Valley visited the San Mateo Maker Faire during Intel sponsored Maker Education Day. In 2013 Intel will introduce Maker Spaces as a pilot project in some of Intel's Computer Clubhouses in the United States.

Intel Involved

An additional program that supports STEM education is our Intel Involved volunteer program. This program provides opportunity for employees to impart their knowledge, technical skills, and work experience to transform education in K-12 schools and universities near our site communities. As volunteers they serve as role models and mentors to students in K-12 and higher education and are real world examples of the opportunity available in STEM careers.

Through the Intel Involved Matching Grant Program (IIMGP), the Intel Foundation extends the impact of that service by donating cash to qualified schools where Intel employees and retirees volunteer at least 20 hours in a year. In 2012, our employees volunteered over 235,000 hours in our local schools. The anticipated benefit to local schools, when the calculation of qualified hours is complete, will be approximately $2 million.

Partnerships

Intel and the Intel Foundation do the vast majority of our work in education and philanthropy through partnerships. Partners are selected based on common goals and objectives for each program or initiative. Typically we involve government (local, state, federal, departments of education, etc.), other corporations, non-profit entities, and other funders such as private foundations. Our goal is always to maximize the impact of our investment by using our funding and influence to bring together coalitions that can greatly increase the scope and scalability of what we could do on our own. We believe that governments and their agencies are essential partners for scaling solutions. We believe other corporations bring real world experience and pragmatism - and often the kinds of marketing and communications skills that help to tell the story of critical work to a larger audience. We believe that non-profits in the education arena with a track record of effectiveness and impact help us to understand the needs and voices of the clients or 'customers' they serve so well. And of course other funders who share our goals and philosophy can help us attain a much larger impact.

One example of our partnerships is our extensive work with Society for Science & the Public (SSP), and the many other organizations involved in the Intel International Science & Engineering Fair (Intel ISEF) and the Intel Science Talent Search (Intel STS).

In the US alone, Intel ISEF and the many affiliated and feeder science fairs in 48 states reach an estimated 150,000 high school students. While we fund a total of $665,000 in scholarships for all of the top award winners in each of the 17 categories of research (including the Gordon E. Moore award of $75,000 to the grand award winner), hundreds of public and private entities provide an additional $2.3 million in scholarship awards in various special categories. Students from US science fairs account for 65% of the finalists in Intel ISEF.

Our Educator Academy brings teams of educators from five different states each year, together with comparable teams from countries all around the world. There they share best practices both in how to create and manage high impact competitions of their own, but even more importantly, how best to educate and prepare students as young scientists who can conduct independent research, break new ground in science, and compete effectively both at local fairs and at Intel ISEF. The Army, Navy, Air Force, National Institutes of Health and the National Academies of Science are all involved in providing research opportunities for students and scholarships for young researchers. The list of active partners in this vast effort encompasses public and private entities of virtually every stripe.

Another successful partnership is with a university near one of our sites. In order to deliver Intel Math we partner with the University of Arizona and local school districts to find ways to lower the cost and increase the impact on student achievement. The Institute for Mathematics and Education (IM&E) at the University of Arizona is the National Training Agent for Intel Math. The purpose of the Training Agency is to help scale the program throughout the country while preserving its quality and fidelity. The IM&E oversees the delivery of Intel Math at all current and future adopting sites. It coordinates the recruitment and certification of all senior trainers and instructors, implements improvements and revisions to the curriculum, centralizes the delivery of course materials, ensures rigorous course delivery standards are upheld, monitors program success with centralized evaluation materials, and supports states and school districts with program adoption. Intel would not have been able to scale and grow the program without this partnership.

Similarly, with Intel Teach, we partner with state departments of education and regional training agencies to deliver the program in multiple states. Together we refine the courses offered and develop recommendations for content that meets the needs of the teachers who are the program's participants and beneficiaries. In the last year, we have refined the content of Intel Teach to support common core state standards, an initiative that Intel enthusiastically supports.

A grant from the Intel Foundation helped Arizona State University (ASU) significantly increase participation in the Engineering Projects in Community Service (EPICS) program in 2011. EPICS is a series of service learning classes developed by Purdue University, in which students solve engineering and technology-based problems for nonprofit community agencies, schools, and government entities. One team at ASU is designing low-cost ways to use solar power to prevent brownouts at a girls' school in Bangladesh; another team is working to develop a mobile, nature-oriented video game designed to encourage young girls to be active outdoors.

At the national level, Intel works with organizations such as the National Governors Association (NGA) and the Council of State School Officers (CCSSO) to advance education reform. Our Intel Teach program was recognized by the NGA in 2010 with its prestigious Public Private Partnership Award.

At the federal level, Intel was a founding member of "Change the Equation," a CEO-led initiative designed to answer the President's call to move the U.S. to the top globally in science and math education over the next decade. In support of the initiative, Intel has committed to provide professional development training to an additional 100,000 U.S. teachers over a three-year period through Intel Math, Intel Teach and our Intel ISEF Educator Academies.

Evaluation

Evaluation is a critical tool that we use both for continuous improvement of our programs, and to measure their overall impact. Our goals are to learn how to do our work more effectively, share what we learn for the benefit of other funders, help our grant recipients increase their impact, and ensure that we stay focused on effectiveness and scalability rather than on little jewels that might make us feel good, but cannot truly address the systemic issues we are targeting. At the same time, Intel takes a pragmatic approach to evaluation; it is entirely possible to spend as much or more time evaluating a program as implementing it. We try to ensure that we use evaluation as a means to increase impact rather than as an end in and of itself. Expenditures on evaluation are kept proportionate to the size of the grant or program, and we strive to use evaluation to help our grant recipients increase their reach and impact without distracting them unduly from the tasks at hand. In some cases we have funded independent third party evaluations of our programs, as was the case with Intel Teach and Intel Math. In other cases the evaluation was conducted jointly by Intel Foundation staff and the grant recipient.

One example is our evaluation of the Undergraduate Research Opportunity (URO) initiative developed and managed in partnership with the Semiconductor Research Corporation (SRC). It is well-understood that as many as 50 percent of all undergraduates enrolling as freshmen in engineering, computer science and related degree programs will drop out or change majors before their junior year. The percentage of those who, on average, continue to graduate school for a masters or Ph.D. is far smaller. We had seen good evidence that giving these students - especially women and other underrepresented populations - the opportunity to do research while undergraduates greatly increased rates of retention and graduation in their field. The addition of supportive classes and discussion groups focused on explaining the why and how of graduate school also made a tremendous difference. Partnering with 14 universities and the SRC, Intel provided stipends that allowed 600 students to participate in undergraduate research. Our jointly conducted evaluation showed that more than 97 percent of those students completed an undergraduate degree in a technical major, and nearly half continued onto graduate school - overwhelming evidence of real impact and success. By virtue of having conducted the research and with these data in hand, the SRC has already been able to recruit a second funding partner, allowing them to increase significantly the number of university partners and student researchers.

An independent evaluation of Intel Teach, our teacher professional development program that has reached 600,000 teachers in the US and more than 10 million around the world, was conducted by experts at the Center for Children & Technology (CCT), associated with the Education Development Center. As with the evaluation of the SRC URO, our focus was on measuring real impact – i.e., changed teacher behavior, improved classroom learning, changes in attitude, etc. Using both formative evaluation - to assess and improve actual implementation - and summative evaluation - to measure overall impact - we have been able to stay on a path of continuous improvement and growth.

Conclusion

Education has been Intel's primary philanthropic focus for decades. Intel has over 200 programs in more than 70 countries that provide professional development for teachers, support and celebrate student achievement in science, technology, engineering, and math, and bridge the digital divide with relevant, local online content for educators, students and parents. Our experience in education worldwide has informed our understanding of the need for higher standards and more rigorous assessments for our students here at home.

In the past, the job of schools was to filter out the few natural scientists from the crowd and send them on to an elite education to become academics and researchers. Today, we need far more people with these skills to take positions in academia, in industry, in government. All young people need a far better grasp of technology and science simply to live in this increasingly complex and rapidly changing world inundated with data, climate changes, and revolutionary advances in medical science. As microprocessor technology becomes ever more complicated, there is great value to Intel in increasing the diversity of the pool of people searching for answers to scientific questions, both profound and practical, especially given the persistent the lack of qualified American job applicants for our microprocessor manufacturing and research and development facilities.