

**Written Testimony by Neil Lamb, PhD,
Vice President for Educational Outreach,
HudsonAlpha Institute for Biotechnology**

**before the Subcommittee on Labor, Health and Human Services, Education, and Related Agencies
of the Committee on Appropriations of the United States Senate
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Introduction

Good morning Chairman Blunt, Ranking Member Murray, and members of the Subcommittee. Thank you for inviting me to offer testimony today regarding K-12 STEM education and workforce development, a subject about which I am particularly passionate.

I work at the HudsonAlpha Institute for Biotechnology, a nonprofit genomic sequencing and research institute focused on accelerating scientific discovery into biotech entrepreneurship. The Institute is located in Huntsville, Alabama – a city where over 16% of the metropolitan workforce holds a job in a STEM-related field (<https://www.bloomberg.com/graphics/2015-stem-jobs/>). At HudsonAlpha, we create a better tomorrow using our expertise in research, patient care, innovation and education. We analyze and interpret DNA to understand its meaning. This includes genetic information from patients with health issues, from agriculturally important crops, and from organisms that may provide untapped sources of energy. Our president and science director, Richard Myers, managed a team that sequenced a significant percentage of the human genome and we are one of the top DNA sequencing centers in the country. Our faculty are recognized experts in both human and plant genomics. A clinic on our campus is dedicated to whole genome sequencing for disease diagnosis. Also on our campus are more than 30 biotech companies – some in the same hallways as our research labs. As part of the HudsonAlpha model, industry entrepreneurs sit elbow to elbow with researchers, clinicians and educators – and society benefits from their collaboration.

However, by themselves, scientific and technical capability cannot translate genomic knowledge into well-being; an understanding of basic genetics and genomics is required by a number of key social and occupational groups, such as physicians, farmers, legislators and the general public, in order for the full promise of genomic discovery to be realized.

As the Vice President for Educational Outreach at the Institute, it is my privilege to strategically help cultivate a scientifically literate society and to nurture the formation of tomorrow's life science workforce. Our programming targets learning from youth through workforce professional development and on to continued adult education. This means HudsonAlpha has a unique understanding of the current state of STEM literacy as well as the necessary ingredients to assemble a pathway encompassing a lifetime of learning. I hope that today's hearing contributes to a larger conversation not only about the importance of STEM education and workforce development, but also the necessity of a STEM-literate citizenry for the well-being of our society at large.

The current landscape:

STEM jobs increasing as prepared future employees decreasing

The United States has long been the world leader in using science and technology to drive innovation and build wealth. The STEM field has contributed to more than 50% of post-World War II US economic growth, even though it historically has accounted for only about 5% of the American workforce. Today, the U.S. Department of Commerce notes that STEM careers are growing at 17 percent, nearly double the rate of growth in other occupations. Eighty percent of the fastest growing America jobs require STEM skills.

Unfortunately, our country is currently not producing enough qualified graduates to fill these jobs. For every STEM professional available for hire, there are nearly two open STEM positions. Almost two and a half million unfilled STEM job vacancies are estimated for the coming year.

A poor foundation, a leaky pipeline and a learning disconnect

Simultaneously, American students are academically falling behind the rest of the world, lacking a strong STEM foundation. Results from the *Programme for International Student Assessment*, show that among industrialized nations, U.S. students ranked 24th in science and 38th in mathematics. Similarly, while nearly half of last year's 2.1 million high school graduates who took the ACT test expressed an interest in STEM majors or careers, just over a quarter of those interested students met or surpassed the ACT STEM benchmark – an indicator of whether a student is appropriately prepared for first year science and mathematics coursework. About 60 percent of students who initially enroll in a STEM-based major in switch to a non-STEM field or drop out of college entirely. Among women and minorities, that number rises to 80 percent.

At HudsonAlpha, these national statistics are mirrored in our Alabama observations. This is often referred to as the “leaky” STEM workforce development pipeline. The consequences are a decline in the number of students who ultimately become scientists, engineers and workforce innovators.

To engage, retain and prepare students for careers in STEM-related fields such as genomics, we see a critical need to implement approaches that connect learning with real-world application. Recent developments in genomics and biotechnology offer solutions to pressing issues of human health and food security. New discoveries advance the field rapidly. Healthcare professionals must be grounded in genomics to bring state-of-the-art diagnosis and treatment to patients. Farmers must rely genomics as a tool to shape breeding strategies for livestock and crops. Entrepreneurs must have sufficient appreciation of genomics, capital and access to talent in order to develop and market genomic innovations effectively. Speaking more broadly, all American consumers require the necessary science literacy to make informed choices about how genomics impacts their lives, as well as the lives of family and friends.

STEM Education at HudsonAlpha

For these reasons, HudsonAlpha passionately pursues educational outreach to students, teachers, health professionals and the community at large. We leverage the scientific discoveries and their commercial

applications to build activities and experiences that foster genomic literacy and prepare tomorrow's science and technology workforce. I am honored to work with a remarkable team of talented individuals who provide educational resources that are in the hands of students, teachers, clinicians, and everyday citizens across Alabama, throughout the country and around the globe.

Federal funding programs leveraged at HudsonAlpha

During our ten-year history, HudsonAlpha's Educational programs have leveraged funding from three federal agencies: The Department of Labor, NASA and the National Institutes of Health. Each of the programs developed with federal funding helped to build a stronger foundation in science education, plug the leaky workforce pipeline, or provide experiences that applied science knowledge to real-world situations.

1. From 2007-2010, HudsonAlpha was one of the key partners in a **U.S. Department of Labor Workforce Innovation in Regional Economic Development (WIRED)** grant for North Alabama and South Central Tennessee. This funding developed hands-on modules for middle and high school students to explore chromosome behavior in cells, diagnose genetic disorders and use bioinformatics databases to reinforce concepts about DNA structure and function. Each activity linked genetics concepts to the professionals who use this knowledge in their everyday career. Over the last six years, we have expanded from three to eleven of these activities, annually reaching more than 100,000 students nationwide.

This Department of Labor support also allowed HudsonAlpha to launch a summer internship program with the nonprofit research labs and educational outreach, economic development and communications departments as well as with many of the biotech companies located on the campus. Undergraduate and master's level graduate students participate in internship experiences that range from in-depth laboratory research to biotechnology marketing, communications and business strategy. Today, more than 250 BioTrain interns from 36 colleges and universities have trained at the Institute and many have advanced to careers in genomics research, bioinformatics and science communication.

2. In 2010, HudsonAlpha received funding from the **National Aeronautics and Space Administration** to construct an interactive children's exhibit about cells, as well as introduce older students to emerging research and career possibilities in genetics and biotechnology. HudsonAlpha also implemented a summer academy for high school biology instructors. This two-week program produced significant gains in educator content knowledge about genetics, and measurably increased educator confidence in teaching that content to students. Today, summer educator programs continue to be a cornerstone of our professional learning programs.
3. A 2011-2017 **National Institutes of Health Science Education Partnership Award** allowed us to develop Touching Triton - an online serious game using the concept of long-term space travel to understand common complex disease risk (triton.hudsonalpha.org). Students analyze family history, medical records and genetic test results for one of six crewmembers embarking on a 20-year space mission to a distant moon of Neptune. Based on their assessment of disease risk, students work in teams to pack the spacecraft with the appropriate resources to maintain crew

health. Our educators collaborated with NASA engineers to ensure spacecraft design and storyline elements were scientifically accurate (www.nasa.gov/audience/foreducators/touching-triton). The online game is now implemented in classrooms across Alabama and was launched nationally at last year's National Association of Biology Teachers meeting. With over 12,000 student accounts created to date, it was selected as a 2015 finalist in the Serious Games Showcase and Challenge, organized by the Interservice/Industry Training, Simulation and Education Conference.

The success of HudsonAlpha's educational pathway

Alabama students, educators and the biotechnology industry have significantly benefitted from the federal initiatives that supported our educational programming. From our campus in Huntsville, Alabama, HudsonAlpha's team of science educators provide educational tools and learning opportunities that are utilized by learners of all ages in our state, across the U.S. and around the world. Nearly 80 percent of Alabama high schools use HudsonAlpha-designed classroom kits. Our workshops and summer academies strengthen a network of over 500 Alabama educators. These two initiatives, both launched with federal funding, significantly shape the trajectory of life science education across our state.

Moreover, programs launched with federal funds have become models for programming other states. Licensing agreements have expanded our reach nationally and our digital activities are used around the globe, reaching more than 1 million individuals across all 50 states and in 139 countries.

For every dollar awarded in federal funds, HudsonAlpha has obtained 4 dollars of non-federal funding. This includes corporate support from groups like Boeing and Lockheed Martin, as well as private philanthropic dollars, institutional support, and state educational funds.

STEM leadership, federal funding and a STEM-literate society is critical

With fierce competition from other countries seeking to overtake the U.S. position in achievement and innovation, sustained national support of STEM literacy is critical. At the same time, states, nonprofits and industry must also invest to nurture budding science and engineering professionals. A motivated and growing workforce pipeline is required to keep pace with emerging human needs. The innovations that provide solutions will come from creatively applied STEM advances. Children today will pursue STEM careers that we haven't even imagined, and we will be faced with making decisions regarding how to apply scientific discoveries that have not yet been made to our lives. One of our nation's most essential responsibilities will be preparing our citizenry to lead the world in the development and use of advanced science and technologies will continue to be one of our nation's most essential responsibilities.

Again, I'd like to thank the committee for providing this opportunity to speak about the importance of Federal support for STEM education and workforce preparation. I would also like to thank our state's delegation, specifically Senator Shelby, for the continued support of this issue and of HudsonAlpha. On behalf of our founders, research faculty and the 35 biotechnology companies housed on our campus, I'd like to extend an invitation to visit and/or hold a future field hearing on the HudsonAlpha campus.