Equity, Evidence and Innovation in Science, Technology, Engineering, and Mathematics (STEM) Education

Ramón Barthelemy

Ramón Barthelemy is a policy fellow at the U.S. Department of Education and a former Fulbright Scholar in Finland. He has studied issues of equity and access in STEM with a focus on women and LGBT people. Currently, he works on K12 and higher education policy in the Department's STEM Office.

Ramón holds a bachelor's degree in Astrophysics from Michigan State University and a masters and Ph.D. in Science Education from Western Michigan University (WMU) where he received a fellowship awarded by the National Science Foundation's Alliances for Graduate Education and the Professoriate (AGEP) program. He is also a recipient of the Michigan Space Grant. AGEP is committed to the national goal of increasing the numbers of underrepresented minorities, including those with disabilities, entering and completing STEM graduate education and postdoctoral training. Ramón is the founder and first president of WMU's oSTEM chapter (out in Science, Technology, Engineering, and Mathematics).

Melissa Moritz

Melissa Moritz serves as the Deputy Director of STEM at the U.S. Department of Education (ED). In this capacity, she supports STEM policy and programs at ED that focus on STEM teaching and learning, from preschool to workforce. She serves on numerous interagency working groups and co-chairs the P-12 STEM working group as part of the White House Committee on STEM Education (CoSTEM).

Prior to joining ED, she served as the Vice President of Science, Technology, Engineering and Math (STEM) and Education Initiatives at Teach for America (TFA). In that capacity, she oversaw TFA's national STEM Initiative and managed the team that led TFA's Early Childhood Education Initiative, Diverse Learners Initiative, Military Veterans Initiative and Native Alliance Initiative. As part of the STEM Initiative, Melissa created TFA's first computer science cohort and raised nearly $10M to support the recruitment and training of new STEM educators.

After graduating from the Massachusetts Institute of Technology with a B.S. in Biology in 2006, she joined TFA, where taught middle school science at MS 321 in New York City. Melissa was named one of the "100 Women Leaders in STEM" in 2012 and previously sat on STEMConnector's Innovation Task Force and the US News STEM Advisory Council.

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STEM Office: Vision, Mission and Strategies

Vision:

STEM[1] learning is important for everyone. The relevant, real-life skills that people develop when learning STEM subjects help make everyone better problem-solvers and citizens. To achieve the vision of **STEM literacy for all**, the Office of STEM at the U.S. Department of Education seeks to:

- Maximize access to high-quality STEM education for all students, from Pre-K through post-secondary students, both in and outside the classroom.
- Inspire and prepare students to achieve proficiency in the STEM disciplines and to consider pursuing careers in STEM fields, particularly people of color, females, and special needs populations.
- Support educators who teach STEM subjects to ensure they have access to the tools and resources they need to prepare students with the STEM skills needed for college, career and life.
- Identify and support the implementation of innovative and scalable approaches and research strategies that improve the effectiveness of STEM education in formal and informal learning environments.

Mission:

We seek to improve access to quality STEM education for all students, particularly students from groups that have historically been underserved in the STEM fields, including students in low income communities, students of color, females, students with special educational needs, and students living in rural communities. To accomplish this we will focus on the following **seven** priority areas:

1) Improve the P–20 experience for all students, especially underserved students.
2) Enhance access to high quality out-of-school and informal STEM learning experiences that build upon and complement formal, classroom-based learning experiences.
3) Support teachers who teach STEM subjects (with an emphasis on expanding the scope of P–20 STEM to include Pre-K and computer science).

[1] Definitions for which disciplines should be considered part of 'STEM' (Science, Technology, Engineering and Mathematics) vary considerably, but for the purposes of this document and the Department of Education's STEM work, our primary focus is on grades P-12 for which STEM primarily consists of math and science plus the emerging fields of computer science, engineering and technology. Technology can also mean many things, in our context we are focused on supporting students to utilize technology to build and create technology as well as supporting educators to use technology as a tool for learning. In post-secondary education, STEM is defined to encompass majors, certifications and coursework that contribute to learning in these disciplines. STEM learning takes place in many settings and STEM skills such as critical thinking, problem solving, experimentation, data analysis, argumentation from evidence and observation are foundational for all students regardless of intended major or career.

4) Collaborate across multiple sectors, particularly innovative media, to increase awareness of, and interest in STEM disciplines and careers and connect STEM to real-life.
5) Increase students' access to community-based resources (e.g., link the Department's grantees to initiatives such as My Brother's Keeper, STEM Learning Ecosystems) by identifying and connecting to STEM-focused initiatives with similar or complementary goals.
6) Bring together research communities focused on formal and informal STEM learning to identify effective tools, strategies and programs that can be used in new and innovative ways to enhance student interest, motivation and learning.
7) Identify knowledge gaps and work to fill those gaps through innovative research practices, thus expanding the evidence base for promising practices in STEM education.

Strategies:

To impact the above priority areas, we employ the following strategies:

- **Strengthen existing Department of Education STEM programs**: Support Math and Science Partnerships, 21st Century Community Learning Centers, School Improvement Grants (SIG), Teacher Quality Partnerships, Investing in Innovation (i3), Ready to Learn (RTL) and many STEM-focused programs and their grantees. Collaborate across the Department to effectively integrate STEM as a priority in federal programs and support grantees' successful implementation of STEM-related projects.
- **Enhance inter-agency collaboration focused on STEM**: Foster stronger linkages across agencies that have STEM education programming. Collaborate with other agencies to identify synergistic activities that elevate awareness of, interest in and proficiency in the STEM fields.
- **Communications and Outreach**: Use convenings, events, speeches, and other mechanisms to highlight models, interventions, data, leading practices and policies for formal and informal STEM learning at the federal, state and local level and encourage broad adoption. Leverage senior leadership at the Department and across agencies to amplify key STEM messages.
- **External Partnerships**: Partner with non-government strategic partners (e.g., media, non-profits, funders, state STEM coalitions) to support these priorities. Leverage unique assets and capabilities to improve access, equity, and student engagement in STEM.
- **Influence and Shape the Future of STEM Education**: Identify and help cultivate, disseminate and encourage adoption of innovative, promising, and evidence-based practices. Catalyze research, development and innovation in STEM education to help answer such questions as how to cultivate and leverage connections between formal and informal education and how best to utilize technology to support students and teachers. Promote alternative approaches to innovation in research and development in education technology and help coordinate efforts across government agencies and private foundations (e.g., the Department's proposed ARPA–ED initiative).

Key focus areas and messaging:[2]

[2] http://www.frameworksinstitute.org/toolkits/STEM/elements/files/STEM-talking-points.pdf

- **Equity** – To improve education in this country we need to make sure that no matter where children live or what school they go to, they have an equal opportunity to access quality learning environments. This includes making sure all schools have teachers and programs that can teach students science, technology, engineering and math—or what we call "STEM".
- **STEM proficiency for all students** – We must ensure that all students have the knowledge and skills they will need in order to thrive in the 21st century workplace and world. This starts with a strong foundation gained from early STEM experiences, both during the school day and during out-of-school time, and is sustained and supported throughout students' educational careers.
- **STEM support for all teachers** – All children deserve excellent teachers in STEM subjects. We must prepare and support educators to ensure they have the tools and resources they need to inspire, cultivate and steward students' STEM learning.
- **Evidence-based practice** – Successfully implementing improvements in STEM education requires identifying and scaling innovative practices and technologies that provide evidence-based improvement to education. We must encourage public and private research funding agents to identify these innovations and provide the evidence-based required for their adoption.

Emerging areas of opportunity:

- **Early Learning** – Current research indicates that young children have the capacity for constructing conceptual learning and the ability to use the practices of reasoning and inquiry. Learning science and engineering practices in the preschool years foster children's curiosity and enjoyment in exploring the world and lay the foundation for life-long science learning both in and outside of P–12 settings and throughout their entire lives.
- **Computer science** – Computer science (CS) coursework (including applications of CS like cybersecurity & robotics) provides access to foundational problem-solving skills of benefit to all children. Despite the opportunities involving CS skills, less than one-quarter of students nationwide have access to rigorous computer science courses.[3] We need to ensure all students have equitable access to these courses and experiences.
- **Synergies between formal and informal STEM** – Increasingly, effective and enriching STEM opportunities are happening outside the classroom. While the impact of experiential learning is well documented, we need to develop stronger and more extensive connections between the formal and informal learning communities. As noted in a recent National Research Council report, "The ways in which young people learn about STEM has fundamentally changed in the past decade. More so than ever, young people now have opportunities to learn STEM in a wide variety of settings, including clubs, summer programs, museums, parks, and online activities."[4]
- **STEM Learning Ecosystems** – The concept of a "STEM Learning Ecosystem" has recently emerged as a promising approach both for increasing overall interest and engagement in STEM within a community as well as for addressing disparities in access to quality STEM learning opportunities. A STEM Learning Ecosystem is a learner-

[3] http://www.prweb.com/releases/2012/12/prweb10219767.htm
[4] Identifying and Supporting Productive STEM Programs in Out-of-School Settings, National Research Council, June, 2015.

centric model that leverages community assets across multiple settings that together constitute a rich array of learning opportunities for young people. Such settings include schools, community organizations such as libraries, after-school and summer programs, STEM-rich institutions such as science centers and museums, as well as informal experiences at home. A learning ecosystem harnesses the unique contributions of all these different settings, providing multiple and varied opportunities for STEM learning to all children so that they may become engaged, knowledgeable and skilled in the STEM disciplines.

- **Innovations in television and media –** Promoting lifelong learning in STEM involves leveraging a variety of media approaches. Working with the White House and various media outlets, the STEM Office has the opportunity to infuse more STEM-focused content into traditional media platforms such as television and educational games, while promoting the increased use of STEM programming by other types of media commonly used by students (e.g., social media, comics, transmedia). The STEM Office will continue to promote positive portrayals of STEM careers and disciplines that include equity in race, gender, and socio-economic status.