STEM EDUCATION IN ACTION: LEARNING TODAY . . . LEADING TOMORROW

HEARING

BEFORE THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

ONE HUNDRED TWELFTH CONGRESS

FIRST SESSION

THURSDAY, JUNE 16, 2011

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Thursday, June 16, 2011

STEM EDUCATION IN ACTION: LEARNING TODAY ... LEADING TOMORROW

THURSDAY, JUNE 16, 2011

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, DC.

The Committee met, pursuant to call, at 10:05 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Ralph Hall [Chairman of the Committee] presiding.

RALPH M. HALL, TEXAS
CHAIRMAN

EDDIE BERNICE JOHNSON, TEXAS
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U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

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Subcommittee on Research and Science Education
STEM Education in Action: Learning Today... Leading Tomorrow
Thursday, June 16, 2011
10:00 a.m. - 12:00 p.m.
2318 Rayburn House Office Building

Witnesses

Dr. Karen Lozano, Professor at University of Texas Pan American, Parent to Pablo Vidal and Mentor to the i.streets (Intelligent Streets) Discovery Montessori School Team, McAllen, TX

Master Pablo Vidal, 3rd grade student at Discovery Montessori School and member of the i.streets (Intelligent Streets) Team, McAllen, TX

Mrs. Brenda Conwell-Dudley, Parent to Jack Dudley and Mentor to the HEADS UP! Virginia Virtual Academy Team, Leesburg, VA

Master Jack Dudley, 6th grade student at Virginia Virtual Academy and member of the HEADS UP! Team, Leesburg, VA

Ms. Amy Attard, Science Teacher and Coach to the I-TBS: Intra-Trachea West Hills Middle School Team, Commerce, MI

Miss Claudia Cooper, 7th grade student at West Hills Middle School and member of the I-TBS: Intra-Trachea Team, West Bloomfield, MI

Ms. Anne Manwell, Science Teacher and Mentor to the 3Drenal: Kidney Bio-Printer Stuyvesant High School Team, Brooklyn, NY

Miss Alison Reed, 10th grade student at the Stuyvesant High School and member of the 3Drenal: Kidney Bio-Printer Team, Brooklyn, NY

HEARING CHARTER

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

STEM Education in Action: Learning Today . . . Leading Tomorrow

THURSDAY, JUNE 16, 2011
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

On Thursday, June 16, 2011, the Committee on Science, Space, and Technology will hold the first in a series of hearings to highlight Science, Technology, Engineering, and Math (STEM) education activities across the Nation, their role in inspiring and educating future generations, and their contribution to our future economic prosperity. The first hearing, *STEM Education in Action: Learning Today.. . . . .Leading Tomorrow*, will showcase the finalists, parents, teachers, and mentors of the ExploraVision Awards National Competition, sponsored by Toshiba and the National Science Teachers Association.

Witnesses

- **Dr. Karen Lozano**, Professor at University of Texas Pan American, Parent to Pablo Vidal and Mentor to the i.streets (Intelligent Streets) Discovery Montessori School Team, McAllen, TX
- **Master Pablo Vidal**, third-grade student at Discovery Montessori School and member of the i.streets (Intelligent Streets) Team, McAllen, TX
- **Mrs. Brenda Conwell-Dudley**, Parent to Jack Dudley and Mentor to the HEADS UP! Virginia Virtual Academy Team, Leesburg, VA
- **Master Jack Dudley**, sixth-grade student at Virginia Virtual Academy and member of the HEADS UP! Team, Leesburg, VA
- **Mrs. Amy Attard**, Science Teacher and Coach to the I-TBS: Intra-Trachea West Hills Middle School Team, Commerce, MI
- **Miss Claudia Cooper**, seventh-grade student at West Hills Middle School and member of the I-TBS: Intra-Trachea Team, West Bloomfield, MI
- **Ms. Anne Manwell**, Science Teacher and Mentor to the 3Drenal: Kidney Bio-Printer Stuyvesant High School Team, Brooklyn, NY
- **Miss Alison Reed**, 10th-grade student at the Stuyvesant High School and member of the 3Drenal: Kidney Bio-Printer Team, Brooklyn, NY

Overview

- ExploraVision is a science competition for grades K–12. Students are asked to research a technology of their choice and explore what that technology could be like in 20 years. Teams explore how their visions of technology could work and what breakthroughs are necessary to make their ideas a reality. The competition is sponsored by Toshiba and the National Science Teachers Association (NSTA).
- In the U.S, student mastery of STEM subjects is essential to thrive in the 21st century economy. As other nations continue to gain ground in preparing their students in these critical fields, the U.S. must continue to explore a variety of ways to inspire future generations. Finding ways to improve STEM education activities beyond the scope of the Federal government, including using best practices derived from non-federal sources, is key to the future prosperity of the Nation.

Background

ExploraVision Competition

Now in its 19th year, ExploraVision is a science competition that encourages K–12 students to work in groups of two to four assisted by a teacher and a mentor

to simulate real research and development teams. Students are asked to research a technology of interest and explore what that technology could be like 20 years from now. The technology could be something as basic as a water fountain to something as complex as nanotechnology. Teams investigate how their visions of technology could work and what breakthroughs are necessary to make their ideas become reality. Since 1992, more than 287,000 students have competed in this hands-on competition, sponsored by Toshiba and the National Science Teachers Association (NSTA), which inspires students and fuels imagination.

ExploraVision is designed for students of all interest, skill, and ability levels. The competition is open to students enrolled in public, private, or home school in the United States and Canada. Students compete in four entry categories: Primary Level (Grades K–3), Upper Elementary Level (Grades 4–6), Middle Grade Level (Grades 7–9), and High School Level (Grades 10–12). Judges rate teams on creativity, scientific accuracy, communication, and feasibility of vision. Teams are organized into six regional areas of the United States and Canada. A judging committee selects 24 teams, one for each grade-level category in each of the six regions. All 24 regional winning teams must complete a Web site for its future technology and prototype. Out of those 24 teams, a national judging committee consisting of leading science educators, as well as science and technology experts, selects eight finalist teams. From those finalists, the judges award four first-place and four second-place prize winners. [1]

Prizes include the following:

Students

- First Prize (4 teams): $10,000 U.S. Savings Bond for each student.
- Second Prize (4 teams): $5,000 U.S. Savings Bond for each student.
- National Finalists (8 teams): An expense-paid trip to Washington, DC, in June for ExploraVision Awards Weekend for each national winning student and his/her parents/guardians.
- Regional Winners: A Toshiba CamileoT Camcorder for each student and an awards ceremony for each regional winning team at its school where the team will receive a winner's banner, plaque and other gifts.
- Honorable Mention (500 teams): A unique prize and certificate for each student.
- All Participants: A certificate of participation, entry gift and a special discount on Toshiba computer products for every student whose team submits a complete entry.

Coaches and Mentors

- National Finalists: An expense paid trip to Washington, DC, in June for ExploraVision Awards Weekend for the coach and mentor of each national winning team and a one-year NSTA membership to coaches of the national winning teams.
- Regional Winners: A Toshiba CamileoT Camcorder for the coach and mentor of each regional winning team.
- All Participants: A special discount on Toshiba computer products, certificate of participation and an entry gift for each coach and mentor of every team that submits a complete entry.

Schools

- Regional Winners: A Toshiba laptop for each of the schools of the regional winning teams.

Toshiba America, Inc.

The Tokyo-based Toshiba Corporation is a leading innovator and diversified manufacturer and marketer of advanced electronic and electrical products, spanning information and communications equipment and systems, Internet-based solutions and services, electronic components and materials, power systems, industrial and social infrastructure systems, and household appliances. Toshiba employs over 14,000 people in North America. Toshiba America, Inc., is the holding company for five Toshiba operating companies in the United States, with operations in 13 states and the District of Columbia. [2]

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[1] Data collected from ExploraVision Web site *www.ExploraVision.org*.
[2] *http://www.toshiba.com/tai/*.

National Science Teachers Association (NSTA)

Founded in 1944, the Arlington, Virginia-based National Science Teachers Association (NSTA) promotes excellence and innovation in science teaching and learning. NSTA's current membership includes more than 60,000 science teachers, science supervisors, administrators, scientists, business and industry representatives, and others involved in science education. NSTA seeks to provide opportunities for scientific literacy, excellence in teaching, learning through collaboration, and research that will enhance and improve science education for all students.[3]

STEM Education and the Federal Government

A consensus exists that improving STEM education throughout the Nation is a necessary condition for preserving our capacity for innovation and discovery and for ensuring U.S. economic strength and competitiveness in the international marketplace of the 21st century. The National Academies *Rising Above the Gathering Storm* report placed major emphasis on the need to improve STEM education and made its top priority increasing the number of highly qualified STEM teachers. This recommendation was embraced by the House Science, Space, and Technology Committee following the issuance of the report and was included in the 2007 *America COMPETES Act*. The 2010 *America COMPETES Reauthorization Act* continues this priority.

Beyond activities authorized in *America COMPETES*, President Obama has called for a new effort to prepare 100,000 science, technology, engineering, and math (STEM) teachers with strong teaching skills and deep content knowledge over the next decade. As a component of achieving this goal, the FY12 Budget Request proposes an investment of $100 million through the Department of Education and the National Science Foundation (NSF) to prepare effective STEM teachers for classrooms across America. This proposal also responds to a recommendation by the President's Council of Advisors on Science and Technology (PCAST) to prepare and inspire America's students in science, technology, engineering, and mathematics.[4]

In addition, the FY12 Budget Request proposes $90 million for the creation of an Advanced Research Projects Agency–Education (ARPA–ED) with the mission of driving transformational improvement in education technology.[5]

The President's new "Educate to Innovate" campaign leverages Federal resources with over $700 million in private-sector resources. The goals of the program are to increase STEM literacy so that all students can learn deeply and think critically in science, math, engineering, and technology; move American students from the middle of the pack to top in the next decade; and expand STEM education and career opportunities for underrepresented groups, including women and girls.

With specific regard to K–12 STEM education funding beyond what has already been identified, the FY12 Budget Request calls for $206 million for the Department of Education's proposed Effective Teaching and Learning in STEM program; $60 million (28 percent) increase for NASA's K–12 education programs; $300 million for an "Investing in Innovation" program (expansion of a Department of Education American Reinvestment and Recovery Act program); and $185 million for a new Presidential Teaching Fellowship program.

The FY12 Budget Request devotes $3.4 billion to STEM education programs across the Federal government.[6] The 2010 *America COMPETES Reauthorization Act* called for the creation of a National Science Technology Council (NSTC) Committee on STEM Education to coordinate federal STEM investments. The first-year tasks of the committee are to create an inventory of Federal STEM education activities and develop a five-year strategic Federal STEM education plan. The inventory, as well as a similar Government Accountability Office (GAO) survey requested by the Committee on Education and Workforce, is currently underway and results are expected before next year.

The GAO survey is an update of one last prepared by the Office in 2005. In a 2007 inventory of Federal STEM education programs, the Academic Competitiveness Council (ACC) identified 105 programs and approximately $3.12 billion in FY06 appropriated funds across the Federal agencies for STEM education at all lev-

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[3] *http://www.nsta.org/*.

[4] White House Office of Science and Technology Policy, *Winning the Race to Educate Our Children*, STEM Education in the 2012 Budget, p.1.

[5] White House Office of Science and Technology Policy, *Winning the Race to Educate Our Children*, STEM Education in the 2012 Budget, p.1.

[6] White House Office of Science and Technology Policy,*Innovation, Education, and Infrastructure: Science, Technology, STEM Education, and 21st Century Infrastructure in the 2012 Budget*, p. 2.

els, including 24 programs designed for K–12 students funded at approximately $574 million. However, the ACC set parameters on its inventory, limiting the programs for inclusion to those "primarily intended to provide support for, or to strengthen, science, technology, engineering, or mathematics education." As a result, the ACC inventory excluded many educational activities supported by the Federal R&D mission agencies that are managed through larger research programs and offices, including major research facilities, and that do not show up as separate line items in the budget.

In the 112th Congress, the Science, Space, and Technology Committee will continue to hold oversight hearings and briefings on STEM education activities across the Federal government and will closely monitor the scope and findings of both the NSTC and the GAO Federal STEM education inventories.

Chairman HALL. The Committee on Science, Space, and Technology will come to order, and I say to you a very cheerful good morning, and you have a right to say good morning back if you want to.

I want to welcome you to today's hearing. It is entitled "STEM Education in Action: Learning Today . . . Leading Tomorrow." And by gosh, we have a lot of leaders in front of us, and every one of us from my right to my left and all of us here are very proud of all of you. I will recognize myself first for five minutes for an opening statement, and then we will recognize Ms. Johnson, who is the leader of the Democratic participants here to my right, and Ms. Johnson and I are not only close here physically, our districts are separated by a thin line. We work together, and I have known her for many, many years and always admired her.

I would like to welcome everyone here today for what is the first in a series of STEM Education in Action hearings. The purpose of these hearings will be to highlight various science, technology, engineering, and math—that is the STEM—education activities across the Nation, their role in inspiring and educating future generations, and their contribution to our economic prosperity.

The Federal Government is investing several billions of dollars on STEM education activities, primarily at the Department of Education and the National Science Foundation, but also in every agency under the Committee's jurisdiction. However, there are numerous companies, foundations, nonprofit organizations and other groups who are doing their own part, and on their own dime, to successfully promote STEM education and inspire our next generation of scientists, engineers, entrepreneurs and our leaders.

Today's hearing focuses on one of those successful and impressive initiatives, the Toshiba/National Science Teachers Association ExploraVision Competition. This competition is open to students in grades K–12. Students are asked to research any science technology of their choice and explore what that technology will look like in 20 years. Our witnesses today represent four of the eight winning teams, who as a part of their prize, received an expense-paid trip to Washington, DC, and we welcome you here and we are happy that you received that. I congratulate and all of us congratulate all of the teams for your extraordinary accomplishment of first or second place in this national science competition that attracted over 4,000 entries. All of you are an inspiration to students, teachers and parents all over and all around this country from one ocean to the other.

From 12:30 to 2:30 today, all teams will have their projects on display downstairs in the Rayburn Foyer. I encourage all of my colleagues to stop by and spend some time talking to these incredible students about their impressive award-winning projects.

This Nation has always been the leader in innovation, and our children and grandchildren, like the ones in front of us today, are the key to our future success. I look forward to getting to know more about each of you, why you were moved to do the project you chose, and what all of you, students, parents and teachers, learned by participating in this competition.

[The statement of Mr. Hall follows:]

PREPARED STATEMENT OF CHAIRMAN RALPH M. HALL

I would like to welcome everyone here today for what is the first in a series of *STEM Education in Action* hearings. The purpose of these hearings will be to highlight various Science, Technology, Engineering, and Math (STEM) education activities across the Nation, their role in inspiring and educating future generations, and their contribution to our economic prosperity.

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Chairman HALL. At this time I recognize Ms. Johnson for her opening statement.

Ms. JOHNSON. Thank you very much, Mr. Chairman, and good morning to all. I want to start by congratulating the students who are here today and welcoming you and your teachers, parents and mentors to the Committee. I was reading about some of the winning science fair projects, and I must say that I am truly impressed by all of the outstanding work you have done, and I know that you are proud.

Unfortunately, there are too many students across the country who do not have the opportunities to participate in inspiring STEM activities or to receive a high-quality STEM education. The most recent National Assessment of Educational Progress, the NAEP, study found that less than half of our Nation's students are demonstrating solid academic performance and proficiencies in science, and this is a startling statistic when you consider that the many recent experts report warning that our competitive edge will be lost if we do not vastly improve our STEM education in this country.

No one entity can solve this problem alone. There is a role for all the key shareholders and stakeholders, including Federal and State governments, local school districts, higher education, informal education organizations and industry. I am pleased to hear today about the work Toshiba has done to support STEM education through this ExploraVision competition, and there are many other companies. My hometown company, Texas Instruments, is one of them, Exxon Mobil and also AT&T, so I know that there are many that help to participate.

I also want to emphasize the importance and the unique role of the Federal Government in improving STEM education. Many Federal STEM programs, including those supported by the National Science Foundation and the Department of Education, are really making a difference in our universities, our community colleges, and K–12 schools across the Nation. There are also many valuable programs being funded through other federal agencies, such as NASA, NOAA, NIST, EPA and the Department of Energy. These agencies are filled with thousands of scientists and engineers who make a difference in their own communities and for students across the country. As working STEM professionals, the real-life work that they do using STEM is so inspiring to our young people.

But the Federal role is more than that. The National Science Foundation is the premier STEM education research organization in the country. For decades, the NSF has been a leader in improving our collective understanding of how students learn, and how we can develop the most effective and inspiring curriculum and train the most effective and inspiring teachers. This isn't about the Federal Government taking over curriculum or teacher certification. It is about researchers contributing their deep expertise to making sure that our teachers are well prepared and our students are really learning. I would be interested in hearing from the teachers on the panel today about your own training, and how they have helped you to implement your best practices in teaching STEM in your own classrooms.

While today's hearing is about a non-Federal program, there was some discussion in the hearing charter about Federal programs and spending in STEM, so I just wanted to make a couple of comments about that. I hope you are not too quick to judge based on numbers alone. The OSTP, in response to the COMPETES Act, is leading an effort to inventory current programs across the government to improve coordination and develop priorities going forward. Many of the individual agencies are also responding to recommendations from outside advisory groups and restructuring their education programs and management. While this committee should continue to be vigilant in ensuring that our limited STEM education budgets are being used as wisely as possible, as we have been for many years, I want to express my own confidence in the coordination efforts currently underway. I believe we should let them play out for the next several months before we rush to judgment about what we should or should not be spending on STEM education. And finally, I hope that the committee will have the opportunity to review the OSTP report and other agency STEM efforts in hearings with administration officials.

Today, though, I look forward to hearing from these student winners about what initially sparked their interest in STEM, and what role their teachers, parents and other mentors have played in helping them to reach their goals. This is an issue that I take seriously, and you can check my record. I have been interested in it and talking about it and working at it since 1974. This is an issue that is a serious one. We have an education crisis in this country, and there is a very real possibility that we will lose our competitive edge and that our children will no longer have the opportunities

that we had if we do not remain committed to investing in and improving STEM education.

So thank you again for being here today and I look forward to this very interesting discussion. I yield back.

[The statement of Ms. Johnson follows:]

PREPARED STATEMENT OF RANKING MEMBER EDDIE BERNICE JOHNSON

Good morning and thank you, Chairman Hall, for holding this hearing. I want to start by congratulating the students who are here today and welcoming you and your teachers, parents, and mentors to the Committee. I was reading about some of your winning science fair projects, and I must say that I am truly impressed by all of the outstanding work you have done. You should all be very proud.

Unfortunately, too many students across the country do not have opportunities to participate in inspiring STEM activities or to receive a high-quality STEM education. The most recent National Assessment of Educational Progress (NAEP) study found that less than half of our Nation's students are demonstrating solid academic performance and proficiency in science. This is a startling statistic when you consider the many recent expert reports warning that our competitive edge will be lost if we do not vastly improve STEM education in this country.

No one entity can solve this problem alone. There is a role for all the key stakeholders, including federal and state governments, local school districts, higher education, informal education organizations, and industry. I'm pleased to hear today about the work Toshiba has done to support STEM education through the ExploraVision competition.

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to investing in and improving STEM education. Thank you again for being here today and I look forward to an interesting discussion.

Chairman HALL. The gentlelady from Texas yields back.

If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

I ask unanimous consent that the gentleman from Texas, Mr. Hinojosa, and the gentleman from Michigan, Mr. Peters, be allowed to sit with the Committee and participate in the hearing. Is there objection? The chair hears none.

At this time I would like introduce our panel of witnesses. I yield two minutes to my good friend and fellow Texan, Mr. Hinojosa, to introduce our first team.

Mr. HINOJOSA. Thank you, Mr. Chairman.

As the representative from the 15th Congressional district of Deep South Texas, it is truly an honor for me to welcome the Discovery Montessori School of Edinburg, Texas, to the House Science, Space, and Technology Committee. As the Ranking Member of the Subcommittee on Higher Education, we work closely with this Committee on Science and Space and Technology because together we hope that by 2020 we can be able to generate and accomplish a goal that was set out by the President, and that was to have an additional 100,000 engineers here in our country.

I am delighted to be here to congratulate all the students being recognized from throughout the country but especially I congratulate the students, teachers, parents, coaches and administrators of the Discovery Montessori School for winning first place for grades K through three of the 2011 Toshiba/NSTA ExploraVision Science Competition. What an extraordinary accomplishment. Their winning project, Intelligent Streets, reduces intersection accidents by using smart translucent film installed on windshields that receive signals from either traffic lights or satellites. This clearly demonstrates that students in the Rio Grande Valley of south Texas can become the scientists and the innovators of tomorrow.

We in Texas are extremely proud of the Discovery Montessori School's dedication to academic excellence and for creating a learning environment for children that fosters the development of high-order thinking skills, scientific discovery, exploration and creativity. Today we are fortunate to have three extraordinary individuals with us from that school. Pablo Marcelo Vidal, soon to be a fourth grader, is a resident of McAllen, Texas. We also have the pleasure of saying that Marcelo started school at the age of three at the Discovery Montessori School. He is extremely passionate about science and math and belongs to the Bronx Aquatics swimming team. This impressive young man is a role model for his peers. We also have Veronica Rego Martinez, the team's coach, who is a graduate of the University of Texas at Brownsville and serves as the primary and lower elementary Montessori teacher. Ms. Martinez has a profound love for teaching young children. Dr. Karen Lozano, Pablo's mother, serves as Julia Vechero Endowed Chair of the Mechanical Engineering Department at the University of Texas Pan America. Dr. Lozano earned a doctorate in mechanical engineering and material science from one of our Nation's best, Rice University in Houston, and has received numerous awards for her

extensive research and exceptional teaching. Rita Caldwell from the National Science Foundation visited at UT Pan America and praised her as one of the best professors in the country.

We welcome all of you to today's hearing and thank you, Mr. Chairman, for allowing me this opportunity.

Chairman HALL. I thank you, sir, and you yield back your time?

Mr. HINOJOSA. Yield back.

Chairman HALL. I say to those out there who have Mr. Hinojosa as your Congressman, you are very lucky. He represents his district well and we are proud to have him as we are you, and Jack, we are pleased that you brought your mother with you today, by golly. Actually, our second witness, Mrs. Brenda Conwell-Dudley, accompanied by her son, Jack, they are representing the first-place National winning team for the fourth through sixth grade age group. Their winning project, the Heads Up helmet, is a military helmet designed to protect soldiers on the battlefield. Joining Jack and his mom today are his teammates, Abby Porter and Jovia Ho from Tolbert Elementary School and Sydney Dayyani from Belmont Ridge Middle School. Jack is home-schooled and attends Virginia Virtual Academy. We also welcome the team's coach from the academy, Mrs. Penni Harrison.

I now yield two minutes to the gentleman from Michigan, Mr. Peters, to introduce the third team of witnesses.

Mr. PETERS. Thank you, Mr. Chairman.

It is my pleasure to be here today to introduce two of my constituents, Claudia Cooper and her coach and teacher, Amy Attard. Claudia is an outstanding student at West Hills Middle School in West Bloomfield, Michigan, and is joining us today because she is part of a winning team in the ExploraVision Science Competition. Her teammate, Samantha Tarnopol, is also here as well as teacher Russ Purdy, and I would like to welcome them to this hearing as well.

The ExploraVision challenges students to envision new technologies that will make our society healthier and safer. Claudia's team designed a surgically implantable disc called the Intra-Trachea Breathing System. The disc will improve the quality of life for millions of Americans who suffer from breathing problems and debilitating respiratory conditions. Claudia's work demonstrates how the application of scientific concepts can improve the quality of our life and meaningfully impact our society. In addition to her scientific pursuits and excellent academic achievements, Claudia plays three sports and the oboe, participates in theater and devotes time to charitable pursuits such as working with children with special needs.

Amy Attard is in her sixth year teaching seventh grade at West Hills Middle School. She holds an M.A. in educational technology and a B.S. in elementary education from the University of Michigan-Dearborn. In addition to teaching science, she is actively involved with extracurricular life in West Hills and is committing to promoting very positive culture and morale within the school. She sponsors and mentors students in the Student Leadership Club, which organizes community service projects and also leads the Count Me In Club, which teaches anti-bullying intervention strategies and self-esteem building. She serves as the grade-level team

leader and is a member of the school's budget, leadership and social committee.

When I speak to school groups back home, I always try to stress the importance of our young people in pursuing careers in science and engineering fields. It is certainly important for their future but it is also important for our country's future, and we should be doing all that we can to encourage our young people's interest in these careers. Claudia and Samantha are great role models for their peers, and I wish them the best in their future scientific endeavors. Claudia and Amy, thank you so much for testifying here today, and thank you, Chairman Hall, Ranking Member Johnson, and my Michigan colleague here, Mr. Clarke, for allowing me to stop by the Committee and welcome West Hills Middle School. Thank you for being here. I yield back.

Chairman HALL. And I thank you for yielding back and thank you for that good visit with these youngsters. I know you are proud of them and I know they are proud of you.

Our fourth witness is Ms. Ann Manwell, accompanying her student, Miss Alison Reed, from Stuyvesant High School in New York. They are representing the 10th to 12th grade age group with their second-place winning project, 3Drenal, a kidney bio-printer. We would also like to recognize Alison's teammates, David Kurkovskiy and Norine Chan.

Typically, I would now recognize our first witness, but before I do, I also would like to take a moment to recognize the other four winning teams that are joining us today and who will also be showcasing their winning projects in the Rayburn Foyer following today's hearing. The Solar Tree Team from Countryside Montessori Charter School in Land O Lakes, Florida; the Blindsight Team from Plainview Old Bethpage Middle School of Plainview, New York; the Subway Smart System Team from Horace Mann School in the Bronx, New York; and the Bionic Auditory Prosthesis team from Hopewell Valley Central High School. You are all to be congratulated and commended for your hard work and impressive projects. We look forward to visiting more with you after the hearing.

Before I ask unanimous consent that your names be made a part of the record, let me just tell you that you must be the cream of the crop, the leaders, and it might be of some comfort to you to know that your Chairman, I am from Texas, we have every type of leader here. Ms. Johnson is a leader in the medical field. She is outstanding in the nursing field. We have all types of folks that are skilled but we look to you all to give us testimony to write our record, and what you say here will be recorded and it will be read 100 years from now and they will look back on this fine young group that came here. It may give you some ease to be here to know that your chairman was such a bad student, one semester I made four Fs and a D, and my dad whipped me for spending too much time on one subject.

I ask unanimous consent that their names be made a part of the record, all of you. As our witnesses should know, spoken testimony is limited to five minutes, so we won't just hold you to that. Try to stay as much as you can. We are so honored to have you here, we will go over, or if you want to give us back a little time, we will

accept it. After which the Committee will have five minutes each to ask questions.

I now recognize the first witness duo, Dr. Karen Lozano and Master Pablo Vidal. I now recognize Mrs. Brenda Conwell-Dudley and Master Jack Dudley.

STATEMENT OF DR. KAREN LOZANO, PROFESSOR AT UNIVERSITY OF TEXAS PAN AMERICAN, PARENT TO PABLO VIDAL, AND MENTOR TO THE I.STREETS (INTELLIGENT STREETS) DISCOVERY MONTESSORI SCHOOL TEAM, MCALLEN, TEXAS

Dr. LOZANO. Thank you very much. Thank you for the introduction. Congressman Hinojosa, thank you for the introduction.

As Congressman Hinojosa mentioned, I am a Professor at the University of Texas Pan American, and growing myself in a field that is underrepresented, you know, by females. I was the fifth woman to get a degree in 25 years at my university had existed at the time in mechanical engineering, and when I went to Rice I also realized that I was only the fifth woman to get a doctoral degree, you know, in mechanical engineering. So I knew how engineering wasn't something that kids will look after.

So I started doing a lot of community service to try to encourage, you know, engineering with kids. So I was very happy when Jessica Vera, one of the former teachers, asked me to participate in ExploraVision. ExploraVision is just very well prepared. You know, the guidelines and everything is just an absolute, you know, program, you know, just an amazing program, and the kids go from—you know, they learn teamwork, history, ethical issues, they learn technology, and it is amazing how when I sit with them and I say okay, come up with ideas, you know, you need to think of something that, you know, will make the world better or will save people's lives or, you know, will help people that are suffering. You know, they come up with amazing ideas that at our level as adults sometimes we don't think of. You know, we can find all kinds of obstacles why that is not possible.

So once they find an idea that they agree that it is possible, then we move into, you know, okay, let us study the present technology, let us study the history, and the future technology. You know, I explain to them, you know, concepts on, you know, how we think, you know, it is possible. Sometimes maybe I even think, you know, that it might not work, you know, but we have to explain the technology behind the idea, you know, to them, and it is just amazing how they learn. Like you can ask him about the electromagnetic spectrum and, you know, he goes oh, you know, the radio waves. You know, it is just amazing how they grasp, you know, the ideas and how the whole program, you know, helps them develop a desire or a passion to pursue science and to learn about what is around them, you know, go around and just think, you know, what is it they can improve, how can they be—how can they develop a technology that will benefit society. So they are engineers, and I guess we are all born engineers. You know, we all played with Legos. But I have seen, you know, working with K–12 how like around fifth grade they start losing that. You know, you get great ideas up to

fifth grade and then they kind of, you know, start tapering down and it kind of goes down, and I have implemented ExploraVision guidelines within my college classes, the senior-level classes, and I ask the students the same thing. I say you are going to follow ExploraVision guidelines and this is your final project, and they have to come up with whatever class we are doing, if it is plastics or nanotechnology or whatever the topic of the class is, they have to come up with a project, you know, that is nonexistent that could be here in 20 years from now, and it is amazing out of the many, many, many projects I have seen, the little ones, they still have brighter ideas, you know, than my college students. Of course, they do an awesome job explaining the technology, you know, in technical terms and all of that, but as far as the idea, you know, I guess the younger the kids, you know, the ideas are, you know, far better.

So we can't afford to lose that creativity, so within the school it is a good idea to give them that freedom to explore, you know, give them that—you know, just maybe implement something like ExploraVision, you know, within the classes. You know, the teachers can implement something related to ExploraVision because it allowed the kids to, you know, innovate. It allowed the kids to explore, and it keeps them engaged, you know, in finding out. Because once they learn that they can look around and find something that could work better, you know, that is a process that they will keep on, you know, for the rest of their lives.

One of the things that I sponsored several years ago, now the kids are going into high school, they were fourth graders, and all of them are going into the science area. They are going into scitech, you know, most of the kids. So it really leaves a very good impression on themselves, you know, and they want to keep on doing it. Next year they are going to try again to do the ExploraVision competition, the high school kids.

So I think it is a great model that could be followed for science education. Thank you.

[The statement of Dr. Lozano follows:]

PREPARED STATEMENT OF DR. KAREN LOZANO, PROFESSOR AT UNIVERSITY OF TEXAS PAN AMERICAN, PARENT TO PABLO VIDAL, AND MENTOR TO THE I.STREETS (INTELLIGENT STREETS) DISCOVERY MONTESSORI SCHOOL TEAM, MCALLEN, TEXAS

Good morning, Committee Members and ExploraVision winners. My name is Karen Lozano. I am a professor of mechanical engineering at the University of Texas Pan American, and the mentor and parent of one of the team members of the K–third first place national winners.

As I started my college years, I realized that engineering was not a popular major, even less among girls, I was the fifth woman to graduate with a mechanical engineering degree in the 25 years that my university had existed. Pursuing later an M.S. and Ph.D. degree at Rice University and joining later the faculty at UTPA, I kept on realizing how little people knew about engineering and how severe the stereotypes were for girls. I was blessed that my mom supported me when deciding to study engineering and was blessed to have a Ph.D. advisor that was highly committed to K–12 education; therefore, it became natural to me that the only way to change perceptions was to be active in our community and be there to talk to kids and parents as well. At least once a month I give magic and science shows, talk to parents of middle and high school students, participate in science fair judging or offer lab tours to K–teachers. I have seen how important these activities can be and have also observed interesting patterns in science attraction of kids.

Being involved in these activities, I was very attracted to participate in ExploraVision when my older son's teacher brought it to my attention back in 2006.

I read the rules and visited the Web site and observed how many of the winning ideas expressed by kids 10–15 years ago were now in the market. Miss Jessica Vera and myself worked with the first team of third graders; I was amazed how kids could come up with great ideas and when guided into the technology behind their ideas, they learned and grasped technical concepts otherwise not taught until later in high school/college level.

In 2006, the team won honorable mention; in 2007 now the kids in fourth grade, they became first place national winners, the experience was even better, now the kids not only learned about a technology but needed to communicate it verbally in front of an audience. This ability has proven extremely beneficial for these kids now starting high school next fall. In 2008, a different team of students (fifth and sixth graders) won second place national award. In 2009 I mentored two teams, with ages ranging from first to sixth grade, and this year one team of third graders.

Besides being a mentor I have incorporated ExploraVision rules in my college classes. The ability to be creative while incorporating scientific knowledge is one of the basic definitions of engineering; therefore it has worked very well in my upper division classes. The ExploraVision competition is extremely well designed and at a young age allows the kids to "dream," at a college age allows kids to develop technologies based on their current learned material, as I asked them, for example, in a polymer engineering class, to look for applications where polymers are not used yet and evaluate their implementation according to the ExploraVision rules or in the nanotechnology class, to develop a new application.

Let me explain the methodology that we follow when preparing for an ExploraVision competition. The kids, teacher and myself meet for about five months, one afternoon a week at a local library room (to avoid distractions); the first four to five meetings are basically to come up with an idea, it is interesting to find out how their ideas are quite novel. Many of those already being researched or coming to the market though the kids were not aware of, therefore for them were novel ideas, and I have been very impressed how if they are encouraged or motivated to be creative they are full of surprises. This ability is many times lost in school age as time passes and kids stop play-pretend. It is very important to keep sparking technological creativity. How can society be benefitted by one of your ideas? A question that school age kids can be asked every year. After voting for an idea, students were asked to choose areas that they were most interested in working on though all of them needed to research all areas, as you are probably aware of. The ExploraVision sections are (I will use the current winning project I.STREETS as an example; in this project they decided to incorporate traffic lights within the windshield of the car):

- Present technology; students researched how traffic lights work.
- History: learned about the history of traffic lights.
- Future technology: this area is where they explained how they envision their idea to work in the future though also need to explain it with some science principles; this is where the help from a mentor, especially for the K–six age groups, comes into play. In this case, as a mentor, I explained to them the electromagnetic spectrum (infrared waves, visible waves, radio waves), explained to them about smart films that could respond to a signal with colors; it is surprising how they grasp the information right away and then they are able to explain it.
- Breakthroughs: they basically explained why their technology is not possible now, besides other aspects in their case is because we do not have yet a translucent film that could respond to a signal in only red, yellow and green colors in order to be glued between the windshield glass.
- Design process: the kids basically do this section on their own, explaining how they worked, when they met, and what other ideas they thought of.
- Consequences: here students find that all they invent will always have positive and negative results. They can also do this completely on their own and they come up with important ideas.
- References: they learned that every time they research something they have to give credit to the one that had the idea first.

As you can see, the ExploraVision competition is a project that not only encompasses technological creativity but encourages students to think beyond the technology and incorporate within the learning process, team work, history, entrepreneurship, and ethical issues (consequences) among other issues. Even though one student is the one that usually has the idea first, carrying out the project allows for a full development of the idea from conception to implementation; therefore, at the end all of them are considered inventors of the idea.

As you can tell, I am particularly impressed with the ExploraVision competition and have enjoyed working with all students since 2006. They usually have formed the team based on friendship, not necessarily they have been from the same school and actually if it is not carried out as a school project has proven beneficial to meet outside of school at a local library. I personally do not think this project is a matter of resources for the school; there are no costs that participants incur rather than their time. I am aware that some schools do it as part of a class project and I believe that is a great idea and from grades K–six could be incorporated within their curriculum where the different sections will be carried out during different courses (history, science, cultural). For the older age group kids, they can do it in the science class as a semester project. Just by asking the questions about inventing something, students will go around their life looking at what can be improved one way or another; you encourage them to keep their creative nature (as all kids are born engineers, always looking around, building and connecting dots) and problem solving skills rather than teach them to wait for information to be provided and expecting them only to learn what they are asked to learn. When kids are given the opportunity to explore through a project like ExploraVision they can surprise us greatly. One of the other winning teams that I had the pleasure to work with where they invented a spray that when placed in the tongue changes the taste buds so broccoli could taste as chocolate and sweets will taste as broccoli; it was, as I-Streets and the other projects, very interesting.

As for parents' and teachers' participation, I believe their role is extremely important, as I always tell my graduate and undergraduate students when we are invited as judges for science school fairs of young kids, we will find projects that clearly you can tell that parents have been involved and that is absolutely great as long as the child can explain what they did and is excited about it. Parent participation is definitively very important and has proven vital for student success in academics, sports, arts, etc.

Chairman HALL. I congratulate you. You were right on the dot, Five minutes.

Now, Jack, is it okay with you if I recognize your mom? Okay. Brenda Conwell-Dudley, we recognize you for five minutes.

STATEMENT OF MRS. BRENDA CONWELL-DUDLEY, PARENT TO JACK DUDLEY AND MENTOR TO THE HEADS UP!, VIRGINIA VIRTUAL ACADEMY TEAM, LEESBURG, VIRGINIA

Mrs. CONWELL-DUDLEY. Good morning, Chairman Hall, Ranking Member Johnson, Members of the Committee and to all the finalists, teachers, mentors and organizers of the Toshiba/NSTA ExploraVision National Science Competition. On behalf of our sponsoring school, the Virginia Virtual Academy, our coach, Mrs. Penni Harrison, and our team, I would like to thank the Committee for inviting us to this hearing.

This is my second year as an ExploraVision team mentor for the fourth through sixth grade age group. I heard about ExploraVision from a mother at one of my son's flag football practices about two years ago. Her son Joshua was a player on the team, was critically allergic to many foods and much of his surroundings. He had actually flatlined in an emergency room that summer and had been brought back to life using intubation without anesthesia after one particularly bad allergic reaction. He was nine years old. He was being treated at the National Institutes of Health in Bethesda for his condition, and while receiving treatment at the NIH, Joshua met another young boy named Colby Tomasello. Colby is a member of the 2009 ExploraVision second-place national winning team and he and his teammates designed an EpiWatch. It is a small, wearable, computerized watch that contains special codes and microneedles that instantly deliver painless doses of epinephrine when the wearer suffers an allergic reaction.

After hearing about Colby's project and after visiting the ExploraVision web site, I was so impressed by what young children could invent that if the opportunity ever arose I promised myself that I would encourage my son to participate. Not more than a week later, his school posted a notice in the student newspaper that they would be sponsoring teams for the first time. I immediately asked my son about participating. He agreed, and invited three of his friends from the fifth grade to join. His 2010 team designed a food poisoning detection device, and it was lightweight, portable and could be used to detect dangerous pathogens in food.

Now we would like to present background and information on our team and our project for Members of the Committee. Our team is comprised of four students who came to know each other through swimming. An important distinction with this year's team is that our four students represent three different schools. Jack was homeschooled using Virginia Virtual Academy's online sixth-grade public school program. Abby Porter and Jovia Ho attend fifth grade at Tolbert Elementary School in Leesburg, and Sydney Dayyani attends sixth grade at Belmont Ridge Middle School in Lansdowne. I would like to take a moment to thank the Virginia Virtual Academy for sponsoring our team and for giving us an unparalleled opportunity to work together: male and female students, elementary and middle school students, home-schooled and brick-and-mortar public school students. I think our team represents the best of the collaborative spirit, and as we all know, collaboration in the field of science is how society will find solutions to the complex and very serious problems that confront us as a Nation.

Starting last September, our team began meeting every week for two hours. The team read news articles and news magazines to become familiar with current events and advances in science and technology. The team brainstormed and discussed multiple ideas over several weeks. The team communicated with our coach, Mrs. Harrison, using Illuminate Lives Web conferencing program. My son frequently uses the program for his online schooling, and it proved to be a great resource for our science team too.

Our team brainstormed several projects, and then Jack saw the picture of Specialist Robert Warren in the Washington Post. Specialist Warren is a soldier who suffered traumatic brain injury from an IED while serving in Kandahar, Afghanistan, in May 2010. Jack selected the idea of creating a helmet that would protect U.S. soldiers from traumatic brain injury due to roadside bombs with a device the team called the Heads Up helmet. The team's design features overlapping polyethylene plates, sophisticated heat and air-pressure sensors, bullet—and shrapnel—stopping gels, and a 360-degree neck collar that inflates to protect the brain and neck in case of a bomb blast.

The team further decided that they would take the proposed technology from the battlefield to the playing field in 20 years or less to help prevent the growing number of concussions in children and athletes with a device called the Heads Up headgear.

Our team has learned a lot about working on an interdisciplinary project. They have learned how to organize and present their knowledge more effectively, and as a result, they have sharpened their communication skills. I am hopeful that participation in this

competition will ignite an interest for members of our team in STEM-related fields but I know that they have at the very least developed a better understanding of the world around them, and I would like to thank the Toshiba Corporation for sponsoring the competition and the National Science Teachers Association for administering this event. Thank you very much.

[The statement of Mrs. Conwell-Dudley follows:]

PREPARED STATEMENT OF MRS. BRENDA CONWELL-DUDLEY, PARENT TO JACK DUDLEY AND MENTOR TO THE HEADS UP! VIRGINIA VIRTUAL ACADEMY TEAM, LEESBURG, VIRGINIA

Good morning to Members of the Committee and to all of the finalists, teachers, mentors, and organizers of the Toshiba/NSTA ExploraVision National Science Competition. On behalf of our sponsoring school, the Virginia Virtual Academy, our coach, Mrs. Penni Harrison, and our team, I would like to thank the Committee on Science, Space, and Technology for inviting us to this hearing. This is my second year as an ExploraVision science team mentor for the fourth through sixth grade age group; I mentored a regional winning team in 2010, and I am a mentor for the first place winning team in 2011. I would like to describe my motivation for participating in ExploraVision's program.

I heard about ExploraVision from a mother at one of my son's flag football practices, in the fall of 2009. Her son, Joshua, a player on the team, was critically allergic to many foods and much of his surroundings. He had flat-lined in an emergency room that summer and had been brought back to life using intubation without anesthesia after one particularly bad allergic reaction. Joshua was nine years old, and he was being treated at the National Institutes of Health (NIH) in Bethesda for his condition. While receiving treatment at the NIH, Joshua met another young boy with similar critical allergies. This second little boy was Colby Tomasello; Colby is a member of 2009 ExploraVision second place national winning team and he and his team mates designed an EpiWatch—a small, wearable, computerized watch that contains special codes and microneedles that instantly deliver painless doses of epinephrine when the wearer suffers from an allergic reaction. The EpiWatch utilizes cell phone and GPS technology to alert medical officials in the event the wearer suffers a life-threatening allergic reaction.

After hearing about Colby's project, and after visiting the ExploraVision Web site, I was so impressed by what young children could invent that if the opportunity ever arose, I promised myself that I would encourage my son to participate. Not more than a week later, his school posted a notice in the student newspaper that they would be sponsoring teams in the ExploraVision National Science Competition for the first time. I immediately asked my son about participating—he agreed and proceeded to invite three of his friends from the fifth grade to join. Jack's 2010 science team designed a food poisoning detection device that looked like a thumb drive, was lightweight and portable, and could be used to detect dangerous pathogens in food. This year's team designed a military helmet to protect soldiers from traumatic brain injury from roadside bombs. I am a huge fan of ExploraVision's science competition, a contest that encourages children in grades Kindergarten through 12th to select a current technology and imagine what it might be like in 20 years. And I am continually amazed by the originality of the students' inventions and the great advantage to society that all of these ideas could potentially provide.

Now I would like to present background information on our team and more detailed information on our project for Members of the Committee. Our team is comprised of four students who came to know each other through swimming. All four team members swim year-round for the nationally recognized Curl-Burke Swim Club and in the summer for the Old Dominion Swim League. As I mentioned, my son had been part of a regional winning team the year before, and in accordance with the rules of the competition, he was not allowed to compete with members of his previously winning team—nor will the children sitting with us today be allowed to compete together as a team next year, or ever again. My son has benefited greatly in this regard: his 2010 regional winning team was all male, and each of the four boys were in advanced math class together. This year's team is predominately female, and while all of these girls excel in math, my son's association with them is through sports. Suffice to say, successful teams come in all shapes and sizes.

Another important distinction with this year's team is that our four students represent three different schools; Jack was homeschooled using Virginia Virtual Academy's online sixth grade public school program, Abby Porter and Jovia Ho attend

fifth grade at John E. Tolbert Elementary School in Leesburg, and Sydney Dayyani attends sixth grade at Belmont Ridge Middle School in Lansdowne. I would like to take a moment to thank Virginia Virtual Academy and Suzanne Sloane, who is the Head of the School, for sponsoring our team and for giving us an unparalleled opportunity to work together: male and female students, elementary and middle school students, homeschooled and "brick and mortar" public school students. I'm a little biased, but I think our team represents the best of the collaborative spirit, and as we all know, collaboration in the field of science is how society will find solutions to the complex and very serious problems that confront us as a nation.

Starting last September, our team began meeting every week for two hours. The team read news articles and news magazines to become familiar with current events and advances in science and technology. The team brainstormed and discussed multiple ideas over several weeks. The team communicated with our coach, Mrs. Harrison, using Elluminate Live's Web conferencing program. My son frequently used this program for his online schooling, and it proved to be a great resource for our science team too. Mrs. Harrison provided us with constructive and invaluable feedback every step along the way, and the team was always eager and excited to use the new communication platform to present their ideas to her.

Some of our team ideas included a stress-releasing ball that would decrease workplace stress, a protective satellite shield to minimize space junk collisions, and a brain-powered car. With Google's announcement of a "Self-Driving Car" within the same time frame, the team realized how quickly the world around them was changing and how important it is to stay on top of the latest developments in science. And then Jack saw the picture of Spec. Robert Warren in the Washington Post. Spec. Warren is a soldier who has suffered traumatic brain injury from an IED while serving in Kandahar, Afghanistan, in May 2010. Jack selected the idea of creating a helmet that would protect U.S. soldiers from traumatic brain injury due to roadside bombs with a device the team called the HEADS UP! HELMET. The team's design features overlapping polyethylene plates, sophisticated heat and air pressure sensors, bullet and shrapnel-stopping gels, and a 360-degree neck collar that inflates to protect the brain and neck in case of a bomb blast.

The team further decided that they would take the proposed technology from the battlefield to the playing field, in 20 years or less, to help prevent the growing number of concussions in children and athletes with a device call HEADS UP! HEADGEAR. This futuristic design features micro layers of impact-resistant, molecular-weight polyethylene sheets spun and covered with highly sensitive temperature and air pressure sensors to detect concussive force. These impact-resistant sheets are also encapsulated with shock absorbing gel that expands to form a protective cushion; instant cold crystals provide metabolic cool-down to prevent intracranial pressure (ICP) build-up—one of the most dangerous results of TBI; and lavender or eucalyptus aromatherapy beads deliver post-impact sensory relief to prevent shock. These composite materials expand under force, extreme air pressure or temperature to ultimately protect the brain from mild, moderate or traumatic injury.

Our team used all of the research tools at their disposal, including conducting email interviews of doctors, engineers and researchers from across the United States—from the University of Washington in Seattle to the University of Maryland in College Park. Using interviews, the library and the Internet, our team worked diligently to learn as much as they could about healthy brain function, traumatic brain injury and the science behind the state-of-the-art technologies surrounding helmet design.

The team's 11-page written submittal and five-page simulated Web designs documented the history and the present technology of helmet design, and included a detailed description of their future design, the scientific breakthroughs necessary to make their new invention a reality, and the future technology's positive and negative consequences. I'm proud to say, the team finished their submittal for the regional competition a full three weeks in advance of the February deadline.

As regional winners, the team was required to expand upon the work they submitted in the first phase in order to compete in the national competition: The team began working right away and they were back to meeting two hours every week, AND on the weekends! They began by building the prototype models. The team felt it was necessary to build a model of both their present AND future inventions in order to better explain their Helmet's design process. After the models were complete, the team worked to find the most compelling clips for their two-minute video. They edited and practiced their parts to ensure the video would tell the complete story of their invention. The Web site is a compilation of all the work the team has done to date and provides a degree of user interface that makes the Web site educational and interesting. Once again, I'm proud to say, the team finished their final submittal for the national competition well in advance of the April 8th deadline.

The national winning teams were announced on May 2, 2011, and here we are. Our team has learned a lot about working on an interdisciplinary project. They have learned how to organize and present their knowledge more effectively and, as a result, they have sharpened their communication skills. I am hopeful that participation in this competition will ignite an interest for members of our team in STEM-related fields, but I know they have, at the very least, developed a better understanding of the world around them. I'd like to thank the Toshiba Corporation for sponsoring the competition and the National Science Teachers Association for administering this event.

And on a tragic, personal note, I would like to offer our coach, Mrs. Penni Harrison, our deepest sympathy on the loss of her husband. We have collaborated with Mrs. Harrison since September 2010, and in all of our team discussions regarding the design of our military helmet, we did not know until six days ago that her husband, COL James W. Harrison, Jr., was killed in action in May 2007 while serving as the Corrections and Detainee expert in Afghanistan. We are very, very sorry for her loss, and we realize that our research, discussions and presentations may have revived painful memories for her—and yet she was always so kind, supportive, and positive when we presented our information to her. Mrs. Harrison truly exhibits the patriotic selflessness of the American military family. It is an honor and a privilege to have worked with her, and we could not have asked for a better teacher, coach, and role model.

Chairman HALL. Thank you. You too are right on the dot. You all might set a record here today.

I now recognize Amy Attard and Miss Claudia Cooper for five minutes. Thank you.

STATEMENT OF MRS. AMY ATTARD, SCIENCE TEACHER AND COACH TO THE I-TBS: INTRA-TRACHEA WEST HILLS MIDDLE SCHOOL TEAM, COMMERCE, MICHIGAN

Mrs. ATTARD. Good morning, Chairman Hall and Ranking Member Johnson, as well as the other Members of the Science Committee. I want to thank you for giving me this opportunity to share the amazing experiences that students at West Hills Middle School have the opportunity to take in, to be a part of in the science classroom.

The ExploraVision program has become a tradition here at West Hills. This is my sixth year being a sponsor of the program, and every year it evolves and it gets better and better. This year along with Claudia Cooper and Samantha Tarnapol, we also in addition to the second-place title had nine honorable mention teams as well, and back in 2008 I had the privilege and honor of coming back to the ExploraVision weekend and I was also the coach of a team back in 2008 who also took the second-place national title. So the ExploraVision program is near and dear to my heart.

Over time, as I have carried out this program with the students, changes have been made to make it better, to increase the amount of science skills, math skills, engineering skills and this year we really focused on the process of the program. We decided to create an interdisciplinary unit where myself as the science teacher, along with Russell Purdy, the language arts teacher, decided to work in tandem with the students this year to make it more meaningful for the students to bridge their learning process between science education and the language arts classroom.

In science, we focused on what is called the design cycle, which is part of the international baccalaureate program, where the students had to investigate possible invention ideas. They then together as a team had to research the positives and negatives of

their invention and then they had to decide and reflect on which invention they wanted to choose to carry out for this project. In science, they worked together as a team. In language arts, they worked together as a team but more at an independent level. In language arts, the language arts teacher focused on teaching the research process as well as note taking, citing sources of information, and in science, we focused on the collaboration and the communication that needs to take place in order for a team to be successful.

The unit question to get the ball rolling for students was, how can my creativity impact society. We wanted this project to be meaningful for the students so they would have that personal buy-in, so they would be engaged in the topic at which they were researching. So we posed the question: what technology do we currently have today? We looked at current technology, how it has changed and evolved over time, and we also looked at famous inventors and what they have contributed to our society that we still use and benefit from today, and these questions that the students had kind of set the structure and the framework for them to get the ball rolling in terms of what impact did they want to make, who did they want to improve, who was their audience going to be.

So again, we wanted this to be more about human ingenuity, their innovation, their creativity, the limit—or the possibilities were endless. There was no limit to their research, as long as they were learning at the same time and the process that they went through in terms of reflecting and going back and starting the process all over again if they found that, you know what, my idea wasn't working or the technology isn't possible. So from our end, from a teacher's perspective, yes, the project was amazing but it was more about the process: how did you get from point A to point B, to build this wonderful innovative idea.

In addition to the ExploraVision program, we also offer other competitions, science competitions to spark STEM education, which involve the Dupont Science Essay Competition, the Detroit Science and Engineering Fair as well as the Sunrise with Shade Poster Contest. From a teacher's perspective, we have homework that we can check. We work with the parents for the support that they give the school district and they help their children, but going through programs like the ExploraVision and these other science competitions allow the community, whether it be the local community or the global community, to be able to see what is really taking place in the classroom and all the wonderful things that students are now doing today, and it is a great way for them to showcase and highlight their own successes.

ExploraVision is a great venue for differentiation. It allows students to reach their maximum potential. The students that wanted to learn more about one area of technology had that opportunity to do so. Students became experts based on their own invention that they chose to do for this project. So we had multiple groups working in multiple directions, but at the end, we were all able to come back and collaborate at the same time.

Along with the human ingenuity, our goal is to strive for lifelong learners. We want students to become inquirers. My goal as a teacher is to make students want to ask questions. I want them to

ask me questions. I don't want to force-feed them information. It is more meaningful if they have that personal buy-in and that engagement in science education, and through the ExploraVision program and all of these other wonderful science competitions, we are moving in that direction, and as a teacher, to see my students smile every day when they come in and say what are we doing today, I can't wait, what are we learning today, can we look at this, can we talk about this today, to me, my job is easy. They are the ones who are coming in with the inquisitive mindset of wanting to learn more about science.

So I want to thank you for this opportunity to share my passion as a science teacher and the importance of enriching and engaging students in STEM education to become lifelong learners and successful members of society today and 20 years from now. Thank you.

[The statement of Mrs. Attard follows:]

PREPARED STATEMENT OF MRS. AMY ATTARD, SCIENCE TEACHER AND COACH TO THE I-TBS: INTRA-TRACHEA WEST HILLS MIDDLE SCHOOL TEAM, COMMERCE, MICHIGAN

Good morning, Committee Members and national winning teams. My name is Amy Attard, and I teach seventh grade science at West Hills Middle School in West Bloomfield, Michigan. I have been teaching for six years in the Bloomfield Hills School District, which serves suburban students north of Detroit. I would like to take this opportunity to share with all of you the wonderful enriching and engaging experiences students can have as part of their science class.

The Toshiba/National Science Teachers Association ExploraVision Program is just one venue that provides a challenging opportunity for students to become excited about science. This program encourages students to think of an invention that could come to life 20 years in the future. West Hills Middle School has been participating in the ExploraVision Program for over 10 years; it has become a tradition at the seventh grade level. This year we were fortunate to have one of our teams take home the second place title in the nation for the seventh–ninth grade category. The Intra-Trachea Breathing System Team (I-TBS) team made up of seventh graders Claudia Cooper and Samantha Tarnopol chose to work successfully as a team of two, which meant they had double the amount of work compared to a team of four. This year's top winners were selected from a group of 4,346 team entries. Through Claudia and Samantha's hard work and determination, they won a number of prizes for themselves and West Hills alike. West Hills was awarded a Toshiba laptop computer and the mentor, Russell Purdy, and I were awarded Toshiba HD camcorders, along with Claudia and Samantha. In addition to the amazing technology, both Claudia and Samantha were awarded a U.S. EE Savings Bond worth $5,000 and an all-expenses-paid trip to Washington, DC, to attend the ExploraVision Awards weekend along with their families and teachers. In addition to Claudia and Samantha's great success, nine other teams from West Hills earned honorable mentions in the ExploraVision competition. Along with receiving notoriety, the honorable mention groups also received a gift for their accomplishments in addition to every participating group receiving an award and a small participation prize. We continue to promote the ExploraVision Program at West Hills because it allows students to think creatively, and provides them an opportunity to look into their future. In doing so, students are challenged to use their ingenuity to plan, research, and design a product that will benefit mankind. This model forces students to think globally, use problem solving skills and incorporate technology, all skills that are paramount in the future of education. Overall West Hills has done very well in the competition. For the past six years that I have been enriching students with this project, we have always been awarded with at least one honorable mention team,and in 2008 I had the privilege of coaching another team that also took home the second place national title.

The ExploraVision competition is part of a mandatory class assignment in both science and language arts classes. The unit is designed to be interdisciplinary between the two subjects, as both classes worked in tandem to complete the rigorous requirements of the program. Through their science class, students chose their own partners for the project. Each group was made up of seventh graders, and they are all from West Hills. Two hours of each day, one hour in science and one in language

arts, were devoted to work on this project, which was three weeks in duration. During science students worked collaboratively, and in language arts they worked independently. In science the unit was looked at through the lens of scientific research, and the process of the project was presented using the Design Cycle model. The Design Cycle model, which is part of the International Baccalaureate program, is a way for students to problem solve and continually evaluate and reflect on their process as they worked through the project. In addition to the scientific research aspect of the project, the students focused on collaborating and communicating with their team as they worked through the Design Cycle to brainstorm invention ideas and proceed through the research process. At the same time, in language arts class students learned how to properly take notes from various sources, write a research paper, evaluate sources, and cite all of their information correctly. Overall, this project allowed students the opportunity to be creative and forced them to think 20 years into the future. But more importantly, through this project students developed the skills of being an inquirer, a problem-solver, and a communicator and hopefully they will take these skills with them as they move forward in school and eventually out into the real world.

In order to inspire students we looked at famous inventors and how their inventions have contributed to our everyday lives, and to stimulate the innovative minds of the students we posed the question "How can my creativity impact society?" In order for students to move forward they had to answer the following questions: (1) What did I want to improve? (2) Who was my audience going to be? (3) Why would people want my invention? These questions set the stage for students to investigate possible invention ideas, which then led to sketches and design briefs of each invention, and finally students researched the positives and negatives of each idea and its impact it would have on society. From their investigation, each group then collectively selected the idea they wanted to move forward with for the project. Russell Purdy and I provided the structure, deadlines, and rubrics for the students in both science and language arts class, while the students divided up the project equally among their team and set their own goals and expectations for each individual member. While working on this project, students researched information, interviewed family members who had knowledge in certain areas, and in some instances even held phone interviews with companies that sold products related to their invention ideas. The final piece of the project was the culminating research paper and the creation of the Web page graphics, which provided a great opportunity for students to learn various drawing programs on the computer and actually see their process and invention come to life in front of their own eyes through their graphics they created.

In addition to the ExploraVision competition, I also encourage students to participate in other science competitions throughout the school year. Other science competitions in which some of my students participate in are the Science and Engineering Fair of Metro Detroit, The DuPont Challenge Science Essay Competition, and the SunWise with SHADE Poster Competition. Students have done particularly well in these science competitions. This year a current seventh grader took first place in the nation for her poster entry in the SunWise with SHADE Poster Competition and five students across grades seven and eight placed in the Science and Engineering Fair of Metro Detroit.

Overall STEM projects, such as the ExploraVision competition, continue to emphasize the relevance and real-world application of science, math, engineering, and technology. These projects also allow schools to showcase the amazing skills that many of our students possess; skills that might otherwise go unnoticed in the community at large. As teachers it is our role to make sure our students are ready for the future. Whether the future is the next grade level, college, or the workforce, having a good foundation and knowledge in the areas of math and science are important in and out of the classroom. As our society continues to grow into a digital world, technology skills are becoming more of a necessity rather than just a skill. Furthermore, when looking at engineering, the process of being able to problem solve, collaborate with others, and continually reflect is relevant in and out of the classroom, and more importantly it is what makes students become inquirers. As curriculums continue to become more rigorous for students, it is important for teachers and parents to work together and support students so they can reach their maximum potential and, more importantly, see the relevance in what they are learning in order to become life-long learners and successful members of society.

Chairman HALL. Thank you. You were just almost on time, by gosh. You and Jack's mom and Dr. Lozano really expressed your-

self well, and it was interesting, everything you said, and we thank you for it.

I now recognize Ms. Ann Manwell and Miss Allison Reed to present testimony.

STATEMENT OF MS. ANN MANWELL, SCIENCE TEACHER AND MENTOR TO THE 3DRENAL: KIDNEY BIO-PRINTER STUYVESANT HIGH SCHOOL TEAM, BROOKLYN, NEW YORK

Ms. MANWELL. Good morning, Committee Members, colleagues and students. I am Ann de Sostoa Manwell and I have been teaching at Stuyvesant High School, a specialized New York City public high school for math, science and technology, for 14 years.

All the students at Stuyvesant took a qualifying test to be offered a seat at the school, and we have a very rich history of student research and success in student science competitions like Intel/Science Talent Search, Siemens Competition and the International Science and Engineering Fair. We can boast four Nobel laureates among the many scientists, mathematicians, engineers and physicians who are alumni.

But schools like Stuyvesant and all the specialized high schools in your States do not operate in a vacuum. We need the farm teams that you heard about earlier today. I would like to take this opportunity to speak to you today about the role competitions like Toshiba ExploraVision play in developing the students with the skills necessary to participate in our programs.

We at Stuyvesant have found that engaging students in these competitions allows them to be creative, think broadly and critically of the world around them, work in teams, develop time management skills and take ownership of a project. No one now at Stuyvesant remembers when ExploraVision became part of the 10th-grade research chemistry curriculum, but it was probably very close to its 1992 launch. The current chemistry teachers, Samantha Daves and Zhen Chuan Li, have continued to use ExploraVision as a powerful motivating force to develop student skills in scientific thinking.

As you have heard, the ExploraVision competition requires teams of students to take a current technology and push it 20 years into the future. Ms. Daves' teams bounced ideas off of each other, brought in classmates from other sections, grilled parents, consulted online sources for their choice of current technology to develop. The 3Drenal team of Norine Chan, David Kurkovskiy and Alison Reed took an article found by Alison's mother on bio-printing and combined it with what they knew about adult stem cells and signaling molecules and began to see into the future.

Critical at this stage of the students' development, Ms. Daves divided the project into smaller tasks, established a timeline for completion of the various stages of their project. The 3Drenal team recognized their different skill sets and divided up the labor accordingly. Alison was the artist, David provided overall organization, and Norine did background research. They knew that they could consult on various faculty members, especially research coordinator, Dr. Jonathan Gastel, for leads to more detailed information

or to clear up any technical questions they had. They finally put it all together and sent it off.

On the day the awards were made, around school, around the computers at school there were clutches of 10th graders eagerly awaiting to see the results. They did quite well. 3Drenal placed first in the northeast region, and both Dr. Li's and Ms. Daves' research chemistry class had numerous honorable mentions, and there were many honorable mentions in Ms. Daves' regular chemistry class, which were not assigned the Toshiba project as required.

The 3Drenal Team and their classmates were pleased with the performance but really the difficult part had just begun. The team had just four weeks to create a Web site to show off 3Drenal. They had won a Toshiba computer loaded with Web design software, but they had little experience using it. Consultants were needed. Paul Oratofsky, class of '67, helped with the initial Web site design, and later Digital Resource Incorporated, a company headed by Alison's father, David Reed, was enlisted to help with 3D imagery and Web site orchestration. After many hours after school, on weekends, at school or the Chans' or Digital Resources, the Web site was completed and submitted.

A few weeks later, the 3Drenal Team were surprised at school by Toshiba and NSTA representatives announcing their second-place national position in the senior division. They now had to build a prototype. A more detailed design had to be developed, materials had to be chosen, dimensions measured. Scott Thomas, the chemistry physics chair, volunteered to teach Norine enough AutoCAD so that she could program our very real 3–D printer to print parts of the print corners for the control in the future 3Drenal printer. Finally, they had to fashion a clay kidney to represent 3Drenal's innovative product, a new kidney formed by the patient's own bone marrow stem cells stimulated by various molecules to develop into kidney-specific tissues and then have it assembled by the 3Drenal bio-printer.

The 3Drenal Team had pushed an existing technology to future uses. They had to work as a team. They had to recruit experts to help them. They had to articulate their problem and innovative solution clearly and accurately. They had to complete their project on time and had to deal with unfamiliar technology and tools. All these skills will serve them very well if they continue in any of the STEM disciplines or, for that matter, in any discipline they choose to follow.

I hope you have time in your busy schedules to see the prototypes and listen to these students talk about the ideas that they have brought to Washington and for which you so graciously have provided a national venue. Thank you.

[The statement of Ms. Manwell follows:]

STATEMENT OF MS. ANNE MANWELL, SCIENCE TEACHER AND MENTOR TO THE 3DRENAL: KIDNEY BIO-PRINTER STUYVESANT HIGH SCHOOL TEAM, BROOKLYN, NEW YORK; AND MISS ALISON REED, 10TH-GRADE STUDENT AT THE STUYVESANT HIGH SCHOOL AND MEMBER OF THE 3DRENAL: KIDNEY BIO-PRINTER TEAM, BROOKLYN, NEW YORK

Good morning Committee Members, colleagues and students. I am Anne de Sostoa Manwell and I have been teaching biology at Stuyvesant High School, a specialized

NYC Public School of math, science and technology, for 14 years. All students at Stuyvesant took a qualifying test to be offered a seat at the school. We have a rich tradition of student research and success in student science competitions like Intel/Science Talent Search, Siemens Competition and ISEF. We can boast of five Nobel Laureates among the many scientists, mathematicians, engineers and physicians who are alumni.

But schools like Stuyvesant and specialized high schools in all of your states do not operate in a vacuum. We need students prepared by elementary and middle schools to feed our programs. I would like to take this opportunity today to speak to you about the role competitions like Toshiba ExploraVision play in building the skills needed for students to participate in our programs.

We at Stuyvesant have found that engaging our students in competitions allows them to be creative, think broadly and critically, work in teams, develop time-management skills, take ownership of a project, and be proud of their work. No one now at Stuyvesant remembers when ExploraVision became a part of the 10th grade Research Chemistry curriculum, but it was probably very close to its 1992 launch. The current Research Chemistry teachers, Samantha Daves and Dr. Zhen Chuan Li, have continued to use ExploraVision as a powerful motivating force to develop student skills in scientific thinking.

The ExploraVision Competition requires teams of students to take a current technology and push it 20 years into the future. This nurturing of a young person's imagination, starting as young as kindergarten, ensures that as she gets older, she will continue to ask questions and explore her world. Ms. Daves' teams bounced ideas off each other, brought in classmates from other sections, grilled parents and consulted online sources for their choice of current technology to develop. The 3Drenal team of Norine Chan, David Kurkovskiy and Alison Reed took an article found by Alison's mother on bioprinting and combined it with what they knew about adult stem cells and signaling molecules and began to see into the future.

Critically at this stage of their development, Ms. Daves gave the teams a timeline to complete the various stages of their project. The 3Drenal team recognized their different skill sets and divided up the labor accordingly. Alison was the artist, David provided overall organization and Norine did background research. They knew they could consult with other faculty members, especially the research coordinator, Dr. Jonathan Gastel, for leads to more detailed information or to clear up any technical questions they had. Finally it was all together and sent off.

This initial phase can be done in any educational setting. With the motivation of the ExploraVision competition, any STEM teacher can engage students in the creative and innovative thinking necessary to look into the future.

On the day the awards announcement was made, there were numerous clutches of 10th graders crowded around computers to see results. They did quite well. 3Drenal was first in the Northeast region, and both Dr. Li's and Ms. Daves' research chemistry classes had numerous honorable mentions. And there were many honorable mentions in Ms. Daves' regular chemistry classes for whom the ExploraVision project was not required! Toshiba and the National Science Teachers Association (NSTA), ExploraVision's sponsor and administrator, were impressed with the numbers and helped arrange a press conference for all the students, parents, upperclassmen research students, and faculty. Speeches were made, reporters asked questions, pictures were taken and veggies were dipped.

The 3Drenal team and their classmate were pleased with their performance but the really difficult part had just started. The team had just four weeks to create a Web site to show off 3Drenal. They had won a Toshiba computer loaded with Web-design software but they had little experience using it. Consultants were needed. Paul Oratofsky, SHS '67, helped with initial Web site design, and later Digital Resources Incorporated, a company headed by Alison's father, David Reed, was enlisted to help with 3D imagery and Web site orchestration. After many hours after school and on weekends, either at school or the Chan's or Digital Resources Inc., the Web site was completed and submitted.

A few weeks later the 3Drenal team was surprised at school by Toshiba and NSTA representatives announcing their National Second Place in the senior division. This was at 10:30a.m., by 11:40 everyone knew the news and was congratulating David, who was in my molecular science class. But now they had to build a prototype. A more detailed design had to be developed, materials to use had to be chosen and dimensions measured. Scott Thomas, the chemistry/physics chair, volunteered to teach Norine enough AutoCAD so that our very real 3D printer could build the printer corner controls for the future 3Drenal bioprinter. Everyone had to learn to wield an Exacto knife to cut foam-core for the printer cabinet. Finally they fashioned a clay kidney to represent 3Drenal's innovative product, a new kidney formed from the patient's own bone marrow stem cells that were stimulated to develop into

the various kidney tissues, *in vitro*, by tissue-specific signaling molecules and then assembled by the bioprinter.

The 3Drenal team had pushed an existing technology to future uses. They had to work as a team. They had to recruit experts to help them. They had to articulate their problem and innovative solution clearly, accurately and persuasively. They had to complete their project on time. They had to deal with unfamiliar technology and tools. They have accepted acknowledgement for their efforts. All these skills will serve them very well if they continue in any of the STEM disciplines or for that matter in whatever discipline they choose to follow.

I hope you have time in your busy schedules to see the prototypes and listen to the ideas that the ExploraVision teams have brought to Washington and for which you have provided a national venue.

Chairman HALL. Thank you for a good presentation, and I thank all of you for your testimony and reminding Members here that Committee rules apply to us also on the five minutes, and the chair at this time will open the round of questions and I yield myself five minutes.

My first question will be to Alison. Alison, I think you are the senior member of all this group here. Is that right?

Miss REED Yes.

Chairman HALL. That means you are the oldest. Is that right?

Miss REED. Yes.

Chairman HALL. Well, you will feel good to know I am the oldest guy in the House or Senate, so we have something in common, and I picked you to start with. You are what they call a rising junior. Does that mean you are going to be a junior next year?

Miss REED. Yes, I am.

Chairman HALL. I think I was a junior three years. Do you and your teammates know what you really want to study in college yet?

Miss REED. I am actually not sure what I want to do. I feel like I have many options and pathways I can go down. I know that Norine is really interested in becoming a doctor. I think she definitely wants an overall liberal arts education, and she wants to explore every possibility, and so does David, and David is very interested in becoming a writer.

Chairman HALL. Well, I might ask you this. Has winning this competition had any bearing on your decision or changed or hastened your decision?

Miss REED. Yes, it definitely has because we had so much fun and it was so interesting to research and develop our idea, and I think that getting more involved with science and our project has really opened up that area to us and made it more available and more interesting, so I definitely really liked it.

Chairman HALL. Okay. Well, we thank you.

I will ask all students this, and you can give me a loud yes or no and we will kind of determine by the—we have a noise tester up here. Did you like science and math before you started your project? Yes or no. This thing says yes wins by about eight to 10. Another question: do you like it even more now? That is yes again.

All right. I have some time left here. Let me see what else I have. I might ask to all the students, anybody that wants to suggest an answer, what did you enjoy the most about your project and what did you like the least? Who wants to answer that? Hold up your hand. Jack, do you want to answer that? I have been doing business with you ever since you have been here. All right, Marcelo.

Master VIDAL. Painting the prototype.

Chairman HALL. Painting the prototype?

Master VIDAL. Yes.

Chairman HALL. That's a yes. Okay, does anybody else want to say? Yes, Claudia.

Miss COOPER. Hi. My name is Claudia Cooper. I am a seventh grader at West Hills. I think the most enjoyable part about this whole project was when Samantha, my partner, and I first started, we had no idea, honestly it started as a required curriculum activity—not activity, assignment that Mrs. Attard proposed to us, and when we got our inspiration to help people who are suffering from respiratory insufficiency, it really was, I guess, cool to know that we can help people and to see what our generation is capable of and to know that there is possibility as long as someone out there has ideas and minds to think of them.

Chairman HALL. Okay. Thank you.

To all the adults, let me ask you this. Several of you commented on how impressed you were with the ability of your teams to come up with novel ideas such as integral pieces of this competition that you are in. Can you talk about how you helped the students to drill down on their broad concepts, or how did you have to help them do that at all? Perhaps it was a natural part of the process. Anybody want to answer that? Yes, Mrs. Conwell.

Mrs. CONWELL-DUDLEY. We started by reading newspaper articles and news magazines. I felt it was important for the children to become aware of the news around them, to look at what was going on in current events, and so we started brainstorming from that, and that is where we got most of our ideas, and so they were based in fact and they were relevant issues, you know, current to today's ongoing problems, and that is how we started.

Chairman HALL. Did you read anything about any of the current activities of any of us Congressmen?

Mrs. CONWELL-DUDLEY. Of course.

Chairman HALL. Does anyone else care to comment? Yes, Ms. Manwell.

Ms. MANWELL. Yes, and after the kids come up with an idea, you have to ask them, is it feasible, what do you know about it, where does it take you, what do you need to know in order to go forward.

Chairman HALL. All right. I cheated for 10 seconds, and I thank you all for the good answers you gave me.

At this time I recognize Ms. Johnson for five minutes.

Ms. JOHNSON. Thank you very much. It has been informative to listen to the testimony.

As Mr. Hall indicated earlier, we are both Texans, and in Texas, we have around 1,100 school districts, and because of that, we pioneered some distant learning, but I am becoming more and more concerned about the cost of the administration of all these school districts and have wondered whether or not we could substitute some of the administration with distant learning, so I am interested in trying to get information from you of how you feel that using distant learning in STEM education could be successful. I wonder, because we have home schooling involved here, and so perhaps I can ask you, Mrs. Conwell-Dudley, about your experience in feeling that it could be successful.

Mrs. CONWELL-DUDLEY. Well, as I mentioned, we used—we are sponsored by Virginia Virtual Academy in Herndon, Virginia, and we used the online public school program this year for Jack's sixth-grade schooling, and we felt very fortunate that they were willing to sponsor a team, and we used what is called Illuminate Live—it is a Web conferencing program—to correspond with our coach, Penni Harrison, who actually lives in Colorado, and it is how we did our schooling throughout the year and it is how we ran many of our science meetings, and we would send things electronically. We would send attachments. We would, you know, upload our presentations. She could take a look at it in advance and then when we had our meetings, we would, you know, share information that way, and well, here, we are, so it apparently worked very, very well for us, and it was a lot of fun and I felt like we were sort of on the cutting edge of it. So I have to say there was little or no cost involved, and it was fantastic.

Ms. JOHNSON. Now, were you home all the time with Jack?

Mrs. CONWELL-DUDLEY. Yes, I was. I was his parent coach, and so this was a temporary option for us. Jack will be in a brick-and-mortar school next year but we did this for some personal and academic reasons, and we were very thankful that we could use their program. It was outstanding.

Ms. JOHNSON. Thank you.

Now, Jack, how did you like going to school on a camera?

Master DUDLEY. It was fun, and I learned a lot. It was good having somebody actually there to work with you one on one, in this case, my mom, to help me with all of my studies and I think it was a great curriculum.

Ms. JOHNSON. Have you compared that to being in a classroom with other students?

Mrs. CONWELL-DUDLEY. Well, we live in a neighborhood full of children who go to both public and private school, and I would have to say that I think my son's education was on par or perhaps even better in some respects, but I am a little biased.

Ms. JOHNSON. I am not trying to criticize. I am seeking information.

Jack, did you miss having students sitting next to you or you felt you got that through the virtual experience?

Master DUDLEY. I missed having students around me but I just got a lot better learning experience because my mom can just work with me with nobody else asking questions.

Ms. JOHNSON. Thank you. You have a wonderful private teacher.

Dr. Lozano, my time is running out quickly, but in your biography I read that you were the first Mexican-American woman in 70 years to receive a Ph.D. from Rice, and the fifth woman to ever get a Ph.D. from Rice's mechanical engineering and material science department. The underrepresentation of women is quite apparent, and minorities, and I wonder whether you are beginning to see any breakthrough or whether you think it still takes a lot of outreach effort?

Dr. LOZANO. You mean for girls in general?

Ms. JOHNSON. Girls in general.

Dr. LOZANO. You know, girls somehow are taking over, you know, in college in most of the majors where they were, you know—I

don't know, like a lot of the liberal arts and a lot of business, and there are now more girls than boys enrolled in college.

Ms. JOHNSON. In college in general but in——

Dr. LOZANO. In college in general, but in engineering, it is still no higher than 17 percent, so still in my classes of, like, 60 kids, I have, like, maybe five girls and 55 boys. So still, you know, I haven't seen any change since, you know, 10, 15 years ago. So still the girls make a lot less. And it is a very severe cultural stereotype, you know, when you ask people, even boys, you know, what does a mechanical engineer do, and everybody will imagine a hat and oil and boots and, you know, like a dirty type of profession, and in reality when I take them into my lab, I do a lot of tours for—you know, at least 1,000 kids pass by my lab every year, and they are surprised to see that oh, so you actually deal with, you know, prosthesis for the knee and the hip and, you know, so that doesn't have to do anything with oil. You know, mechanical engineer, we also do scaffolds for tissue regeneration. We need to take mechanical properties for the cells to anchor and grow without falling down, you know, and the scaffold has to sustain the load.

So they don't really know exactly what engineering is. So even though engineering is all around us, you know, very small percentage of people know what it is. Even like, I don't know, my son plays piano beautifully and I say you could be the best piano player, but if the materials in the piano are not good, if the, you know, surroundings of the room are not well prepared, you know, you will sound awful, and engineers are around all of that but you don't really see them. You go to the doctor and you see the X-rays and MRIs and laparoscopies and everything and you see a doctor but you don't see the engineer that was behind all that development. So we really never see what engineers do, and every time—I went to Barnes and Noble and kind of just went through books, and I found engineers are either the ones that drive the trains in the kids' books. Or there is an astronaut and right behind are two guys carrying a case and it says engineers. I said, man, those are—you know, the astronauts are the engineers. So really the profession hasn't really been attractive to kids, so we still have to do a lot. And this is all engineering, you know, the creativity that comes with ExploraVision. That is basically what engineering is, just be creative, use science knowledge to develop technology that can benefit society.

Ms. JOHNSON. Thank you very much. My questions were within five minutes, Mr. Chairman. I didn't promise the answers would be.

Chairman HALL. The lady's ten minutes is up.

I now recognize—that was a good answer. We would have tapped here saying, you know, please start slowing down, but thank you for a good, long—a good answer, an honorable answer.

I recognize Mrs. Fudge, the gentlelady from—Mr. Smith, Lamar Smith, the gentleman from—he is chairman of the Judiciary Committee from the State of Texas.

Mr. SMITH. Thank you, Mr. Chairman.

Dr. Lozano, I thank you and Marcelo for making the trip up from south Texas. We don't mean to be picking on you today but it is probably no surprise that those of us from Texas are going to ask

you questions first, and I would like to do so but then invite the other witnesses to comment if they would like to as well. I have sort of a general question with a specific question component to it, and the general question is, well, maybe I should say you already provided part of the answer because I understand you developed a science and magic show for K–12th grade. I wish you could have shown that to us today. That would have been fascinating, I am sure.

But it seems to me that that is one of the answers to the overall question about how do we attract young people to become interested in science and math. The figures have been mentioned but we have about half as many young adults majoring in science and math today as we did 20 years ago, and the trend is now good and other countries are picking up the slack and we would like to see our own American students start majoring more often in those types of subjects. So the real question is, how do we inspire young people, how do we get them interested in those subjects? You showed us in a number of ways how that is possible.

Let me go on and ask a more specific question that you might want to address as well as the general question, and that is, to me, one of the barriers we face is that of false stereotypes, that maybe children from broken homes or from lower socioeconomic backgrounds or whose parents don't speak English well or girls who are oftentimes thought not to be good in math, those are the types of false stereotypes that need to be broken down and that will allow these young people to achieve their potential and give us millions of more young people who might major in the sciences and math, and I think part of the answer is better mentors and frequent tutors and inspirational and better teachers, more money dedicated to those subjects and so on. But do you want to answer the question more generally as to what we can do beyond what you have already mentioned and also how we can counter those false stereotypes?

Dr. LOZANO. That is a very hard question. I guess one of the things is to get, you know, leaders into the classrooms, professors, you know, science teachers, you know, get them into the classrooms, and I think National Science Foundation does an awesome job. You know, every grant that top researcher gets from National Science Foundation, in order for you to get it, it needs to have broader impacts and the broader impacts have, you know, outreach within it. So you need to have great science in order to be given the grant, but if you don't have that section filled, you know, you don't get it. And that forces, you know, everybody within the scientific community to outreach, you know, to K–12, and I think that is a beautiful model, you know, what NSF does.

I think, you know, a lot of kids, they go into high school and they have never—as Congressman Johnson was mentioning, women have never been given the opportunity to see, you know, what is beyond so when they, for example, tour the lab or when we go to the classroom, they give you thank you letters saying that, you know, I wish I could have known you 4 years ago and I would have made very different decisions, you know, about my life.

So I think, you know, we just need to go back to the community and do a lot of that because there is no other way to, you know, get kids, you know——

Mr. SMITH. Hard work, dedication, commitment from all the adults involved. I think you are right.

Mrs. Conwell-Dudley, would you have anything to add to that?

Mrs. CONWELL-DUDLEY. Yes, I would. Thank you. We live in Loudon County, and I can't really speak to the counties that the other schools represent or reside in, but in fact there is a lot of interest in science and technology, and one of the things that pains me as a parent is, and I will give you an example. I have been attending open houses for the Academy of Science, which is a program in Loudon County that is open to all Loudon County high school students, and I have been for the last two years and I have been amazed that every spot in the parking lot is full when they have an open house. It is heartbreaking, really, and you get into the auditorium and it is practically standing room only, and the really unfortunate aspect of this is that there are only 60 to 65 spots in this Academy of Science and there are hundreds of students who are interested in going, and I look at the auditorium, and these aren't kids who are being dragged out of bed in the morning. These are kids who are actually there with their parents deeply interested in getting into this program and yet they can't get in because the competition is so great and there is only one program in Loudon County that addresses the sciences and math in a really advanced way, and it is the Academy of Science. There are 60 to 65 spots. So when you look at the 15 middle schools that are feeding into that program, that is really an opportunity of four kids per school.

Mr. SMITH. So the solution is more programs?

Mrs. CONWELL-DUDLEY. More programs, and whether it is joining up with businesses, partnering with businesses. Like you look at Loudon County and all the businesses in that area, Aerospace Corporation, for one, is one my husband works with, but Boeing and Northrup Grumman. Maybe I am misrepresenting the names because they are merging so often, I can't keep up with them. But I am sure that they are engineers in businesses located within our areas who could partner with the schools to bring science into the schools, to make it more readily available.

Mr. SMITH. Good idea. Thank you.

Thank you, Mr. Chairman.

Chairman HALL. The gentleman's time has expired.

I recognize Mrs. Fudge from Ohio for five minutes.

Mrs. FUDGE. Thank you very much, Mr. Chairman, and thank all of you for being here.

Let me first congratulate all of the contest winners. You should be extremely proud of your accomplishments, and I am very proud of you. I hope you all pursue some career in a STEM field. We certainly need you, and I am looking for great things from each and every one of you.

I would also like to thank our Chairman for holding this hearing, which clearly demonstrates the need for federal education reform and investment in STEM education. The schools represented here are home to brilliant young students. However, they also each rep-

resent some form of privilege or lack of accessibility. Discovery Montessori in Texas is a private school. Virginia Virtual Academy, while free to students living in Carroll County, Virginia, is a modern form of home schooling and requires significant parental involvement. Many of the struggling families in the United States are either single parent who cannot stay home with their students because they must work or two parents who must both work. Schools such as this simply are not an option for many low-income families. West Hills Middle School in Michigan, though public, has less than one percent of students eligible for free or reduced school lunches. In my district, just take the city of East Cleveland, that number is more than 85 percent. And finally, Stuyvesant High School requires students to take a standardized test for admission, which means expensive test prep courses for the students who can afford them, putting low-income students at a severe disadvantage. As a New York City public school, only 2.2 percent of students at Stuyvesant are African American. This number is incredibly low, especially considering that across all public schools in the city, 32 percent of students are African American. The numbers are even more drastic when you look at Hispanic students, who represent 40 percent of the students in the New York City public schools but only 3 percent of the students at Stuyvesant.

Clearly, this is not a level playing field, and I believe that it is our job to ensure that all students in this country have access to quality education and the opportunity to win a contest like ExploraVision.

Now, to my question, which is for Mrs. Conwell-Dudley. Virginia Virtual Academy seems to be very effective in getting kids familiar with technology and interested in science. Do you think that there is some part of the curriculum which you use now in your home that could be transferred to students in the classroom setting that would have the same kind of an effect?

Mrs. CONWELL-DUDLEY. Absolutely. I think the Illuminate Live conferencing program could be used extensively in the schools. I don't see why it couldn't. it worked extremely well for us, and I am not that sophisticated. I am not that smart, but I am smart enough to know that our kids have got to be a lot smarter and so, you know, I am going to do everything I can, and I really think this program, the Web conferencing program, would be a great thing for schools to use.

Mrs. FUDGE. Thank you. I want to again congratulate all of the brilliant young people sitting here today, young men and young ladies, for the work you have done. You have accomplished a great deal. I hope that some day you will be sitting on this Committee talking to young people just like you. Keep up the good work, and to all of you who have assisted and mentored and encouraged, thank you as well.

Thank you. I yield back.

Chairman HALL. The gentlelady yields back her time.

I recognize Mr. Bartlett, the gentleman from Maryland.

Mr. BARTLETT. Thank you very much. I want to use my brief five minutes to emphasize two areas. One is the importance of teachers, and the second, our need as a country to dramatically increase the number of our students going into science, math and engineering.

It was a teacher who changed my life. I went to college in 1943, Washington Missionary College in Takoma Park, Maryland, to become a medical missionary. My first degree was in theology, which has served me very well in Congress, by the way, because I learned to love the sinner and hate the sin. I was going to be a medical missionary so I had to take some courses to go to medical school, and I had a really fantastic teacher and I took all of his courses and enough other courses that when I finally graduated from college in 1947, that I had a major in biology and a minor in theology. I had a major in biology and a minor in chemistry. I went on to get a doctorate in science, and I taught for 24 years.

Our youngest son of 10 children was a terrible student. He wouldn't pay any attention. We were going to lose him. Every year we would wonder should we keep Ross back. And finally it was a teacher in his sixth grade, a science teacher in the sixth grade that turned him on. Now, Ross graduated from UMVC number one in a class of 140 some engineers. He has five children, a Ph.D. He is returning to Maryland, thankfully, and he works for one of our big government labs. So here are two lives that have been dramatically turned around by teachers, so thank you, thank you very much for what you do.

I was listening to the news this morning and I was reminded again of our priorities, which I think are pretty darn distorted. A Vancouver team lost. I have no idea who they are because I tuned out sports because I think they are kind of the equivalent of gladiators in Rome and we know what happened to Rome. But, you know, their team lost so they are really upset and they are turning over police cars and breaking windows and the riot police are out trying to quiet them down. I watch the White House and the people that they invite there and slobber all over and they are not scientists and mathematicians and engineers, they are not academic achievers, they are athletes and entertainers.

This year, the Chinese will graduate seven times as many engineers as we graduate, and about half of our graduate engineers will be Chinese students. And by the way, they don't stay here anymore because there are plenty of good jobs back in China so they are going there.

We represent less than five percent of the people in the world and we have a fourth of all the good things in the world, and I have a huge concern that we are not going to be able to retain our position as the premier economic and military power in the world if we are turning out one-seventh as many scientists, mathematicians and engineers as our competitor is. What can we do as a country to change the culture? Because, you know, you get a culture, a community, a society gets what it appreciates and we just don't appreciate our bright young kids in science, math and engineering. When I was a kid, they called us squares. That is an old term, isn't it? Now, what are you, geeks and nerds now? And, you know, pretty girls won't date bright boys and a really bright girl plays dumb to get a date. This is a really sad reflection on our society. What do we need to do so that we can capture the imagination of the American people and get more of our young people to go into careers in science, math and engineering. I know you won't be able to give an adequate answer to this in the minute and seven sec-

onds we have remaining so I would encourage you to please write for the record something that will help us so that we will know what we can do here in this Committee to do a better job of turning on our people and getting more of our young people to go into science, math and engineering.

Chairman HALL. The gentleman's time has expired. Do you have any figures on how many lawyers they are turning out over there?

Mr. BARTLETT. Actually, you know, I go to groups of young people and I ask them what they are going to become, and they are going to become lawyers and political scientists. Now, we have enough of both of those, quite enough of both of those, don't you think? We just need to turn that around. A society gets what it appreciates. We just don't appreciate science, math and engineering, but that is what makes the wheels go around and, you know, that is going—if we aren't able to get around this, we are not going to be number one.

Chairman HALL. Your point is made.

Mr. BARTLETT. Thank you, sir.

Chairman HALL. We have about 18 votes in another 15 minutes. We are going to try to go on through. Mr. Clarke, the gentleman from Michigan, I recognize you for five minutes, five quick minutes.

Mr. CLARKE. Thank you, Mr. Chair.

I am from the city of Detroit. I represent metropolitan Detroit. I am on this Committee at the recommendation of Representative Peters, who is right here who is your Member of Congress, and I just want to thank West Hills Middle School for making us really proud in Michigan.

This is a little personal story. This is really to Claudia and to Samantha. You know, when I was growing up in elementary school, I was one of the few kids that had asthma, so I went back and visited, you know, some of these elementary schools now that I am an elected official. I remember asking one class, anybody raise your hand if you have asthma. Half the class raised their hands. And where I was raised too, you know, we have an incinerator right near us a few blocks away, and we had plants there. My dad used to work in the Rouge plant. So a lot of people have breathing problems because the contamination, because of pollution, because we smoked cigarettes and my dad smoked them without filters before he realized that it was a problem. This was a long time ago.

So the fact that you have created a prototype of a way to provide people with oxygen who need it without having to carry those big tanks, that is going to really give people a lot of freedom because a lot of us, more and more people are growing older and living longer and will likely have to live with these chronic breathing problems.

My question, and if I could, Mr. Chair, I would like to just ask this to Claudia and also Samantha. I know you are not sitting, but after Claudia responds. What did you either enjoy the most out of developing this intra-trachea device enjoy or learned about it the most or what you got out of it? I am just curious. Now, here is the reason I am asking you this. Because in your answer will probably be the actual value that other students would get, and that would probably encourage them to do this type of research that you are

doing right now that can actually save people's lives, or at least give somebody a better quality of life as they grow older.

Miss COOPER. Well, thank you, Mr. Clarke. Our inspiration actually came from my grandma, who was oxygen dependent for the last few months of her life, and as you were saying, it weighs down your freedom, and this device would hopefully restore that freedom and let patients do what they want to. It is the sheer joy of knowing that there are possibilities out there, like I said before, and that our minds, our generation can do that. I think working with Samantha was one of the most amazing parts of it because she is so funny and she is very, very bright, and we couldn't have done it without her. I think just opening our minds, because neither of us were very into science before this competition, and when we first heard of it, it was just an assignment. It was not anything that we wanted to do necessarily, but once we started going, we saw how incredible this competition can be and how great this is.

Mr. CLARKE. Wonderful. And if possible, if Samantha, you could just come up and share with me your experience about doing this research.

Miss TARNOPOL. Well, I would probably say most of the same things as Claudia because we did most things together, but I learned so much from this competition because before this I was really not into technology, and I was not—and I learned so much from this and I learned so much about our invention, and I really like helping people, so it is probably what I would say the most.

Mr. CLARKE. Well, this is wonderful. I am going to yield back my time, but I think we have got the answer. So all the students right now who are watching this, you don't even have to be into science or math or technology, but if you want to help somebody, you see somebody that you know has a problem, could be in your family or a friend of yours, this is a way to really help them and help a whole bunch of people fast is to get involved in these projects, so that could be it. Let us not worry about the science and the math and the technology. Let us try to help people, and that way we can actually help our country. Thank you so much.

And also, the last point, I wanted you to testify so you would get used to this so when you come up here, if you choose to do this in a few years from now, you have already had the training.

Chairman HALL. The gentleman yields back. Thank you, Claudia and Samantha. They call you Sam or Samantha? Good testimony.

At this time I recognize the gentleman from California, Mr. Rohrabacher, for as much of five minutes as he wants to use.

Mr. ROHRABACHER. Well, thank you very much, Mr. Chairman, and let me just note that I did not do well in math and science when I was a kid. I wish I would have, and I think that if I would have done better in math and science, I wouldn't be here today. But I want you to know, the only good side of that story is that I did not become a lawyer. In fact, when I ran for Congress the first time, my most effective slogan was: vote for Dana, at least he's not a lawyer.

And I want to segue in with the kids on this. You know, the bottom line is that kids can see what our priorities are in our society, and they notice that lawyers are the ones with the nice houses and nice cars and a lot of times they see the engineers as not having

such a nice reward for this profession that they have chosen. I believe the way we get more engineers and more scientists and such is we pay them better, and how we pay them better is, we just make sure that our own children have the opportunities to get good jobs that pay well, and I am sorry to bring up other issues, but the fact is, we seem to be bringing in people from all over the world in order to depress the wages of our engineers and our scientists when instead we should be elevating the pay of those people who are teaching science and those people who get into science and engineering. So that is just a couple thoughts.

I also am a little bit concerned that movie stars and athletes, you know, they make huge amounts of money and everybody knows that, and people will begrudge an inventor the money that he gets from a patent. I mean, the fact is, it is a good thing for someone to invent something that changes the lives of so many people, and for that person to benefit by making a lot of money from a patent is a good thing, and you would not believe how much we have got here where the powers that be are coming down on these small inventors for insisting that they get a royalty for what they have invented, and there is a big patent fight looming right now in Congress where some of us are trying to protect the little guy, the small inventor, and there are other people who have a lot of interest here who are, you know, protecting the interests of some big corporate leader who started off as a lawyer, of course.

But with that said, I think that we can make scientists and inventors cool, and I want to ask the kids whether or not our engineers and scientists, people who are engaged in these types of things, are they considered cool by your fellow classmates now or, no, they are not. I am seeing heads shake. What about you, Marcelo? Do some of your classmates look at someone, an engineer or a scientist, as someone who is cool?

Master VIDAL. Well, after my mom does, like, a magic show but it is really engineering, all my classmates are like, oh, wow, that is so awesome.

Mr. ROHRABACHER. All right. There you go. Hey, dude, that is great.

Master VIDAL. Yeah.

Mr. ROHRABACHER. Jack, what about you? What do your fellow students think about it? Is it cool to be an engineer or a scientist?

Master DUDLEY. My dad, he is an aerospace engineer, and whenever I told my friends about it, they would always be wowed about that and they thought it was really cool that I was able to see a rocket launch and they thought engineers actually were very cool.

Mr. ROHRABACHER. Oh, that is great. Okay. All right. Claudia?

Miss COOPER. Well, you know, I am in that squirrely seventh-grade time where it depends what you mean by cool, but I guess, when Mrs. Attard first started the unit showed us inventions that were created and asked us if we knew who those inventors were, and after she gave us the names and we said oh, yeah, that is kind of cool, and then of course he is before our time a little but she showed me Bill Nye, the Science Guy, the TV show. So I think that is what really triggered our minds, and bringing the competition into our school kind of set off—I mean, there were people who went home, they went on Google, and they went on Bing and they typed

in who invented the microwave and they would come to school the next day and share it with everyone. So I guess that is kind of what——

Mr. ROHRABACHER. Okay. All right. Alison?

Miss REED. I go to Stuyvesant High School, which is a very science-oriented high school, and we are kind of nerdy, so I don't know if we really represent everyone, but to become an engineer, a lot of kids aspire to be a scientist, and a lot of our parents are scientists or engineers or doctors, and everyone admires their parents so much and I think everyone really admires scientists.

Mr. ROHRABACHER. Okay. That is cool. Being admired is cool. Let me just say, I admire each of you, and my heroes are people who have come up with things that have changed people's lives for the better, and too many times kids hear only the negative side, how horrible things are getting. Well, you should also know and be taught about what great opportunities we have to make things better, and you are the kids who are going to make it better, so congratulations for participating in these wonderful projects and all the good things you are going to do now for the rest of your life. Thank you.

Chairman HALL. The gentleman's time has expired. In defense of lawyers, I will tell you a quick story. A guy was making a speech and he said I hate all lawyers, they are all geeks, and a guy in the crowd said I object to that, and he said well, I am sorry, I didn't mean to offend you, are you a lawyer. He said no, I am a geek.

The chair recognizes Mrs. Edwards.

Mrs. EDWARDS. Well, thank you, Mr. Chairman, and to the Ranking Member, I feel that there has to be some redemption because, you know, as my colleagues know, I spent several years as a systems engineer working on the Spacelab program at Goddard Space Flight Center and then I became a lawyer and now I am in Congress. There is a lot of redemption going on out there.

But I am just so excited to see all of you here, your educators, your mentors, your parents, and of course the students, and I think when we ask ourselves, you know, are we going to be okay in the next generation, the next decades, I think we look at you young people and we know that we are going to be just fine because we will be in your hands. So thank you very much for your participation today and your testimony.

Like the Ranking Member and our Chairman said, education in the STEM fields is really important to me. I mean, I see, you know, all across this country that it is really clear that the challenges of the future are going to be solved by us grabbing ahold of technology for the 21st century, and the way that we do that is to educate in our STEM fields, and, you know, although I know that some of my colleagues have expressed, you know, concern about whether these same kinds of things can take place in a public school setting versus a private school setting, I think it takes the collection of that to happen, and I think as parents, and I know as a parent that my goal was to just find the best place for my child to be educated because I always described that our children aren't science experiments but they are works in progress and what works for one child may not work for another, even though I recognize that the vast majority of this country's children are going to be educated

in our public schools and so we have to figure out a way that we can get that right in the STEM fields.

In my Congressional district in my state, we are home to some of the best science and technology supported by government and our private sector any place in our country. We are home to the Goddard Space Flight Center, NASA's premier program around the earth sciences, and NOAA, that helps us figure out our weather and climate across the country and around the world, the National Institutes of Health in Bethesda, Maryland, where so much good work is coming out of there, and the National Institute of Standards and Technology, and I know I look to all of these agencies and the various private sector corporations that develop around there to also have a robust relationship with our school system and with our young people because I think it is important for us to figure out how we take some of that private sector energy that you mentioned, Dr. Lozano, and that we channel that into a relationship with our schools, and that is not always an easy relationship because sometimes we create barriers that make it difficult for those who are in the STEM fields and professions to participate actively in our school system, so I think that we have to figure out ways that we can better encourage those things.

I just really have—and there is a bell, but I am not out of time yet—really just one question for the students, and I wonder if each of you can tell me the other things that you do in addition to your work around science that contributes to your learning, whether it is arts or music and sports that means that we are really developing whole children. Go right ahead.

Master VIDAL. I do swimming one hour a day Monday, Tuesday, Wednesday, Thursday, Saturday morning with Davin all the time, and I just finished the soccer season, so now I am watching TV.

Mrs. EDWARDS. All right. Well, thank you.

And Jack, what about you?

Master DUDLEY. I play piano. I take Chinese. Occasionally I will play flag football, and my swimming season is just about finished, and me and two other teammates are on a robotics team.

Mrs. EDWARDS. Congratulations.

And Claudia?

Miss COOPER. Well, I go to summer camp in the summer. I do a lot of acting in musicals, and I play a little tennis. I do a lot of extracurricular stuff at school, a lot of community service, and I actually do a little bit of circus performing arts too.

Mrs. EDWARDS. Excellent. Thank you.

Alison?

Miss REED. I do a lot of art, and that really helps me visually and that helped me on the project with realizing what everything would look like and how it would be structured. I play sports. I play tennis and I swim and I play the piano, and yeah.

Mrs. EDWARDS. Well, thank you all very much for being here, and I think what that indicates is that we have a lot to do to educate the whole child in addition to what we are trying to develop in the science and STEM fields. Thank you.

Chairman HALL. The gentlelady yields back her time.

I thank all the witnesses for their very valuable testimony, all of you and your input. The members of the Committee might have

additional questions for any of you, and we will ask you to respond to those in writing if they write to you. The record will remain open for two weeks for additional comments from members.

I want to recognize Ms. Johnson for a minute; however, she needs a quick response. I recognize you at this time and then I will dismiss you.

Ms. JOHNSON. Thank you very much, Mr. Chairman.

I want to say to Alison and Claudia, Jack and Marcelo and Samantha and all the rest of you that I have not learned your names, you have been really a spark in my life this morning because we struggle so hard to try to pinpoint what direction we need to go to make sure that this quality education is available, and you are letting us know that you are some of the examples of what we strive for, and so I want to thank you, thank all the teachers and parents who are here. We really honestly do depend on you to carry our future, and I just want to thank you for what you are doing and keep it up, and encourage many more to join you. Thank you.

Chairman HALL. Well said, and thank you. The gentlelady yields back her time.

Let me remind everyone that science fair and all of these teams and their projects are in the Rayburn Foyer from 12:30 to 2:30, and that is on the first floor, so I am going to be there and I am going to try to ask Jack if he missed the girls more than he did the boys or the boys more than he did the girls. So I have some good questions to ask you, Jack. I hope I see you down there.

The witnesses are excused and this hearing is adjourned.

[Whereupon, at 11:37 a.m., the Committee was adjourned.]

Appendix I

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Karen Lozano, Professor at University of Texas Pan American, Mentor to the I.Streets (Intelligent Streets) Discovery Montessori School Team, McAllen, Texas

Questions submitted by Chairman Ralph M. Hall

Q1. We need the best and brightest to become scientists and mathematicians, but we also need the best and brightest to become teachers of all subjects, particularly math and science. What do you think we could do to encourage more bright and articulate students to consider education as a profession?

A1. Something that I have implemented (following my professor from Rice University, Dr. Barrera) at The University of Texas Pan American is to have my research assistants (Undergraduate and Master students) help me when I give magic and science shows to K–12 students as well as helping with the development of the activities that we will present. These activities expose engineering students to K–12 student learning experiences and several of my students had chosen teaching middle and high school. National Science Foundation had a program called graduates into K–12; this program promotes faculty to be very creative as to activities where their STEM graduate students participate in education related activities and possible could ignite the students to consider teaching as a profession but if not, it leaves in them the knowledge and experience that they have to be involved with the community. Such programs are very important to promote teaching experiences while developing a passion to work with K–12.

Engineers are quite practical people in nature; the current environment in K–12 education where teachers are heavily restricted by many rules and regulations imposed into their curriculums and the need to teach for standardized tests drives them away from this honorable profession since some experience a level of frustration and either decide to leave the profession or they do not consider it. Teachers are the core of the education process and their focus and energies should go to their students though they feel that administrators are now their primary customers. If their students were their primary customers, even larger size classrooms could be handled; all my education from 1-12th grade I was in classroom of 50 students and one teacher though we were the focus of the teacher not filling up forms and forms for evaluators and so.

Q2. What elements of your pre-service or in-service training have been most helpful in meeting the daily demands of working with students, developing innovative classroom strategies, and delivering content-rich instruction to students of all levels and abilities?

A2. In reality I have never taken courses aimed at developing pedagogical techniques, though having been exposed since my fifth–12th years as a volunteer (well, in high school and college as required for all as community service hours) to teach younger students religion, math, crafts, and organization skills to build/beautify schools and rural areas (paint buildings, cut grass, repair streets, etc). Then having experienced as a graduate student the opportunity to do science and math with younger students has allowed me to develop the ability to communicate simple and complicated issues to people of all ages. It is important to present practical, real life issues as examples; students can then identify abstract facts and think of possible solutions. Once students are engaged and understand the problem they can work on a solution. Personally I experienced situations where I never understood the problem though learned the complicated math and sequence to obtain a correct answer without ever understanding (at that time) what I was doing.

Q3. As a parent and mentor, what were the biggest challenges for you helping the students with their projects?

A3. The biggest challenge when working with my own children as a mentor is the fact that I expect more of them and set the expectations quite high. I am present to guide them in their brainstorming process, and help them divide the tasks though they have to do all the work, and I quizzed them quite often in their acquired knowledge, when they are ready to think on how their ideas could work in the future I explain to them science concepts that are usually way too elevated for their age so I have to prepare the material in a way they could grasp it. After that they are again on their own to continue with their project; K–third grade students need much more help than fourth-sixth or older students. The older they are, they basically work on their own after initial meeting. Working with the ExploraVision objec-

tives is quite an easy process; the rules have been very well thought of and are clear and easy to follow, not to mention the "award" that students can get; this motivates them considerably.

Q4. You are a college professor and testify that you mentor in a number of ways beyond ExploraVision. Can you please expand on these community activities and your experiences? How many students and teachers do you think you influence each month with your lab tours, talks, and magic and science shows? Who is funding these activities or do you volunteer your time?

A4. I strongly believe that engagement with K–college students is an important mission of a faculty member; we have been very blessed and have worked so hard to obtain an advanced degree that it is a responsibility to communicate the walked path. As many kids, I also had a childhood where "money" was not around, there were many, many sacrifices that my family went through for education (it was always a top priority), the schools that I attended did not have air conditioning, even less heaters, we had windows! I try to communicate to all kids the importance of appreciating everything, they have what is needed in school, so with my presentations I try to instill in them a "possible dream" and a sense of appreciation.

I do several "Magic and Science" shows where I do demonstrations and explain the science behind while asking questions as to what practical application they see. These presentations are on an average one per month of about one and half hour. They can be either at the University where students take time to tour the facilities, or I go to the school and conduct the presentations either in gyms, cafeterias or classrooms. Have also participated in Parent Nights where I do similar presentations to parents and talk about college opportunities while sharing my own experiences as a female in a male-dominating field. ExploraVision is a type of "one-on-one" mentoring activity since the benefitted kids have been at the most eight per year though this year have been invited by a school that will start an ExploraVision club where the participation will be mandatory, and I will host several weekly sessions on innovation and creativity classes. Have also developed some experiments to teach science to fourth–sixth grade students where I attended their school every other Friday and offered practical examples of the concepts they were learning during the week. I did this in a private school given the opportunity for the teacher to accommodate the hours without affecting the required curriculum, it was very well received by students. Have also worked with Region I and several programs such as TexPrep, ABC of Science, Science camps and so. I could say that about 1,000 kids are influenced per year, with about 10–20 teachers. National Science Foundation had funded most of the activities and many others are as a volunteer.

Question submitted by Representative Randy Neugebauer

Q1. The students before us today seem to have a genuine interest in the projects they have undertaken, and they appear to enjoy taking the initiative to learn and better themselves. What techniques do you find are most successful in encouraging students to become engaged in math and science projects? How should we be capturing the imagination of young students through STEM programs?

A1. Young students are the easiest to work with since by nature they are scientists and engineers, they like to observe and experiment with. The best technique is to show them something exciting such as an experiment with liquid nitrogen or a chemical experiment such as the "elephant toothpaste." Then I tell them that if they succeed in their math and science classes, they can later come to play with such experiments when in college. I make sure to tell them that many times they might ask themselves why are they learning some aspects of math or science, for example when learning algebra, at that time it might seem useless and they might not find an answer as to the importance of learning such material though I tell them that in order to be able to experiment as I do, they need to develop an analytical mind (a problem solver ability) and the only way to do it is to solve many, many, many math problems, such as swimmer who swims miles and miles to develop muscles and abilities to compete in a 100-yard event. Same with their brain, a problem solver ability will develop only after mind training. So I ask them to see homework and math as training for their brain. As for ExploraVision kids, I tend to invite them to my lab at the beginning so they can get excited into solving problems.

Responses by Mrs. Brenda Conwell-Dudley,
Mentor to the Heads Up! Virginia Virtual Academy Team,
Leesburg, Virginia

Questions submitted by Chairman Ralph M. Hall

Q1. We need the best and the brightest to become scientists and mathematicians, but we also need the best and the brightest to become teachers of all subjects, particularly math and science. What do you think we could do to encourage more bright and articulate students to consider education as a profession?

A1. As the daughter of two public high school teachers, I can tell you, based on my parent's frustration with the U.S. education system, that the following issues dominated conversations at our dinner table:

- Men and women who entered the teaching profession (regardless of the subjects they taught) to have their summers off. Men and women who entered teaching because it was "easy" and because they couldn't get fired. Men and women who had little or no interest in teaching as a profession, or working with kids, in general.
- Students who wanted a "B" for showing up to class and an "A" for handing in homework— regardless of quality. Parents who felt the same way. High school students who were incapable of writing coherent sentences and complete paragraphs.

(Note: My parents consistently taught in predominately white, middle class to upper-middle class high schools.)

Encourage the best and the brightest into teaching by giving them and highly sought after teachers MORE AUTHORITY, RESPECT and BETTER PAY. In hard-to-staff schools, set up the hiring process like a four-year stint in the military and keep cycling in new and motivated young teachers by providing great benefits and compensation. Reduce the Administration staff ranks. Cycle the poorly performing teachers into adult education where they will be held more accountable or simply let them go.

Q2. As a parent and mentor, what were the biggest challenges for you helping the students with their projects?

A2. The biggest challenge for me was motivating my students by engaging them in conversation and research without also having to entertain them. We live in an entertainment and celebrity obsessed culture; all of our children are being raised on a steady diet of televised dance and singing contests, YouTube stupidity and video gaming. I had to constantly challenge my team to stop waiting for me to lead the discussions and to stop expecting that every science meeting would be "fun."

Q3. As a mentor to the HEADS UP! Helmet team, what role did you play beyond being a parent to Jack?

A3. I set up the team schedule and I conducted all of the team meetings. I assisted the team, when necessary, with their research, brain storming, project selection, delegation of work and research efforts, model building, Web site design, and video development. I was with the team at every step of the process.

Q4. You commented on how impressed you were with the ability of your team to come up with novel ideas, such an integral piece of this competition. Can you talk about how you helped the students drill down on their broad concepts, or did you have to help them do that at all, perhaps it was a normal part of the process?

A4. As a mentor, I wanted to initiate the students as to the importance of following what is going on in the world. I've mentored two winning teams, and I've learned that children in this age group (Grades four–six) really need an adult to help them focus their attention on the issues that are important to our nation and our planet. That is why this year's team started their initial research by reading current issues of the *Washington Post*. Most children I've encountered do not read newspapers, news magazines, and they do not follow the news in the media (online, televised, etc.) nor do their parents. My son follows the news on a daily basis and he is quite well informed; he is particularly interested in U.S. military efforts in Libya right now. I'm guessing he knows more about current events than some adults.

Q5. . . . What techniques did you find are most successful in encouraging students to become engaged in Math and Science projects? How should we be capturing the imagination of young students through STEM programs?

A5. Answer: P-U-B-L-I-C-I-T-Y. If science and math students received as much publicity and public adoration as football players and cheerleaders, we would have a surplus of engineers and scientists in this country.

Case in point: When our science team won first place in this year's Toshiba ExploraVision Science Competition, our local paper, *Leesburg Today*, printed a bulletin about the team that was 1″ tall by 2″ wide—no photo—and our team's accomplishment was buried at the back of the paper. At the very same time our press release was available, Dr. Ballard of the JASON project (a program designed to excite and engage middle school students in science and technology) was lecturing in the Leesburg area on the importance of STEM education. It was so heartbreaking to see, that in spite of our team's hard work, the article that ran adjacent to the article highlighting Dr. Ballard's work and his plea for more students in the sciences, was a lengthly article about a new skateboard park, complete with a large color photo of a teenage boy doing a very dangerous flip on a curved ramp . . . without wearing a HELMET!

Responses by Mrs. Amy Attard, Science Teacher and Coach, to the I-TBS: Intra-Trachea West Hills Middle School Team, Commerce, MI

Questions submitted by Chairman Ralph M. Hall

Q1. What inspired you to become a science teacher?

A1. I wanted to become a science teacher because of the inquiry-based experience I can provide for students. I love the hands-on application of science, along with the real-world connection that science can allow students to discover. Part of my inspiration came from knowing that I can gear my instruction using an inquiry based model, and I can encourage students to ask questions and apply what they are learning in science to their everyday life, which makes it more meaningful and relevant. The science curriculum sets the stage for exploration, so to be able to watch students learn and go above and beyond the curriculum because they are excited and curious is what inspires me on daily basis.

Q2. What elements of your pre-service or in-service training have been most helpful in meeting the daily demands of working with students, developing innovative classroom strategies, and delivering content-rich instruction to students of all levels and abilities?

A2. I was very fortunate to have had an amazing college experience that provided numerous opportunities for me to go into classrooms across many different school districts, grade levels, and subject areas. This diversity allowed me to see different teaching styles, programs, strategies, and classroom management techniques that I was able to pull from and apply to my own classroom as a teacher. It was through these pre-service opportunities and my student teaching that I was really able to have a hands-on experience and begin to apply everything that I learned and read about in my education classes to the real science classroom. In addition to my pre-service experiences, now as a professional working teacher I can also say that I learn everyday from colleagues. I work on a team with other professional educators who have the students' best interests and needs as a top priority, and through our daily communication and collaboration I continue to grow as an educator every day.

Q3. We need the best and brightest to become scientists and mathematicians, but we also need the best and brightest to become teachers of all subjects, particularly math and science. What do you think we could do to encourage more bright and articulate students to consider education as a profession?

A3. Students look up to their teachers as role models, and I think that teachers need to encourage students to go into education as a profession. Students watch their teachers' every move, and if a teacher is showing they are enthusiastic and enjoy what they are doing everyday, then that can encourage students to follow in the steps of their role model. Communication about career education and opportunities for professional growth as an educator are conversations teachers need to have with their students to encourage and inspire them to take on the challenge of educating the next generation so they, too, can have a good-quality educational experience.

Q4. A hallmark of a good teacher, it is said, is the ability to inspire curiosity in students. In my own experience, I have found that students are naturally curious—born scientists, really. Yet many older students do not like science or math and are not particularly interested in it. What happens to that spark, that natural curiosity? How do we re-ignite it for those who have had it extinguished? And how do we fan the spark for those who still have it?

A4. I think as students get older they have more demands and pressures placed on them to do well, pass tests, get into a good college, and land a good job, so students are still curious but don't have extra time in their day to explore their curiosity. Unfortunately, as students get older, doing well on tests take precedence over exploration. I think that offering classes throughout the school day that partner with local businesses that revolve around an area of science is a great for students to see how they can use science once they are out of the classroom and regain their enthusiasm for the subject. Furthermore, this type of educational experience can really open doors for students to explore their curiosity and redevelop their passion for science because they will once again be able to see its relevance to the real world. For those students who still have a passion for science, offering extra-curricular programs, clubs, and competitions for students to get involved in will provide additional opportunities for students to test new ideas and further explore their cu-

riosities about science education so they can continue to enjoy learning about science outside the classroom.

Q5. It is interesting that West Hills Middle School uses ExploraVision as an interdisciplinary activity, involving both science and language arts. Do you know how many other teams make this a multi-subject activity? How many teams did West Hills support this year? Do you limit the competition to seventh graders at your school, or do you encourage other grades to participate?

A5. Making the ExploraVision competition an interdisciplinary project/unit was new this year, and we plan on using the same model in future years because is was so successful. Unfortunately, I am unaware of any other teams outside of our own that took this approach to the competition and would highly recommend it for future teams. This year we had just fewer than 50 teams take part in the competition, which represented every seventh grader at West Hills Middle School. As of today the competition only takes place in the seventh grade because it aligns with the seventh grade science and language arts curriculum; however, we encourage students to participate in the competition as eighth graders who want an additional science challenge and experience, since they have already been through the process and don't require the direct teaching that takes place.

Question submitted by Representative Randy Neugebauer

Q1. The students before us today seem to have a genuine interest in the projects they have undertaken, and they appear to enjoy taking the initiative to learn and better themselves. What techniques do you find are most successful in encouraging students to become engaged in math and science projects? How should we be capturing the imagination of young students through STEM programs?

A1. I find that any real-world connection I can make encourages students to become engaged. Whether it is through open-ended unit questions, music, television, video games, or live demonstrations I can do in front of students, as soon as they can apply what we are discussing or learning in class to an area of their life outside of school their motivation and excitement skyrockets. STEM programs provide the opportunity for students to become problem solvers, and I find that when I pose a competition like ExploraVision to the students, I have them wear the hat of a problem solver and look at their own life. Personal buy-in can add to engagement and motivation so if students can reflect on what we currently have today and follow a problem-solving process, similar to an engineer, they have a drawing board to change their future for the better.

Responses by Ms. Anne Manwell, Science Teacher,
Mentor to the 3Drenal: Kidney Bio-Printer Stuyvesant High School Team,
Brooklyn, NY

Questions submitted by Chairman Ralph M. Hall

Q1. It is impressive that Stuyvesant High School can count five Nobel Laureates amongst its alumni. Clearly, you are doing your part to inspire future generations, but you make a valid point that students must be well prepared in elementary and middle school in order to attend your school. What is your current enrollment and do you have to turn students away? How many different schools feed into Stuyvesant and are they specialized schools as well? Please expand on the make-up of the student population at Stuyvesant.

A1. Stuyvesant High School is one of eight selective NYC Public High Schools that rely on the Specialized High School Admissions Test. (LaGuardia HS is a ninth specialized school that admits students by portfolio or audition.) In the fall about 26,000 (yes, twenty-six thousand) eighth graders take this test for the approximately 5,300 seats available. They also list three schools in order of their preference for admission. 24,000 students named Stuyvesant as one of their preferences. This past spring Stuyvesant offered 961 students seats for the Class of 2015. Of these 816 accepted. These students came from about 150 NYC public middle schools and 30 private/parochial schools. But six public middle schools contributed over 40% to the class. Two are magnet schools for the Gifted and Talented, and three others have a math/science leaning as their names indicate, Christa McAuliffe, Pasteur and Curie.

Congresswoman Fudge was correct in identifying the low percentage of our black or Hispanic students, but that does not reflect the other minority groups served by the school. The first group are students from families falling below the poverty line. Stuyvesant HS receives Title 1 funding as do four of our larger feeder schools. About 45% of students qualify for free or reduced-fee school meals. This means limited family funds available for "expensive" test prepping.

Surnames of Stuyvesant's graduating classes from the early 20th century are a pretty good indicator of the prominent immigrant groups in NYC, and that has continued into the 21st century. Therefore, the next minority group is our immigrant/first generation population, which is reflected by 72% of the Class of 2015 identifying themselves as Asian. "Asian," of course, lumps together everyone with roots from Turkey to the Far East. Chinese and Korean students were the first to show up in NYC and Stuyvesant. Now there is a noticeable rise in students from Pakistan-India-Banglagesh area. Tied to this is the home language of our students. Indeed, of the three students on the 3Drenal team, David speaks Russian exclusively to his parents, and Norine speaks Mandarin to her grandmother who lives with her. At parents' conferences, about a fourth of parents I see bring someone to translate for them. And another fourth probably should have!

The final group served by Stuyvesant is a minority in STEM fields, girls. Every student, not just the XY individuals, graduating from Stuyvesant must have completed a pre-calculus or advanced algebra sequence and four years of science. Our Robotic Team has had girls in Chief Engineer positions. Science Olympiad officers and captains have been girls. I cannot give you the percentage of girls who have taken AP classes in STEM areas because of summer recess, but two-thirds of my Advanced Topics Research class were girls and 60% of a research track Molecular Science course were girls.

I will not pretend that Stuyvesant students are not elite. They have been selected for this. Certainly, not all of them represent minority groups but many are poorer than their classmates, from families newly arrived in America, or are under-represented in STEM fields.

Q2. Do you know what percentage of your students attend college? Pursue a STEM degree? Pursue a graduate STEM degreee or enter a STEM field?

A2. Stuyvesant has consistently seen 99+% of its graduates go on to a four-year college and mostly to tier one colleges. Neither the College Office nor the Alumni Association keeps rigorous data on the areas that our graduates enter, but there was a survey done in 2004, the 100th anniversary of the school's opening, that asked alumni what career they entered. I've gone through that data base and pulled out occupations consistent with a STEM undergraduate degree. Of the 9,200 alumni reporting, 38% listed occupations from accounting to veterinary medicine. I am unable to get a number of advanced degrees in STEM fields, but 550 reported being physi-

cians/surgeons and another 270 were university professors, with their field unnamed.

Q3. What elements of your pre-service or in-service training have been most helpful in meeting the daily demands of working with students, developing innovative classroom strategies, and delivering content-rich instruction to students of all levels and abilities?

A3. I think that the key to your question is "delivering content-rich instruction to students of all levels." A teacher must know her subject matter. Therefore, the most important element in my pre-service training was a BS degree with a major in biology (36+hrs.) and a minor in chemistry (20+hrs.) and an MS in biology (49 hrs.). This strong background in science allows me to ask questions that direct students in their study. If a bright sixth grader questions gravity, I can draw on this background knowledge to ask the student when gravity kicks in as he walks along a line on desktops. Similarly, I can lead a student with a weak background in science with questions that break down the topic into manageable bits.

The most helpful element in my in-service years has been a program at NYU. Directed by developmental biologist Malka Moscona, a promoter of "life-long learning," *Recent Advances in Science Seminar Series* is a monthly Saturday morning session at which research faculty from NYU and other research institutions present their current research to NYU School of Ed students, high school teachers and students. The atmosphere is informal—"stop me anytime for questions"—and some really cool stuff is presented—Harold Varmus told us about Gleevec. I can keep current and network with professional scientists and other teachers and students who attend bring back to the classroom a bright-eyed enthusiasm for research.

Q4. We need the best and brightest to become scientists and mathematicians, but we also need the best and brightest to become teachers of all subjects, particularly math and science. What do you think we could do to encourage more bright and articulate students to consider education as a profession?

A4. That's a hard sell. Bright kids interested in STEM areas who are entering college want to work in STEM areas. It is probably easier to recruit potential teachers in their post-graduate years or after they have worked in their field for a while. Not only will they be more experienced, they probably be more mature and more able to cope with the rigors of the classroom.

Q5. What inspired you to become a science teacher?

A5. Two instances when I was working at Memorial Sloan-Kettering Cancer Center probable played important roles propeling me into the classroom. First when my son was in kindergarten I got a mouse from E. A. Boyce, a section head there, to put into a "Science Box" for Paul's class. At each side of the box the kids were encouraged to use one sense to describe what was in the box. Chandradat used his sense of smell to discribe an open field! Wow, that was cool! The second event was when I was volunteering at a Brooklyn non-profit, Project Reach Youth. Their afterschool program worked with disadvantaged youngsters and I would bring in some science project on occasion. One time I brought in different types of fish and we were going to look at different scale types, body shapes and fin arrangement. The take-home part was a crayon rubbing of a fish. Everything was going fine except one little boy grumpily said "I can't do this!!" "Yes, you can. Hold down the tail and paper with this hand and use the crayon in this hand." Only later when he was happily displaying his rubbing did I notice that he had little use of his hand! If I could influence these two little kids to see and do something in science with these little projects, maybe I could do it on a larger scale by becoming a teacher.

Question submitted by Representative Randy Neugebauer

Q1. The students before us today seem to have a genuine interest in the projects they have undertaken, and they appear to enjoy taking the initiative to learn and better themselves. What techniques do you find are most successful in encouraging students to become engaged in math and science projects? How should we be capturing the imagination of young students through STEM programs?

A1. This is a two-pronged exercise. First you have to lead the student to the project. Requiring one for the class is the surest way to do this. Now you have to make the student engaged—a much, much harder proposal. The student has to take possession of the project to become engaged. The teacher cannot assign a topic. I will often start off by asking the students to complete their interest inventory with categories from "really cool!!!" to "wouldn't touch it with a 10-ft pole." Next, reading science can stimulate questions. *Scientific American, SciAm Mind, Discover, National Geo-*

graphic and *NYTimes Science* section are available in the classroom. Often working in a small group will generate the question. After all the work is done, data collected and analyzed it is important to have the student scientists communicate their findings. Each project that my freshman research class worked on is displayed in a poster session on the hallway walls outside of the classroom and each group presents the poster to the rest of the class. The posters stay up well into the next academic year and the students can see other students, teachers and visitors examining their work.

Participation in competitions is a great tool to sustain student interest in a STEM project. Local science fairs to national competitions are a way to show off students' work. In this regard ExploraVision is unique. Traditional science fairs require some sort of experimentation to be completed. Often this requires specialized equipment or chemicals not always available to student in every type of school. Students involved in an ExploraVision project use their imaginations to come up with an idea, develop skills to accumulate background information, use logic to project their idea into the future and then hone communication skills to present their idea to the national judging panel. Each of these steps develops a core skill present in every district's, every school's, every grade's educational plan. With four grade-level categories and 500 Honorable Mention Awards, the ExploraVision competition can be used as a strong motivator for engaging students at all levels in STEM fields.

Responses by students of Dr. Karen Lozano (Jorge Vidal), Mrs. Brenda Conwell-Dudley (Jack Dudley), and Ms. Anne Manwell (Alison Reed, Norine Chan, and David Kurkovskiy)

Questions submitted by Chairman Ralph M. Hall

Q1. How do you find time to be involved in all the extracurricular activities and focus on school work and win national science competitions?

Response by Master Jorge Vidal

A1. The more you have to do, the quicker you get everything done. You see I am a "A" honor roll student in one of the top middle schools. I swim 22 hours a week, eight times a week year round. I also play several instruments, including piano, guitar and harmonica. I am a 14-year-old who has won the ExploraVision national science competition twice. Now how does one person do so much in one day? It's simple, every time you get a free minute you do your homework, or projects. All schools have study hall or tutorial period during school hours, take advantage of that time. Get your homework done there so you can do other activities after school. Since I know that I will not be getting home till 8:30 p.m., I won't have much time to do homework when I get home, so I do it in school. On the other hand, kids who go home after school have the whole afternoon to do homework so they procrastinate and leave it for later, knowing that they will have time later, but they procrastinate so much that before they know it, it is 10:30 and they haven't started their homework. It is good to have a full schedule even if it is with house chores in the afternoon. The more you have to do, the quicker you get everything done. So what does that mean? I have a lot of things to do in 24 hours, and I have to get everything done and do it right. So I work fast and efficiently with my work and do time management and don't waste time playing video games and watching TV, or texting/playing on my cell phone. On the weekends I rest, spend time with my family and go to church. If I can do it, then the other tens of millions of teenagers living in America can do it, no excuse! Being involved in sports is very important. Having a hobby such as playing piano, taking art class, etc., is also very important. And good grades in school to top it off. If all the kids in America had a full schedule, you will see a big difference in grades, promised. It is not easy, but possible.

Response by Master Jack Dudley

A1. I find time to be involved in extracurricular activities (e.g., national science competitions) and time to focus on school work by not participating in too many extracurricular activities. I also try to do as much of my homework at school as possible.

Response by Miss Alison Reed, Miss Norine Chan, and Mr. David Kurkovskiy

A1. As students in Stuyvesant High School, one of the most rigorous and demanding public high schools in New York City, we are often faced with the challenge of balancing schoolwork and extra-curricular activities. It is something we have been doing since freshman year, as we are urged to devote ourselves to community service, school sports teams, school publications, and extra projects in addition to the learning we do in classes. David Kurkovskiy writes for the school newspaper, participates in Stuyvesant's literary magazine, and volunteers periodically for his school. Norine Chan is part of Stuyvesant's fencing team, and competes for Stuyvesant's speech and debate team. Alison Reed is a member of the tennis team, and contributes to art for school productions. All three of us have devoted countless after-school hours in working on the Toshiba ExploraVision contest.

With such packed extracurricular schedules, it is difficult for us to complete assignments and study for our classes. Stuyvesant offers advanced classes, and all of us took an advanced placement course in history this year. Some of the arduous honors classes we took included trigonometry and chemistry. In order to balance the time of our studies and other activities, we would have to make the most of any free time we had. This meant that hour-long train rides to school would involve cramming for the day's exams. Many lunch periods would be spent completing homework in advance, so as to make up for the time spent on the project after school. There would be nights when we all returned home at 11 p.m.; in one case, this was the day before a difficult trigonometry honors test. In times like these, we would have to sacrifice long-deserved sleep on weeknights. In spite of this all, all of us are relatively good in managing and making the most of our time, and all of us completed the school year with averages above 96. Because of the strong foundation in academics and time management we received as high school freshmen, we were able to balance the Toshiba project, schoolwork, and extra-curriculars.

Q2. One of the interesting themes I have heard each of you touch on is that of teamwork. Often in grades K–12 there is little emphasis placed on learning to work together; instead we focus on understanding facts and concepts individually. What has this experience taught you about working together with others, fellow students, teachers, and mentors?

Response by Master Jorge Vidal

A2. There is not a single job in the world where you won't have to work with other people, and listen to what they have to say and use your communication skills to brainstorm ideas and other concepts. If this concept of working with others is not taught as a little kid it will be very hard to develop as an adult. Just like a language, a kid will learn the language like a sponge, but try and teach a language to an adult and it will be very difficult. ExploraVision forces students to work with others, brainstorm ideas, listen to what others have researched and what they have to say. Very similar to what an individual has to do in a job. Working as a team from when you are a little kid helps develop those communication skills needed for the future. It is easier and faster at times to work alone. Not having to listen to what others have to say and do everything your own way, but really when is that going to happen in a job. You have to listen to what your boss has to say and what your coworkers have to say. For example in Montessori education teamwork, interacting with other individuals is highly encouraged. ExploraVision does an excellent job in incorporating this skill. And more of this should be incorporated into schools across the United States.

Response by Master Jack Dudley

A2. This experience taught me that working together with others, fellow students, and adults is much better than working on my own. I have learned that you can get much more done with a team and it is more fun. It is also easier to generate good ideas, and filter out the bad ones.

Response by Miss Alison Reed, Miss Norine Chan, and Mr. David Kurkovskiy

A2. Working together on the Toshiba project has taught us that a group project requires the contribution of all its members. We would all have to share opinions on whichever part of the project we were working on, be it the color scheme of the Web site we had to create, or how to phrase certain ideas in our written proposal. Many times there would be a disagreement, and knowing when the right time to yield to the others became difficult. In order to overcome these disagreements, we learned to compromise. Compromise, in addition to bettering our project, is an important life skill we learned over the course of our project. It allows an efficient work ethic and furthers team building.

Working as a team also fosters friendships, and it has strengthened the bond between the three of us. By facing looming deadlines and difficult decisions together, we've learned to trust and respect each other. In addition to working as a team, we had to employ the help of teachers, and other students while working on our project. Our coach, Samantha Daves, helped keep us organized by giving us periodic deadlines and overseeing the development of our project. Our mentor, Ms. Manwell, consulted us for biological accuracy in our Web site and paper, and worked with us in strengthening our ideas. We've also received much help from the assorted faculty of Stuyvesant High School, whose different talents helped us throughout our project. Biology teacher Jonathan Gastel gave us constructive criticism on our idea during its early stages. Technology teacher Elka Gould taught us elements of video editing and reviewed the video on our Web site with us. Finally, the assistant principal of the chemistry and physics department, Scott Thomas, helped us in building our prototype. In addition to enlisting the help of teachers, other students have offered their services. For example, friends of ours helped us in cutting pieces for our prototype and designing the initial logo for our Web site. By working on the Toshiba project, we've learned to work with each other, our teachers, and other students.

Question submitted by Representative Randy Neugebauer

Q1. What has been the most rewarding part of your experience with these projects and competitions? After participating, do you think you would be more or less likely to pursue science or math as you get older?

Response by Master Jack Dudley

A1. The most rewarding part of my experience with these projects and competitions is the thrill of winning, and the excitement of learning new things. Another rewarding part of my experience is working as a team to solve problems that the world

is facing today. After participating, I think that I am more likely to pursue science and math when I grow older. I would like to be a rocket engineer like my dad, and that definitely involves math and science.

Response by Miss Alison Reed, Miss Norine Chan, and Mr. David Kurkovskiy

A1. The most rewarding experience of the Toshiba ExploraVision contest was learning to work as a team and seeing an idea come to fruition. We were able to see our idea of building a 3D bio-printer through from the initial concept to its final stage as a prototype. Seeing it as a final product was rewarding because countless hours were spent in writing the paper and creating the Web site. Completing the Toshiba project has made us aware of the scientific opportunities in our future. All three of us consider science as an important subject and a possibility for our career. Norine Chan wishes to become a doctor when she is older. David Kurkovskiy, though undecided about his future profession, will be participating in the Intel Science Talent Search competition for social science in the next year. Alison Reed, too, considers pursuing a career in science as a possibility for her future.

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