CONFERENCE REPORT

Held May 30 – June 2 in downtown Washington, DC, NIH SciEd 2017 was the sixth NIH-wide conference for science education projects funded by the National Institutes of Health. The 75 projects represented at the conference were funded by the following programs:

- Science Education Partnership Award (SEPA), Office of Research Infrastructure Programs (ORIP), Division of Program Coordination, Planning and Strategic Initiatives (DPCPSI), Office of the Director
- NIH Blueprint for Neuroscience Research Science Education Award
- IDeA Networks of Biomedical Research Excellence
- Science Education Drug Abuse Partnership Award (SEDAPA), National Institute on Drug Abuse (NIDA)
- Science Education Awards, National Institute of Allergy and Infectious Diseases (NIAID)
- National Science Foundation

The 218 conference participants included 62 project PIs, 18 Co-PIs, 16 project managers, 25 project staff, 11 evaluators, 9 graduate students and post-doctoral fellows, 4 teachers, 34 other individuals, and 28 federal government employees, including NIH staff (NIGMS, NHGRI, NCI, NIDDK, NIDA) and representatives from other federal agencies involved in science, technology, engineering and mathematics (STEM) education at the pre-kindergarten – grade 12 (P-12) levels. These agencies included the National Science Foundation (NSF), and the U.S. Army Medical Research and Materiel Command (AMRMC).

The conference began with a keynote address by Jon R. Lorsch, PhD, director of NIH NIGMS, who highlighted the synergies of the SEPA program with other biomedical research workforce development programs at NIGMS. In the next keynote address, Eric D. Green, MD, PhD, director of NIH NHGRI, described several major highlights in genomics over the past 14 years since the human genome was first sequenced that have permitted advances toward the goal of genomic medicine. A hands-on, interactive plenary session led by SEPA PIs Joseph Krajcik, PhD, and Barbara Hug, PhD, engaged participants in the initial strategies of developing assessments that elicit learners' thinking, knowledge and skills. In the final keynote, Christopher Hoadley, PhD, spoke about design-based research.

Breakout sessions addressed equity, diversity and health disparities, informal science education, science teaching and learning, STEM games for learning, teacher professional development, research and evaluation, and project administration. A reception featuring demonstrations of games, apps and technology-based educational materials provided another opportunity for participants to view the products of SEPA projects. All projects were invited to present a poster about their work during one of two poster sessions. Participants reported that they returned home energized by gaining new ideas for evaluation and other project components, learning about STEM education priorities at the national level, networking, and forming new collaborations.

NIH SciEd 2017 Conference Organizing Committee

Kristin Bass, PhD, *Rockman et al*

Judy Brown, PhD, *Patricia & Phillip Frost Museum of Science*

Ann Chester, PhD, *West Virginia University*

Theresa Gillespie, PhD, MA, *Emory University School of Medicine*

Lisa Marriott, PhD, *Oregon Health & Science University*

Robin Rockhold, PhD, *University of Mississippi Medical Center*

Robert Russel, PhD, *Division on Research & Learning, EHR, National Science Foundation*

Louisa A. Stark, PhD, *University of Utah*

Jennifer Ufnar, PhD, *Vanderbilt University*

J. Michael Wyss, PhD, *University of Alabama at Birmingham*

Conference Support

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Report prepared by:

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Genetic Science Learning Center, University of Utah

Conference Schedule

TUESDAY, MAY 30

5:30–7:30 Conference Check-in and Networking Reception
Poster Set-up

WEDNESDAY, MAY 31

7:15–8:30 Breakfast

7:30–8:30 Late Conference Check-in and Poster Set-up

8:30–8:40 **Welcome**
Louisa A. Stark, PhD
Chair, NIH SciEd 2017 Conference Organizing Committee, University of Utah

8:40–9:40 **Keynote Address**
Jon R. Lorsch, Ph.D., Director, National Institute of General Medical Sciences (NIGMS), NIH

9:40–10:00 Break

10:00–11:00 **Keynote Address:**
Enhancing Genomic Literacy: Rationale, Opportunities, and Challenges
Eric D. Green, M.D., Ph.D., Director, National Human Genome Research Institute (NHGRI), NIH

11:00–12:00 **Update on the SEPA Program**
L. Tony Beck, PhD, Science Education Partnership Award (SEPA), Center for Research Capacity Building, National Institute of General Medical Sciences (NIGMS), NIH

Overview of the SEPA Process Evaluation
Jill Feldman, PhD, Westat Senior Study Director

12:00–1:30 Lunch

Mentor-Mentee groups meet for newly-funded SEPA projects
See list of assigned tables
Room: Franklin Square/McPherson Square

1:30–1:45 Poster set-up in breakout rooms – ONLY set session A posters on tables
Topic-oriented poster sessions will be held in breakout rooms

1:45–2:45 **Poster Session A – even-numbered posters**

Authentic Research Experiences for Students & Teachers
Room: Independence F/G

Curriculum Development
Early STEM
Room: Farragut Square

Informal Science Education
Room: Lafayette Park

Student Science Enrichment
Rural STEM
Room: Franklin Square/McPherson Square

Teacher Professional Development
Room: Independence A – round tables

2:45–3:00 Take down even-numbered posters; set up odd-numbered posters

3:00–4:00 **Poster Session B – odd-numbered posters**

Authentic Research Experiences for Students & Teachers
Room: Independence F/G

Curriculum Development
Early STEM
Room: Farragut Square

Informal Science Education
Room: Lafayette Park

Student Science Enrichment
Rural STEM
Room: Franklin Square/McPherson Square

Teacher Professional Development
Room: Independence A – round tables

4:00–4:15 Break; Return all posters to the tables in the plenary room

4:15–5:30 **Concurrent Breakout Sessions**

Working With Populations Suspicious of Science
Strand: Equity, Diversity, and Health Disparities
Room: Lafayette Park

Understanding and Measuring STEM Career Development
Strand: Research and Evaluation
Room: Franklin Square/McPherson Square

But How Well Does it Work? Immersing High School Students in a Research-Design-Evaluate Cycle to Learn About Health Messaging
Strand: Science Teaching and Learning; Research and Evaluation
Room Farragut Square

Curriculum Development and the NGSS: Connecting Science Learning With the Lived World of Our Students
Strand: Science Teaching and Learning
Room: Independence F/G

Effective Professional Development Design and Implementation: What do Teachers

Need and Want?
Strand: Teacher Professional Development
Room: Independence A

Resources Available from National Science Foundation STEM Education Resource Centers
Strand: Project Administration
Room: Independence I

Commercializing your SEPA
Strand: Project Administration
Room: Independence H

Dinner on your own

THURSDAY, JUNE 1

7:15–8:30 Breakfast

Meeting for all new SEPA PIs
L. Tony Beck, PhD, Science Education Partnership Award (SEPA), Center for Research Capacity Building, National Institute of General Medical Sciences (NIGMS), NIH
Room: Franklin Square/McPherson Square

8:30–10:00 **Assessment Workshop**
Joseph Krajcik, PhD, Lappan-Phillips Professor of Science Education; Director of CREATE for STEM Institute, Department of Teacher Education, Michigan State University

10:00–10:15 Break

10:15–10:35 **NIHSEPA.org: A Website for the SEPA Community**
Nancy Moreno, PhD, Associate Provost for Faculty Development and Institutional Research; Professor, Allied Health Sciences and Family & Community Medicine, Baylor College of Medicine

10:35–11:00 **The Trans-NIH Native American Research for Health Program**
Sheila A. Caldwell, PhD, Program Director, Center for Research Capacity Building, National Institute of General Medical Sciences (NIGMS), NIH

11:00–12:00 **Keynote Address: Rigorous Design, Rigorous Research: Inventing the Future of Learning with Design-Based Research**
Christopher Hoadley, Ph.D., Associate Professor of Educational Communication and Technology, Program in Digital Media Design for Learning, and Program on Games for Learning. New York University

12:00–1:30 Lunch

1:30–2:45 **Concurrent Breakout Sessions**

Discussion with Christopher Hoadley on Design-Based Research
Strands: Research and Evaluation; Informal Science Education

Room: Lafayette Park

Evaluating Teacher Professional Developments: Insights From Three SEPA Projects
Strand: Research and Evaluation
Room: Independence A

Establishing a Basic Genomic Literacy Framework for K-16 Students
(double session, 1:30–4:15)
Strand: Science Teaching and Learning
Room: Independence F/G

Planning Competitive National Science Foundation Proposals
Strand: Project Administration
Room: Independence I

Models for Building Relationships With Students and Communities That Support Science Learning and Success
Strand: Equity, Diversity, and Health Disparities
Room: Farragut Square

Science of Learning: How do SEPA Projects Incorporate Theories of Learning Into Curriculum?
Strand: Science Teaching and Learning
Room: Franklin Square/McPherson Square

Big Data in STEM Learning
Strand: Science Teaching and Learning
Room: Independence H

2:45–3:00 Break

3:00–4:15 **Concurrent Breakout Sessions**

The Evolution of the "How We Role" Evaluation: Lessons Learned From Four Iterations of Learning Assessments
Strand: Research and Evaluation
Room: Lafayette Park

Establishing a Basic Genomic Literacy Framework for K-16 Students (double session, 1:30–4:15)
Strand: Science Teaching and Learning
Room: Independence F/G

Bilingual Exhibitions and Community Leader Dialogues in Rural Colorado Libraries
Strand: Informal Science Education
Room: Farragut Square

A Discussion of Science Identity Formation: Methods by Which Persons Find Their Space in STEM
Strand: Science Teaching and Learning
Room: Independence H

STEM Relationship Pipelines: A Core Component of Long-Term Impact
Strand: Equity, Diversity, and Health Disparities
Room: Independence A

Engaging a Pipeline from SEPA to IDeA Programs
Strand: Equity, Diversity, and Health Disparities
Room: Independence I

Connecting Current Research to the Next Generation Science Standards
Strand: Teacher Professional Development
Room: Franklin Square/McPherson Square

4:15–5:30 **Networking Reception**

Demonstrations of Games, Apps and Technology-Based Educational Materials

Dinner on your own

FRIDAY, JUNE 2

7:15–8:30 Breakfast

8:30–9:45 **Concurrent Breakout Sessions**

Tried and True Evaluation Instruments
Strand: Research and Evaluation
Room: Independence H/I

Best Practices in Professional Development: What SEPA Grantees Have Learned from K-12 Teachers and Students
Strand: Teacher Professional Development
Room: Franklin Square/McPherson Square

Stories from the Field: Institutional Challenges in IHE- ISE Partnerships
Strand: Informal Science Education
Room: Lafayette Park

Have a BLAST with DNA Subway's Blue Line
Strand: Science Teaching and Learning
Room: Independence A

Game-Based Learning 101: Introduction to Game Design, Formal Systems, and Rules
Strand: STEM Games for Learning
Room: Independence F/G

Personal Data Trackers in STEM Education
Strand: Science Teaching and Learning
Room: Farragut Square

9:45–10:00 Break

10:00–11:15 **Concurrent Breakout Sessions**

Diabetes, Obesity, and Cardiovascular Disease (DOC) Working Group
Strand: Equity, Diversity, and Health Disparities
Room: Lafayette Park

Monitoring the Alignment of Program Objectives to Instruments: How to be an Evaluation Auto Mechanic
Strand: Research and Evaluation
Room: Independence F/G

Approaches to Evaluating Authentic Research Experiences
Strand: Research and Evaluation
Room: Independence A

Strategies for Integrating Disciplinary Literacy into Science and Health Curriculum
Strand: Science Teaching and Learning
Room: Franklin Square/McPherson Square

Student-Produced "Question-Framed Videos" and Science Identity Formation
Strand: Science Teaching and Learning
Room Farragut Square

Getting Started in STEM Games
Strand: STEM Games for Learning
Room: Independence H/I

11:15–11:45 **Town Hall Discussion**
L. Tony Beck, PhD, Science Education Partnership Award (SEPA), Center for Research Capacity Building, National Institute of General Medical Sciences (NIGMS), NIH

Lunch on your own

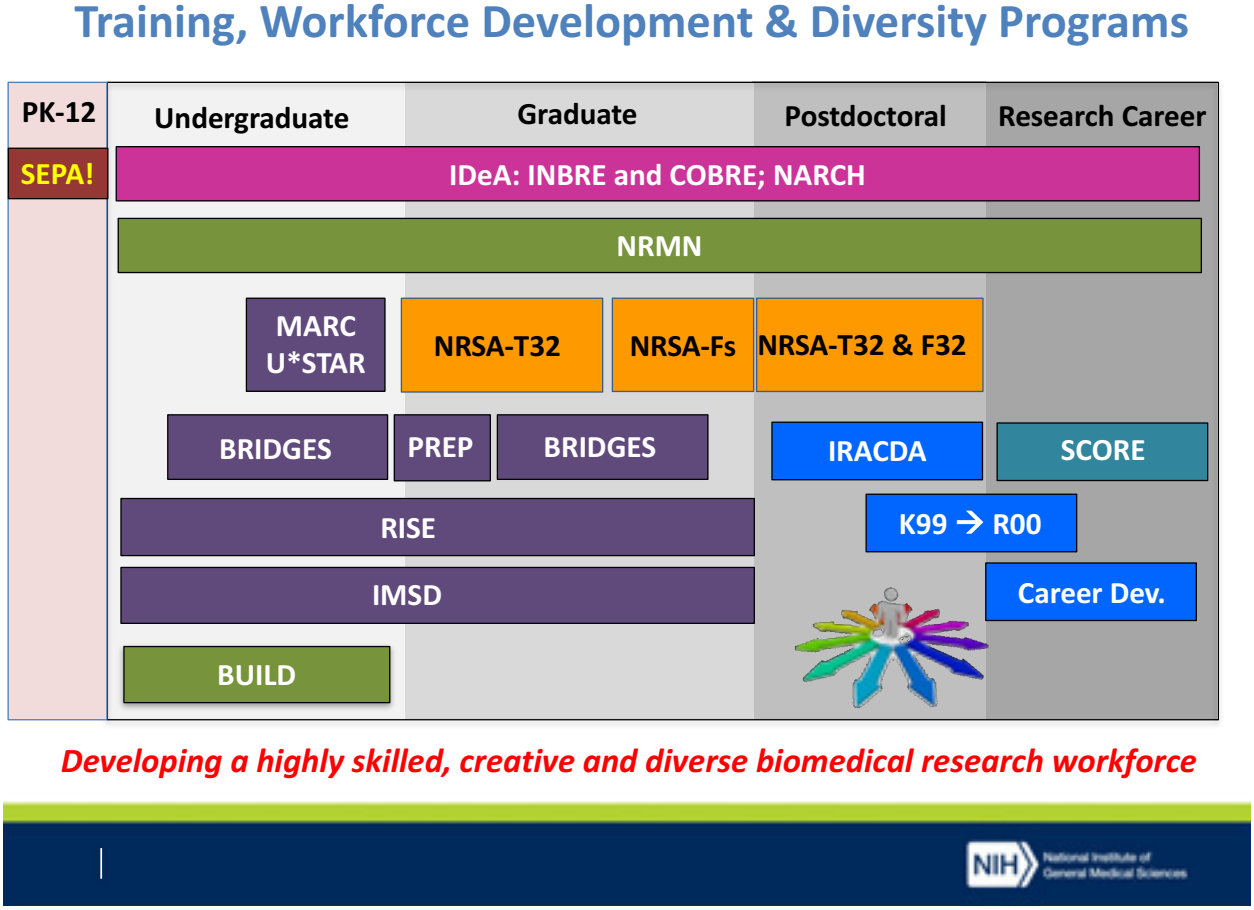
Wednesday May 31, 2017: 8:40 AM – 9:40 AM

Keynote Address: NIGMS and the Next Generation(s) of Biomedical Scientists

Presenter: Jon R. Lorsch, PhD, Director, National Institute of General Medical Sciences (NIGMS), NIH
Reporter: J. Michael Wyss, PhD, Professor, University of Alabama at Birmingham

Dr. Lorsch presented an informative discussion of the varied NIGMS roles related to education across the K-12 continuum. The missions of the Institute are to 1) promote fundamental research on living systems to lay the foundation for advances in disease diagnosis, treatment, and prevention, and 2) enable the development of the best trained, most innovative, diverse, and productive biomedical research workforce possible.

The spectrum of these programs is demonstrated in the figure below, which includes the K-12 component that was added via inclusion of the SEPA program into NIGMS. URLs for programs listed in this figure are at the end of this report on Dr. Lorsch's talk.



Dr. Lorsch indicated that NIGMS is excited to have SEPA in its portfolio. He believes both SEPA and NIGMS will benefit from the arrangement. Dr. Lorsch noted that several states lack a SEPA and expressed his desire to bring a SEPA presence to those states.

SEPA joins the NIGMS Center for Research Capacity Building (CRCB), led by Dr. Fred Taylor. There, it will integrate well with CRCB programs designed to educate, train, and diversify the scientific workforce. In particular, it will incentivize undergraduate and pre-doctoral programs to build bridges with K-12 programs.

SEPA will also enhance connections and synergies with efforts in the NIGMS Division of Training, Workforce Development, and Diversity (TWD). For example, Dr. Lorsch suggested that cross-fertilization between SEPA and the National Research Mentoring Network (NRMN) could broaden NRMN to include teachers and high school students. See below for the names of and links to other TWD programs referenced in the slide above.

Dr. Lorsch believes that together, SEPA, CRCB, and TWD programs will help catalyze institutional changes, expand impact, and help increase the pathway to diversity in the biomedical workforce.

Dr. Lorsch also mentioned that SEPA's evidence-based assessments and innovative teaching methods can enhance the existing outreach activities of NIGMS, while its pre-college resources and website offer exciting new opportunities for the Institute.

He also described how the NIGMS Office of Communications and Public Liaison (OCPL) can work synergistically with SEPA to reach K-12 audiences. For example, SEPA and NIGMS OCPL might collaborate to develop activities for the USA Science and Engineering Festival, scheduled for April 2018 in Washington, D.C. This biennial event has provided great outreach opportunities for NIGMS and could further increase its impact with SEPA offerings.

During the question and answer session, Dr. Lorsch was asked about Hispanic-serving institutions. He noted that such institutions are a priority for all NIGMS programs.

When asked about high school students working as interns in research labs, Dr. Lorsch responded that, although there are some legal hurdles to having minors in the workplace, many programs and institutions have found methods to overcome these challenges and now offer such internships.

NIGMS programs included in the figure above:

Center for Research Capacity Building (CRCB) programs include:

- Institutional Development Awards (IDeA), which is in 23 states and Puerto Rico; among its activities, IDeA includes IDeA Networks of Biomedical Research Excellence (INBRE) and Centers of Biomedical Research Excellence (COBRE)
- Native American Research Centers for Health (NARCH)
- Support of Competitive Research (SCORE) Program
- SEPA: Science Education Partnership Award

Division of Training, Workforce Development, and Diversity programs include:

- NRMN: National Research Mentoring Network
- MARC U*STAR: Undergraduate Student Training in Academic Research
- NRSA-T32: Institutional Predoctoral National Research Service Award
- NRSA-Fs: Individual Predoctoral National Research Service Award Fellowships
- NRSA-F32: Individual Postdoctoral National Research Service Award
- Bridges to the Baccalaureate
- PREP: Postbaccalaureate Research Education Program
- Bridges to the Doctorate
- IRACDA: Institutional Research and Academic Career Development Awards
- RISE: Research Initiative for Scientific Enhancement

- K99 --> R00: Pathway to Independence Award
- IMSD: Initiative for Maximizing Student Development
- Career Development Awards
- Building Infrastructure Leading to Diversity (BUILD)

Wednesday, May 31, 2017: 10:00 AM – 11:00 AM

Keynote Address: Enhancing Genomic Literacy: Rationale, Opportunities, and Challenges

Presenter: Eric Green, MD, PhD, Director of NIH National Human Genome Research Institute (NHGRI)
Reporter: Lisa Marriott, PhD, Assistant Professor, Oregon Health & Science University

Genomics is a term coined in 1987 that describes the discipline of studying all the DNA of a cell or organism (i.e. its genome). The human genome contains ~3 billion bases ("letters") and was sequenced for the first time by the Human Genome Project (1990-2003). The cost for sequencing that first human genome was ~$1 billion and involved the work of many hundreds of scientists. Now the goal is to get the cost of human genome sequencing below $1,000 to permit advances in genomic and precision medicine. Anticipated benefits have applications across many scientific fields, including agriculture, ancestry, livestock, infectious agents, forensics, bioenergy, microbiomes, evolution, and population history.

Dr. Green described several major highlights in genomics over the past 14 years since the human genome was first sequenced which have permitted advances toward the goal of genomic medicine. Specifically, he highlighted:

1) **The cost of sequencing a human genome has been reduced 1 million-fold** and currently falls between $1000-2000. Sequencing a human genome now takes just 1-3 days. Technological advances even permit USB-based analytic devices to conduct mobile sequencing of DNA.
2) **Many tens of thousands of human genomes have now been sequenced,** which support establishing which DNA variants are important and which are inconsequential. Humans have ~99.9% identical genome sequences, in that we differ ~1 out of 1000 bases. The 1000 Genomes Project has illuminated >90 million places in our genomes where the DNA sequencing is different among people.
3) **Profound advances in understanding how the human genome functions** have emerged as knowledge grows about which DNA sequence differences are functionally important. We know that ~1.5% of the human genome sequence directly codes for genes (which total ~20,000), although much of the interesting human biology is not related to the gene sequences per se, but rather how genes are used (e.g., when, where, and how they are turned "on" via regulatory regions of DNA).
4) **Significant advances in unraveling the genetic bases of human disease** have come from the discovery of genomic variants that cause rare diseases (e.g., cystic fibrosis and Huntington's disease). In 1990, 61 rare diseases had proven genomic causes. Today, we know of ~4,700 rare diseases with

established genomic causes. However, the major healthcare burdens worldwide relate more to common diseases, which have complex, multigenic, and non-Mendelian causes (e.g., heart disease and cancer). Deciphering the genomic underpinnings of common diseases requires very large studies to achieve the appropriate statistical power. Success stories are increasingly emerging, such as with cancer.

Dr. Green indicated that despite these genomic advances, an increase in genomic literacy is needed to realize the promise of genomic and precision medicine. He cited the 2011 NHGRI Strategic Plan calling for education across all levels (e.g., healthcare providers, K-16, community, and general public) and offered the proposed GLEE (Genomic Literacy, Education, and Engagement) Initiative as a potential solution to support these efforts.

The audience asked Dr. Green about GLEE's plans, to which he responded might depend on the audience; in general, these efforts will focus on ways to improve fundamental understanding of genomics to make informed clinical decisions. Another audience member questioned why policy makers are not considered an important focus for GLEE, and Dr. Green indicated that policy makers are indeed important, and that NHGRI has staff focused in this area already. Finally, it was suggested by an audience member that a distance learning program for research in genomics would greatly help states which may be farther from resources, to which Dr. Green agreed. Actions on these items continue to move forward.

Wednesday May 31, 2017: 11:00 AM – 12:00 PM

Update on the SEPA Program

Presenter: L. Tony Beck, PhD, Science Education Partnership Award (SEPA), Center for Research Capacity Building, National Institute of General Medical Sciences (NIGMS), NIH
Reporter: Rob Rockhold, PhD, Deputy Chief Academic Officer, University of Mississippi Medical Center

SEPA R25 programs, SBIR/STTR funding, and IDeA state projects have great potential to engage collaboratively and synergistically. SEPA has recently funded a first-ever award to a Native American tribal organization, the Salish Kootenai Tribal College in Montana, an IdeA state. The Denver Museum of Science and Nature recently received SEPA funding for the first SEPA clinical trial, "Genetics of Taste," managed by a museum. The PBS NewsHour has funding to deliver student reporting of topical science and health issues in collaboration with PBS news professionals. A detailed series of graphical presentations of the FY 2016 SEPA awards was offered and opportunities for SEPA to interact to greater extents with IDeA, NARCH, and SCORE programs were discussed.

Dr. Beck reminded the audience of the legacy of Dr. Bruce Fuchs and his Office of Science Education and the development of the NIH Curriculum Supplement Series. From 1996-2016, 500,000 supplements were shipped to pre-K–12 teachers and educators at educational institutions, charter schools, and home schools; in 2016, some 22,000 were distributed.

The SEPA website, https://nihsepa.org/, begun in 2003, has proven to be invaluable to the SEPA community, students and teachers, prospective SEPA applicants, and Dr. Beck and his colleagues for SEPA marketing purposes. Dr. Beck thanked Dr. Michael Lichtenstein, who organized and oversaw incorporation of the early SEPA grantee information on the website.

SEPA has funded a number of projects that use mobile labs, the first being the Boston University CityLab in 1995. SEPA provides an R13 Conference Grant to support the annual Mobile Lab Coalition Conference.

Evaluation

Data were presented showing the stepwise increase in rigor over the last 16 years of SEPA project evaluation requirements and it was stated that SEPA may now have the "most rigorously evaluated STEM program in the Federal government." In 2013, SEPA initiated a $840,000, 2.5 year SEPA Process Evaluation contract with Westat.

Memoriam
Dr. Beck reminded the attendees that a long-time, active, and beloved colleague, Dr. Cathy Ennis, a SEPA PI since 2003, had recently passed away and thanked everyone for their expressions of concern and condolence.

Question and Answer
In response to a question, Dr. Beck indicated that the NCI has initiated a new pre-college STEM initiative, the National Cancer Institute Youth Enjoy Science Research Education Program (R25), that SEPA grantees would likely be called to assist in review of grant submissions for that program.

Dr. Wyss asked if the SEPA evaluation data and project-level outcomes could be useful grantee tools for marketing SEPA's contribution to pre-college STEM. In response, Dr. Beck highlighted the complexities associated with evaluation data from differing programs and the need for additional commonalities to the evaluation tools.

Overview of the SEPA Process Evaluation

Presenter: Jill Feldman, PhD, Senior Study Director, Westat
Reporter: Rob Rockhold, PhD, Deputy Chief Academic Officer, University of Mississippi Medical Center

Dr. Feldman presented a brief overview of her work in evaluation of SEPA programs, which examined 156 SEPA programs between 2004 and 2014.

Dr. Feldman found that the 156 SEPA projects included in the Process Evaluation study were highly aligned with the program's first two goals of supporting development of pre-K–12 curricula and encouraging student interest in science and related careers, and educating the pre-K–12 community and public on topical and health-related issues. Most projects targeted teachers or students in middle and high school and focused on school-based activities or teacher professional development. More than a third of SEPAs proposed focusing on activities targeting the public or families. Across time, few projects focused on NIH-funded research or the clinical trials process, leaving the portfolio moderately aligned with the third SEPA goal. However, this goal was designed to focus on contemporary biomedical issues, which are prominent at some times but not others, so this finding is neither unexpected nor concerning. Although a relatively small percentage of projects in the portfolio were housed at science centers or museums, these institutions have the potential to reach broad swaths of the public, especially exhibits that travel to rural and other low resource settings. However, as is the case for ISE programs in general, project-level evaluations were not able to systematically collect this information. Therefore, project-level data related to these ISE activities understate the SEPA program's actual reach.

The SEPA program funds a significant amount of teacher professional development focused on STEM content and on pedagogy to teach STEM, and sits at the nexus of pre-K–12 and higher education. Despite nearly every proposal saying it targeted underrepresented populations, very few identified which ones or reported data on specific groups, forfeiting opportunities to aggregate findings across relevant grant evaluations and limiting what we can learn about what works, in what contexts, and for whom. Dr. Feldman recommended that future solicitations include a requirement that specific subgroups be named and that related data be disaggregated if the program aspires to contribute to research about broadening STEM participation among underrepresented groups.

Overall, projects engaged in school-based activities and focused mostly on changes in awareness, engagement, and interest, or in communication and outreach. To increase the strength of the evidence generated by future project-level evaluations and to further the long-term SEPA outcome of establishing a comprehensive evaluation system, Dr. Feldman recommended that NIH consider developing a common evaluation framework and monitoring system to coordinate future data collected across the SEPA portfolio. This would not only support increasing the program's contributions to research about broadening STEM participation among underrepresented groups but would also have the potential to expand the kinds of questions that can be answered about the SEPA program's process and outcomes, and streamline annual reporting at the program and project levels.

May 31, 2017: 4:15 PM – 5:30 PM

Working with Populations Suspicious of Science

Facilitators:
Maurice Godfrey, PhD, Professor, University of Nebraska Medical Center
Marnie Gelbart, PhD, Harvard Medical School

Panelists:
Sara Chandros Hull, PhD, Chair, NHGRI Institutional Review Board
Carla L. Easter, PhD, Chief, Education and Community Involvement Branch, National Human Genome Research Institute
Tiffany Powell-Wiley, MD, MPH, Assistant Clinical Investigator, Social Determinants of Obesity and Cardiovascular Risk, National Heart, Lung, and Blood Institute
Erik Stegman, JD, Executive Director, Center for Native American Youth, Washington, D.C.

Reporter: Lindsay Barone, PhD, Program Evaluator, DNA Learning Center, Cold Spring Harbor Laboratory

In this session, panelists focused on exploring the various challenges associated with working with populations that may not be open to participating in scientific research. The presenters each had unique experiences with conducting research in communities that had historically been abused in the course of scientific research. In particular, panelists had worked with Native American and African American populations.

Carla Easter explored the problem of working and sharing with communities when the information at the center of the program is complicated. When it comes to genomics and genetics, these concepts are “just in time” – meaning they’re not generally important to understand for most people until the information is necessary for some reason. Carla encouraged people to think in terms of outreach and engagement, arguing that all information conveyed in these two ways should be both culturally responsive and necessary.

Sara Hull has worked with American Indian/Alaskan Native (AI/AN) populations in her role at the NHGRI Institutional Review Board. She discussed many of the historical violations and examples of “helicopter research” which have ultimately led to various tribes being wary of participating in research with outsiders. She reported on one approach NIH tried: the “IRB internship,” where local IRB administrators are brought to NIH to train on the approach that NIH IRB uses. However, because this approach didn’t work for all groups/tribes, Sara described how they have begun working to develop a curriculum within the NIH research community which is culturally responsive and works for all involved parties.

Erik Stegman has extensive experience working with Native American populations. Erik's presentation centered on the importance of working with youth as intergenerational ambassadors. Because many Native communities are dealing with intergenerational trauma, having Native youth who are trying to break through that history on the side of your project can be extremely beneficial. As an example, Erik described the 2010 Census campaign and the efforts of the National Congress of the American Indian to encourage tribal members to complete the census. Working with Native youth voter groups, NCAI created a campaign around thinking differently about the census and making it work for the community.

Finally, Tiffany Powell-Wiley discussed her work in areas that have limited resources in Washington, D.C. One of the most powerful tools for her cardiovascular health-focused project was collaborating with organizations which had already built trust in the community. They worked with the American Heart Association, which had already built trust in the community as well as identified key community members to serve on an advisory board. One of the things she found to be most helpful was simply being honest about what the goals of the project were. As a research group, too, they have maintained a presence in the community by participating in only tangentially-related activities (including providing health/risk assessments at health fairs and providing health education in churches).

Participants:
Jason Dupuis, Museum of Science & Industry
Charles Wood, Wheeling Jesuit University
Carl Franzblau, Boston University
Kelly Nguyen, Boston University
Carla Romney, Boston University
Don Derosa, Boston University
Brenton Deboef, University of Rhode Island
Jessica Gluck, Discovery Place of Science
Patricia Ward, University Science and Industry
Diane Munzenmaeir, Milwaukee University
Chris Doyle, Montana Tech
Beth Tuck, National Institute of Health, NHGRI
Teresa Ramirez, National Institute of Health, NHGRI
Victoria Coats, Oregon Museum of Science & Industry
Jayatri Das, The Franklin Institute
Sean Freeland, West Virginia University
Elizabeth Genne-Bacon, Tufts University
Debra Yourick, Walter Reed Army Institute of Research
Anne Holland, Space Science Institute
Andrea Panagakis, Salish Kootenai College
Dimitri Blondel, Duke University

Lindsay Barone, Cold Spring Harbor Laboratory
Krista Glazewski, Indiana University
Tiffany Nuessle, Denver Museum of Nature & Science
Patrice Saab, University of Miami
Bette Schmit, Science Museum of Minnesota
Douglass Coleman, Duke University
Belen Hurle, National Institute of Health, NHGRI
Laurie Jo Wallace, University of Boston
Jim Cotner, University of Minnesota
David Petering, University of Wisconsin
Maurice Godfrey, University of Nebraska
Jalisa Ferguson, Georgia State University
Lorna Gitari-Mugambi, Georgia State University

Understanding and Measuring STEM Career Development

Presenters:
Erin Hardin, PhD, Professor, University of Tennessee
Melinda Gibbons, PhD, Associate Professor, University of Tennessee

Reporter: Alonzo Fields, Science Museum of Minnesota

Introduction to Career Development Theories

- Many of our SEPA projects include the goal not just of increasing students' science literacy/knowledge, but also of increasing their *interest* in STEM in general and in STEM-related careers in particular.
- Many even within the social sciences are not aware that there is a rich empirical and theoretical literature on how people develop career interests and make career decisions.
    - Vocational psychologists and others have been studying career development for over a century.
        - Frank Parsons' work at turn of 20th century
        - Post WWII career guidance movement
    - More contemporary theories; major types:
        - Person-Environment Fit (e.g., Holland)
        - Described basic premise
        - Very useful in some ways, but do not tell us how interests develop in the first place
        - Developmental theories (e.g., Super, Gottfredson); developmental stages; speaks to the kinds of opportunities we should be providing our students
- Until ~ high school, growth stage: learn about self and world of work
- High school through college exploration: try things out
    - Social Cognitive Career Theory (SCCT) – our main focus

Overview of SCCT and How SCCT is Related to STEM Career Development

This theory is the most used right now, and probably has the best empirical research base. It is also the one that has been explicitly and repeatedly applied to understanding STEM career interests and decisions specifically.

Participants discussed in small groups the SCCT constructs that seem important to measure in their own SEPA-funded projects (current or future). The presenters then led a whole-group discussion of what stood out for each group, possible missing constructs, and where certain constructs might fit within the model.

Overview of Possible Assessment Instruments That Might Be Used by SEPA Projects

- Learning Experiences
    - Learning Experiences Questionnaire (LEQ; Schaub & Tokar, 2005) – 120 items (20 per Holland Code) – high school students (see Garriott et al., 2013).
- Self-Efficacy
    - MSE – 12 items (Fouad & Smith, 1996) – middle school students
    - MSSE – 6 items (Smith & Fouad, 1999) – high school/college students
    - Expanded Skills Confidence Inventory for High School Students (ESCI-HS; Betz & Wolfe, 2005) – 112 item (8 items per 14 domains, based on Holland themes; e.g. 8 item Math subscale and 8 item Science subscale)
    - CGSES – 30 items; Gibbons, 2005
- Outcome Expectations
    - MOE – 9 items (Smith & Fouad, 1999)
    - MSOE – 7 items (Fouad & Smith, 1996) – middle-school students
    - MSOE – 10 items (Lent, Lopez, & Bieschke, 1991) – college and high school
    - COE – 19 items (Flores, Navarro, & DeWitz, 2008) – high school students
    - CGOES College-Going outcome expectations – 28-items (Gibbons, 2005) – middle school students.
- Barriers & Supports
    - Educational barriers: PEB-R – 45 items (McWhirter, 1997, revised by Gibbons, 2005) – appropriate for grades ?? – 12?
    - Parent and school personnel support: (CASSS; Malecki, Demaray, & Elliott, 2000) measures a person's perception of general or specific support, which either helps overall functioning or acts as a shield against negative outcomes (Malecki, Demaray, & Elliott, 2004). The GASSS is appropriate for use with 3rd- through 12th-grade students.
    - Perceived barriers/supports to math/science careers – 8 items (Lent et al., 2001; later modified by Lent, Brown, Nota, and Soresi, 2003).
- Interests
    - MSINT – 20 items (Fouad & Smith, 1996; Smith & Fouad, 1999) – middle school & high school students
- Aspirations
    - Math/Science Intentions and Goals Scale – 6 items (MSIGS; Fouad & Smith, 1996) – middle-school students

Wrap-up discussion: Participants asked many questions about what instruments might be best, and the importance of measuring a variety of constructs.

Participants:
Melani W Duffrin, East Carolina University
Ashley Roseno, East Carolina University
Shannon Carlin-Menter, University of Buffalo
Anja Scholze, The Tech Museum of Innovation

Maureen Munn, University of Washington
Loran Carleton, Parker Purdue University
Laura Tenenbaum, Walter Reed Amy Institute of Research
Sarah Singer, Hezel Associates
Preeti Gupta, American Museum of Natural History
Michael Kennedy, Northwestern University
Stephanie Tammen, Tufts University
Berri Jacque, Tufts University
Alonzo Fields, Science Museum of Minnesota
Ann Chester, West Virginia University
Lisa Aslan, Health Resources in Action
Christopher Villa, Helix Solutions
Madison Spier, Texas A & M Health Science Center

But How Well Does It Work? Immersing High School Students in a Research-Design-Evaluate Cycle to Learn About Health Messaging

Facilitator: Rebecca Smith, PhD, Co-Director, UCSF Science & Health Education Partnership, University of California San Francisco
Reporter: Revati Masilamani, PhD, Postdoctoral Fellow, Tufts University School of Medicine

The goal of this SEPA-funded project was to have students recognize their roles and potential as agents of change in the community by building an awareness of major health topics. Year 1 of the grant focused on infectious disease and year 2 focused on antibiotic resistance. Teachers in San Francisco high schools were asked to identify students who had displayed an interest in science (the majority from backgrounds underrepresented in science) to participate in a community-based research experience.

The students participated in a research-design-evaluate cycle, the first step of which was to engage in a formative research survey. The survey involved developing a learning-progression construct map to assign levels to the informational content knowledge of different people in the community. As part of this workshop, participants assigned levels for interview transcript data based on the construct map as students had done.

Observations made from the data collected allowed students to set their messaging goals for community health awareness. They created posters with a little help from graphic designers and then used it on focus groups of high school students to evaluate.

To do a large-scale evaluation, students used a randomized intercept survey targeted at visitors to the Bay Area Science Festival. Students designed questions specific to the disease-topic to evaluate the effectiveness of the health messaging. Visitors at the science festival were exposed to the health message poster for a short period of time followed by the survey.

Participants in this workshop viewed student health messages, followed by a review of message evaluation data and discussion of the pros and cons of strategies to measure message effectiveness.

Challenges:
Participants discussed the challenges of the evaluation cycle of the study, one of which was a lack of permission to have people younger than 15 take the survey. There was also a robust discussion of the pros and cons of a pre-post versus a retrospective approach to evaluation design.

Results:
The study showed improvement on multiple key tenets of the "Health Belief Model" after exposure to the health messaging:

- Perception of susceptibility
- Perception of severity
- Benefits of taking action

These results encouraged students' self efficacy and a mindset that, with effective messaging and widespread targeting, they can be effective agents of change to health mindsets in a community.

Participants:
Gwen Stovall, University of Texas of Austin
Revati Masilamani, Tufts University
Phyllis Ault, Education Northwest
Bruce Nash, Cold Spring Harbor Laboratory
Shona Ramchandani, Science Museum of Minnesota
Kelley Withy, University of Hawaii
Elizabeth Ozer, University of California
Denise Ekberg, University of Texas of Austin

Curriculum Development and the NGSS: Connecting Science Learning with the Lived World of Our Students

Presenters:
Barbara Hug, PhD, Clinical Associate Professor, University of Illinois
Brian Reiser, PhD, Professor, Northwestern University
Idit Adler, PhD, Research Associate, Michigan State University
Joseph Krajcik, PhD, Professor, Michigan State University

Reporter: Dina Drits-Esser, PhD, Senior Research Associate, University of Utah

Introduction

The presenters highlighted two different (though similar) curriculum development processes with the same end goal: NGSS-aligned curriculum materials that are coherent from the student perspective.

They then engaged participants in thinking about the early steps of the curriculum design process.

Overview of NGSS

- All of presenters' work is based on NGSS.
- Science, engineering, and technology are essential for scientific literacy.
- NGSS is based on the most solid evidence we currently have of how students learn and learn science.
- Phenomena and 3-D instruction - Disciplinary Core Ideas (DCIs), Science and Engineering Practices (SEPs), Crosscutting Concepts (CCCs) – build toward student Performance Expectations (PEs)
- Instead of *learning about*, students are *figuring out*.
- Central role of phenomena: things or events that can be observed; they are repeatable. Most kids get mixed up between a phenomenon which is an event vs. something theoretical.
- Phenomena are what science is about.
- DCIs (disciplinary core ideas) of a field (e.g., evolution in biology); they're how experts know; they serve as conceptual tools
- CCCs (cross-cutting concepts) cut across disciplines; key ways of looking at phenomena; important idea related to what science is all about
- Practices: How scientists and engineers know and do, what they use to study the natural world and design world. They are not linear, they work together (not separately). How are practices different from inquiry? – there is overlap but difference is shift to figuring out what is going on.
- 3-D learning: The 3 dimensions are working together. Rope analogy (when all 3 strands work together, the rope is much stronger). Help kids to be innovative, solve problems. Take-away: 3 dimensions that together help kids make sense of the world. The NGSS (based on *Framework*) is different from what we're used to because we use all 3-Ds. Gives example of PE from 6th grade units.

Critical for Curriculum Designers

PEs are what students can be assessed on at the end of instruction. We should not be planning our lesson on a PE alone. We want to build toward that PE by end of grade band.

Joe's process: They select PEs, unpack them, select phenomena, DCIs, practices, CCCs, develop a storyline. Though chart looks linear, it is not. Everything builds on each other.

Barbara: Bundle PEs, unpack, candidate phenomena, storyline, student products. Not linear, but iterative process. All the while, think about candidate phenomena. Think about how it all links together. How does one idea flow to another? They need to be linked so students can make connections and gain a deeper understanding of content.

Step 1. Examine NGSS resources
Provide resources:
Online and print resources:
Framework for K-12 Science Education
NGSS

Whole-group discussion: Question about assessing based on PEs. They are meant to be used at the end of a grade band rather than the end of a unit or grade. They are built upon one another; they are meant to be developed across time through different experiences.

Step 2. Unpack PEs

Look to DCI in the PEs, talk about what goes into this statement.
Read corresponding sections in the Framework, look above and below specific grade band to see how this component of the DCI fits into the larger picture.

Report out/questions:

How do teachers respond to this?
Barbara: Some districts are giving teachers lots of time to process.
Joe: I can't stress enough the importance of these two first steps. We don't know all of the DCIs—we all need to really delve into this. It is a long process to understand this. Highly recommends two NSTA books that have been recently released.

Step 3. Brainstorm phenomena

What makes a productive phenomenon:

- Addresses targeted DCI element
- Is observable to students, either through firsthand experiences or through someone else's experiences (such as a recording or set of measurements)
- Is likely comprehensible to students
- Is attention-getting and thought-provoking and requires some explanation so that it is likely to engage all students and motivate them to focus on the DCI element
- Is efficient in that the benefits justify any financial costs and time devoted to using the phenomenon with students

Using these criteria, begin to identify potential phenomena that address the bundle of PEs that you identified.

Step 4. How to Begin? Driving Questions and Anchoring Phenomena

Timeline in curriculum development.
Provides example from their unit - Health in Our Hands.
Examples of community partners' roles.

Sharing and Discussing
Question – in bundling PEs, how many are workable in a bundle?
Barbara: Variable. Start smaller and see where it goes. You can add to it.
Joe: You don't have to cover an entire PE in a unit. *You just have to be sure to track it*. You can integrate more things. You can pull PEs from other disciplines as well. You just have to come back to the other part if you covered only part of it previously.
Joe: It's a lot of hard work to get teachers and communities to buy in but it is doable.

Effective Professional Development Design and Implementation: What Do Teachers Need and Want?

Presenters:
Jennifer A. Ufnar, PhD, Senior Research Associate/Director, Vanderbilt University
Charlie Wray, PhD, Director, The Jackson Laboratory

Panelists:
Rosemary Riggs, Program Coordinator, UT Health Science at San Antonio
Claudeen Denning, MS, STEM Teacher, Rose Park Middle School
Christine Ziese, Teacher, UT Health Science Center at San Antonio
Stephanie Dumont, Teacher, Brunswick High School

Reporter: Patrice L. Capers, PhD, Postdoctoral Fellow, University of Alabama at Birmingham

This session was created for teachers to discuss their firsthand experiences with professional development (PD) and provide attendees with general ideas to consider when attempting to create effective PD. We had a panel of four teachers where three were still in the classroom (middle and high school) and one teacher was not (adult professional education). They covered their experiences with effective and ineffective PD and then the floor was opened for questions.

Effective Professional Development From the Panelists' Perspective

1. Does not just give information, it explains how teachers can apply information in their classrooms (mentioning how standards are embedded "opens" teachers' eyes).
2. Is free or low cost to attend.
3. Is interesting, meaningful, and understandable at a conventional level through the explanation of abbreviations.
    a. Do not dumb down the material (terminology is important).
    b. Cool to have conversations with experts in the field and expert teachers.
4. Is exciting so that you can bring excitement to your students.
5. Allows people to be knowledgeable.
6. Allows for networking and discussion.
7. Provides authentic applications to the real world.
8. DOES NOT ASSUME TO KNOW WHAT TEACHERS NEED! Facilitators should talk to teachers first to find out what they need to know.
9. Makes the material relevant. Most teachers who participate in PD are invested in professional development and they want to learn.
10. Includes your story (Challenges, Twists & Turns, why did you change careers) so that teachers can pass these stories on to their students as inspiration.
    a. Skype to help students see that everyone is not Albert Einstein.
11. Provide support after PD which includes good mentorship, available for help (via phone, email, or video), and help establish relationship within professional community.

Ineffective Professional Development From the Panelists' Perspective

1. Does not invite conversation with lecture then questions format.
    a. When teachers ask questions, do not repeat what was said earlier. Instead provide more details because they did not understand.
    b. Do not read slides to teachers
2. Is unrealistic or difficult to implement outside of the workshop.
    a. Fieldwork PD can be difficult if teachers do not have a nearby local ecosystem.
    b. Fieldwork that requires travel, time away, or money can be unrealistic.
    c. Fieldwork must have connection with an activity that can be taught at school with borrowed material.
3. Does not mention what materials will have to be purchased to conduct activity or experiment in their classroom upfront.
4. Talks down to teachers; "Don't talk down to me, talk to me."
    a. Do not talk about it and leave it be; help teachers see the end product so they can help you reach the final product.
    b. Do not assume that teachers lack education because they ask a question.

Questions and Answers

1. What is the value of pointing out where PD fits in standards?
    a. Prior to PD, review the standards for your specific group and give teachers an idea of where you think the activity fits in. It gives you credibility that you have taken the time to consider their interests.
    b. If doing PD for one level, show how it connects to a lower level.
    c. Teachers go to PD to teach standards for certification.
    d. If you can come up with a lesson plan to help with standards, run the lesson plan past a teacher.
2. Suggestions to help people recover from ineffective PD:
    a. Notice the signs that let you know PD is ineffective (e.g. dreaded teacher stare, sarcastic laughter, visible lack of interest).
    b. Be honest and transparent and ask group, "What would you like to know?" Asking how to improve and why validates that you care.
    c. Have open dialogue with teachers.
    d. Ask teachers how can this PD be integrated in their classroom.
3. How much choice do you having in picking what PD you participate in?
    a. District decides most of the PD but you get to choose a small number of PD hours which is not very helpful,
    b. Some teachers choose to do more than required so they can attend the PD they are interested in.
4. If you have a choice, how important is in-person networking vs. the online PD option?
    a. It is a personal preference. Some prefer in person so that they can hear, see, and do with others to help foster collaboration.

    b. PD is based on feedback, so there needs to be opportunities for discussions and solutions with more engagement and empowerment. If PD is online, it should have a conference or culminating event at the end.
    c. Online will allow teachers freedom to complete at their own pace.
5. What incentives are necessary for participation?
    a. Examples: Continuing Education Credits, free or low-cost PD, food, stipend or technology (be careful some may be there just for the money so you may have to give non-negotiable required outcomes to receive stipend or technology), not all day, and PD with breaks.
6. Beyond initial experience, what support is needed?
    a. Have someone to contact afterwards.
    b. Need a lot of help initially then wean off to help them transition to independence.
7. Evaluation of SEPA Program (Post PD)
    a. It is hard to say that participating in PD will cause specific outcome; there are too many variables.
    b. Be clear about what you hope to learn (should be measurable; questions should be structured based on what would be beneficial – survey, open-ended, etc.).
    c. Know your audience (e.g. length of course, give a deadline).
8. When asked how much they implemented, most teachers say not very much. So, should we keep asking this question? Is implementing 20-30% a success?
    a. You can provide a pacing guide. 1) Were you able to implement? What are constraints to implementation?
    b. Yes 20-30% is a success because their schedule changes and it is out of the teachers' control. You should talk to teachers the following year because in the second year they have more time to think of ways they can implement the material.
9. How can you incentivize follow up evaluations?
    a. Physically go to schools, build a sustaining relationship, conduct quarterly check up with feedback on what is hindering success.
    b. DO NOT BE A STALKER.
    c. Send emails as you run across articles that might be of interest to your teachers.
    d. Do not email in 6th week or 9th week when grades are due.
10. Do you prefer NGGS or state standards?
    a. Depends on where you are.
    b. It is nice to have both.
    c. You can use NGSS as a guide.

Participants:
Kristin Bass, Rockman Et Al
Ruchita Patel, Rockman Et Al
Jennifer Hellier, University of Colorado
Tim Herman, Milwaukee School of Engineering
Kim Soper, University of Nebraska

Daphne Richard, Irving Independent School District
Scott Woody, University of Wisconsin
Marisa Pedulla, Montana Tech
Julia McQuillan, University of Nebraska
Michele Shuster, New Mexico State University
Denise Ekberg, University of Texas at Austin
Tania Jarosewich, Censeo Group Inc.
Michael Boyd, Iowa State University
Cherilynn Shadding, Washington University
Bongsup Cho, University of Rhode Island
Margery Anderson, Walter Reed Army Institute of Research
Michael Carapezza, Columbia University
Aaron Kyle, Columbia University
Marisa Bowers, City of Hope
Michael Lichtenstein, University of San Antonio
Marlys Witte, University of Arizona
Renee Hesselbach, University of Wisconsin
Christopher Burnett, Baylor College of medicine
Jackie Shia, Challenger Learning Center
Stephanie Messina, Ochsner Health System
Margaret Stieben, American Physiological Society
Karina Meiri, Tufts University
Rashada Alexander, National Institutes of Health
Charles Wray, The Jackson Laboratory
Julie Parker, Mississippi State University
Patrice L Capers, University of Alabama at Birmingham

Resources Available From National Science Foundation STEM Education Resource Centers

Presenters: Robert L. Russell, PhD, Program Director, National Science Foundation
Jamie Bell, PhD, Director, Center for the Advancement of Informal Science Education
Reporter: Sandra Prytherch, M.A., Education Grants Program Manager, University of Nevada, Reno

The presenters gave an overview of the resources and benefits of National Science Foundation Centers (and additional valuable resources in bullets) to SEPA programs and investigators.

Center for the Advancement of Informal Science (CAISE) http://www.informalscience.org/
The CAISE portal engages users in "convening, connecting, characterizing, and communicating" through news, calendar of events, and community participation opportunities. Project development, funding, research, and evaluation sections provide rich support and examples. Additional informal science (IS) resources:

- National Informal STEM Network (NISENET) http://nisenet.org/
- American Association for the Advancement of Science (AAAS) https://www.aaas.org/

STEM Learning and Research Center (STELAR) **http://stelar.edc.org/** STELAR supports for Innovative Technology Experiences for Students and Teachers (ITEST) projects. The site provides a forum for community engagement, I-TEST project overviews, a resource library of publications, instruments, videos, and curriculum, and a calendar of events and opportunities.

Community for Advancing Discovery Research in Education (CADRE)
http://cadrek12.org/ This site focuses on K-12 STEM education, with specific information on resources by topic, event calendar, publications, and opportunities. Follow CADREK12 on Twitter.

Center for Innovative Research in CyberLearning (CIRCL) **http://circlcenter.org/** CIRCL provides topical "primers" – resources in the field of cyber learning, highlighting projects and people. The site includes funding information, calendar of events, and news for stakeholders from education, research, industry, and informal science.

Participants:

Sandra Prytherch, University of Nevada
Julie Cary, Boys and Girls Clubs of the Coastal Plain
Martin Weiss, New York Hall of Science
Theresa Gaines, Georgia State University
Douglas Starr, Stanford University
Donna Cassidy-Hanley, Cornell University
Judy Diamond, University of Nebraska

Commercializing your SEPA

Facilitator: J. Michael Wyss, PhD, Professor, University of Alabama at Birmingham

Presenters:
Dina Markowitz, PhD, Professor, University of Rochester
Melissa Gilliam, MD, Professor of Ob/Gyn, University of Chicago
Andrij Holian, PhD, Professor, University of Montana

Reporter: Ashlyn Sparrow, BS, Learning Technology Director for Game Changer Chicago, University of Chicago

We all want to extend the life of our projects. While federal funding is an option, most grants are capped at five years. However, one of the more interesting methods is commercialization. Drs. Gilliam, Markowitz, and Holian are three successful individuals who have successfully commercialized their SEPA projects.

Melissa Gilliam, MD, Professor of OB/GYN, University of Chicago
Dr. Gilliam is a researcher, physician, and administrator at the University of Chicago. About five years ago, she started a center at the University called Ci3. It was started as a means to work differently with young people, thinking about participatory research and critical making with young people. The idea for commercialization came from the idea that the academy not only produces papers but also makes things, which should be put in the hands of people. Dr. Gilliam believes that academics are not good at doing this from within their universities and got the idea to commercialize and sell games through a completely different entity. Resilient Game Studio, LLC, is responsible for the promotion and dissemination for all games developed within the University of Chicago setting.

The University of Chicago started an incubator called the Polsky Center for Entrepreneurship. Dr. Gilliam used this center as a place to incubate Resilient Game Studio and was able to interact with entrepreneurs who told her how to start a business. She chose to create a for-profit company in order to have access to the Small Business Innovation Research (SBIR) or the Small Technology Transfer Research (STTR) mechanisms. Last year, Resilient Game Studio was awarded two STTRs with a partnership with the University of Chicago.

When starting a company from inside a university, Dr. Gilliam recommends using resources to help think through the logistics of conflict of interest paperwork and licensing fees. The most important take away is to know your university's policies.

Dina Markowitz, PhD, Professor, University of Rochester
In order to widely disseminate her SEPA-generated curriculum material, Dr. Markowitz created Science Take-Out. Her company has developed numerous science kits that are based on grant-funded projects. The kits are commercial and available for sale through

Science Take-Out and other resellers. There are currently 53 kits of which 11 are directly related to their NIH SEPA project. The kits are used in over 3,000 schools and have reached over 5,000 teachers at professional development workshops.

Dr. Markowitz further described the technical components of an SBIR/STTR mechanism. With an SBIR, the grant money goes directly to her company and they are not told to partner with another institution. The only caveat is that Dr. Markowitz cannot be the PI on an SBIR because the PI must be employed 51% time within the company. Her primary source of employment is still at the University of Rochester. In order to satisfy the grant requirements, her curriculum developer works 51% for Science Take-Out, 49% time at the University of Rochester, and acts as the PI on the grants. With an STTR, the small business must subcontract a research institution at 30-60% of the budget.

Do you want to start your own business or do you want to collaborate with an existing business? Dr. Markowitz believes either route is fine; the answer really depends on your own temperament and what you really want to do with your time.

Andrij Holian, PhD, Professor, University of Montana
Dr. Holian has similar beginnings as the previous panelists. He has a series of educational board games that is he developing to get young people to think and solve problems. Each of the board games is accompanied by lesson plans for elementary and high school students. Dr. Holian switched to digital projects in order to distribute his games to thousands of people, compared to one teacher at a time.

Dr. Holian's design process has three steps: design, prototype, evaluate. Once his team has a game idea, he collaborates with teachers to make sure the game aligns with current standards. Once the feedback is received, the design team works on the prototype, incorporating lessons learned from previous games.

Participants:
Sandra San Miguel, Purdue University
Brinley Kantorski, Duquesne University
Leslie Schneider, Tufts Medical School
Scott Rawls, Temple University
Ralph Imondi, Coastal Marine Biolabs
Jawed Alam, Ochsner Clinic Foundation
Yukari Okamoto, University of California Santa Barbara
Laura Romo, University of California Santa Barbara
Barbara Baumstark, Georgia State University

Thursday June 1, 2017: 8:30 AM – 11:00 AM

Plenary Session: Developing Assessments That Elicit Learners' Thinking, Knowledge, and Skills

Presenters: Joseph Krajcik, PhD, Lappan-Phillips Professor of Science Education; Director, CREATE for STEM Institute, College of Natural Science and College of Education, Michigan State University
Barbara Hug, PhD, Clinical Associate Professor, College of Education, University of Illinois at Urbana-Champaign

Reporter: Jennifer Ufnar, PhD, Senior Research Associate/Director, Vanderbilt University

Overview:
This session focused on creating and implementing a workshop that helped to break down the NGSS standards and learning framework to design tasks and assessments that will help students develop a model to explain scientific phenomena.
The goals for the session were to learn how to design a 3D formative assessment model that aligns with NGSS Performance Expectations, explore learning performances, and use rubrics for 3D assessments. The learning goal for the workshop was the ability of participants to judge assessment tasks and their rubrics and determine if those align with 3D learning.

What is Different About NGSS and Science Learning Framework?
The NGSS and Learning Framework focus on making sense of phenomena or designing solutions to problems in science. The learning is within a 3D context. This means that the learning is organized around disciplinary core explanatory ideas, the central role of scientific and engineering practices, and crosscutting concepts. The instruction in the framework builds toward performance expectations, and builds and applies ideas across time. The focus is helping all learners to become scientifically literate. The NGSS helps students learn concepts and build on those concepts over time. The three dimensional component brings together disciplinary core ideas (DCIs), crosscutting concepts (CC), and scientific and engineering practices. These bring together the specific concepts (DCIs), ideas from other scientific areas (CC), and the practices (experimentation). This allows teachers to not just teach the traditional textbook material but also to pull together the basic concepts with experimentation and relate the information across disciplines.

The NGSS standards are organized as performance expectations (PEs), scientific practices, disciplinary core ideas, and crosscutting concepts. To use these in the classroom or with teachers in professional development, you would use the performance expectations as the main learning goal. From this PE, you would "unpack" the DCIs, CCs, and practices to decide what you want the students to learn. A helpful

analogy for unpacking the standards is to basically think of this as grocery shopping and developing a meal. If you create a menu of what you want to cook (performance expectation), you would go shopping for what is needed to cook the meal (DCIs, CCs, and practices). Once you get home, you would “unpack” your shopping bags and lay out the materials (unpacking the standards). Then, you would put those materials together to figure out how best to cook the meal (creating learning performances). You would then give evidence to show why those materials would work in a meal. You would then cook the meal (tasks) and assess the tastiness of the meal (assessments and rubrics). The performance expectations are the end-goals of the instruction, rather than the actual lessons or instructional strategies. These are the goals for the whole unit or topic being taught. The performance expectations combine all practices, core ideas, and crosscutting concepts. Drs. Krajcik and Hug worked with participants to try to unpack the requirements of the performance evaluation to create learning performances and then create tasks and rubrics to assess those learning performances. The learning performances are those learning targets that would help the students work toward the performance expectation. The learning performances have a set of tasks that allow the teachers to facilitate student learning to meet each learning performance. These tasks would be akin to lessons that would incorporate the scientific practices, the disciplinary core ideas, and the crosscutting concepts. Not all tasks might incorporate all three, but all of the tasks together would allow the students to meet all three categories of learning. These learning tasks would then be assessed using a rubric designed to effectively assess the particular task. Teachers can create formative and summative assessments to determine prior knowledge before teaching the concepts, and summative to tease out student growth through the learning process.

Thursday June 1, 2017: 10:15 AM – 10:35 AM

Plenary Session: NIHSEPA.org: A Website for the SEPA Community

Presenter: Nancy Moreno, PhD, Associate Provost for Faculty Development and Institutional Research; Professor, Allied Health Sciences and Family & Community Medicine, Baylor College of Medicine

Reporter: Ann Chester, PhD, Assistant VP for Education Partnerships, Director of HSTA, Director of HCOP, Deputy Director of the Center of Excellence in Women's Health, West Virginia University

The new NIH SEPA website is for STEM and Informal Science Communities. It is both a marketing tool and a tool to link to one another. It hosts an interactive map of all SEPAs. Its purpose is to:

- Promote awareness of the unique roles of SEPA and other NIH-funded science and health education partnerships.
- Facilitate communication and collaboration.
- Disseminate SEPA and related NIH-funded resources, programs, and tools.

Travis Kelleher, takelleh@bcm.edu, is the website guru who can answer questions.
The current aims of the site are to:

- Highlight SEPA projects.
- Ensure mobile-friendly, adaptive designs.
- Enhance the user experience and search capability.
- Incorporate multimedia generated by SEPA projects.
- Foster exploration through enhanced design and featured content.

Each SEPA project has its own page. You can link to current and past projects, create your profile, and create your own content and dashboard. Here is a chance to share pubs, curriculum, videos, etc. You will get an e-mail with a key. Your project on the website is your responsibility.
Next month, we will be collecting simple project data for both national and individual use.
Your Homework is

1. Register on NIHSEPA.org.
2. Update your publications and project resources.
3. Complete the Impact Survey by July 1, 2017.

Thursday June 1, 2017: 10:35 AM – 11:00 AM

Plenary Session: The Trans-NIH Native American Research for Health Programs

Presenter: Sheila A. Caldwell, PhD, Program Director, Center for Research Capacity Building, National Institute of General Medical Sciences (NIGMS), NIH
Reporter: Jennifer Ufnar, PhD, Senior Research Associate/Director, Vanderbilt University

This session focused on describing the Native American Research Centers for Health (NARCH) program and available grants, and the relationships between NARCH and other NIH-sponsored programs.

The Center for Research Capacity Building (CRCB) administers programs including IDeA, NARCH, SCORE, and SEPA. These programs are attempting to create partnerships between the agencies and grantees, but this is not required.

The NARCH program is a trans-NIH program with 15 ICs and OD offices signed on to the program, spanning more than the NIGMS, NCI, NIAID, NIAMS, NIDCR, NIDDK, NIDA, NIEHS, NIMH, NIH, and NIM. The NARCH is a partnership between the NIH and the Indian Health Service (IHS). The NARCH program supports building research capacity within the American Indian (AI) and Alaskan Native (AN) populations to address health issues for AI/AN populations and provide research experience training for faculty and students.

The goals of the NARCH program are to:

- Support collaborations between tribal entities and research institution
- Support health research projects prioritized by the tribal communities
- Support development and research training of students, scientists, and health professionals engaged in AI/AN health research
- Increase research capacity for health research in AI/AN populations
- Focus strongly on supporting education

The NARCH program model for the center grants have very specific requirements for the applicants. NARCH grant applications must be submitted by and awarded to AI/AN tribes and cannot be issued to non-AI/AN universities or research institutions. This allows the tribes to control the programmatic integrity of the grant. All applications must have an administrative core, and can have any combination of the following cores: student career enhancement; a faculty career enhancement; capacity building; and a research project (including pilot projects). There is no overarching scientific theme required for the application, but rather the goal of the application focuses on the health

research needs and requests of the AI/AN community. The budget for the grants is up to $1 million in direct costs per year, with at least 30% of the budget remaining with the eligible AN/AI applicant organizations. The awards are made for four years, and the next application due date is June 24, 2017. The application is only open every two years, rather than annually.

The current NARCH grant recipients are in Alaska, Washington, D.C., Washington, Oregon, California, Arizona, New Mexico, Montana, North Dakota, South Dakota, Oklahoma, Minnesota, Virginia, and Tennessee. The grant in Tennessee was awarded to a large consortium of tribes (United Southeastern Tribes) and the award in Washington, D.C. is to the National Congress of American Indians. Many different tribes can and do collaborate to apply for one of the awards to help with education. One example of this is the Cankdeska Cikana NARCH, which includes Spirit Lake Dakota, Mandan Tribe, Hidatsa Tribe, and Arkora Tribe, among others.

There are currently several different NARCH and IDeA grants which interact. For instance, Blackfeet Community College NARCH and Montana INBRE; Cherokee Nation NARCH and Oklahoma IDeA-CTR; Cankdeska Cikana NARCH and North Dakota INBRE; the South Central Foundation NARCH and Alaska Native Tribal Health Consortium NARCH with both the Alaska INBRE and the Montana IDeA-CTR. Currently, there are 10 NARCH projects focused on AI/AN faculty and/or student enhancement projects, 22 projects focused on research determined by the AI/AN communities, and three projects focused on capacity building within AI/AN communities. NARCH also supports several projects supported under different NIH directorates (i.e. NIGMS is the biggest).

Thursday June 1, 2017: 11:00 AM – 12:00 PM

Keynote Address: Rigorous Design, Rigorous Research: Inventing the Future of Learning with Design-Based Research

Presenter: Christopher Hoadley, PhD, Associate Professor of Educational Communication and Technology, Program in Digital Media Design for Learning, and Program on Games for Learning, New York University
Reporter: Louisa A. Stark, PhD, Professor, University of Utah

In his talk, Dr. Hoadley provided an introduction to Design-Based Research (DBR). He began by pointing out that the best research has traditionally been seen as objective, authentic, insightful, actionable, inspiring, and statistically rigorous, while also leading to improvement in outcomes and/or systemic reforms. In DBR, the research cycle begins with research on educational psychology, continues with designing interventions and evaluating them, then disseminating them, and repeating the process. Below is an outline of the points Dr. Hoadley presented.

The Common Guidelines for Education Research and Development (https://ies.ed.gov/pdf/CommonGuidelines.pdf), developed by the US Department of Education and the National Science Foundation, provide a useful framework for education researchers. They list several types of research:

- Foundational research (methodological and pure research)
- Early-stage or exploratory research (correlational studies)
- Design and development research (formative evaluation and iterative refinement)
- Efficacy research (outcomes under ideal circumstances)
- Effectiveness research (outcomes under typical circumstances)
- Scale-up research (outcomes across real world circumstances)

Challenges in education research include:

- Individual differences, and interaction effects with individual differences (Cronbach, 1972)
- Culture as a core covariate, and product (problems with “controlling for culture”; replicability; lack of universality)
- Enactment (a curriculum is not a pill; enactment is both contingent and requires judgement)
- Technology exacerbates rather than solves these problems

The problems that DBR seeks to address are:

- How do we study what’s best when we don’t even know what best looks like?
- How do we study things we don’t know how to make happen reliably?

DBR is doing research (and making strong claims) through iterative design. It is NOT (a) doing research on designers (design studies); (b) doing research on a design

(evaluation, formative or summative); or (c) doing design through research (research-based design).

The canonical DBR method is:

1. Identify initial draft of problem and context
2. Map conjectures based on a design proposition
3. Collect wide-ranging baseline data in context
4. Work with partners in context to create and tailor design(s) for context
5. Implement iteratively and collect data to test conjectures, understand context, and understand design. Continuously document designed intent, enacted design, and outcomes.
6. As data comes in, adapt the design and the conjectures (Retrospective analysis as appropriate)
7. Begin process of tentative generalization

Conjecture mapping provides an approach to systematic educational design research (Sandoval, 2014; http://create4stem.msu.edu/sites/default/files/event/files/Sandoval%20%282014%29.pdf):

- Design propositions are of the form: "Intervention of type X should have impact of type Y."
- DBR should test an "embodied conjecture"
- That conjecture has at least two degrees of freedom
    - Designed features ("embodiments") are intended to influence learning processes, which represents a "design conjecture"
    - Learning processes are intended to influence learning outcomes, which represents a "theoretical conjecture"
    - You can NEVER test these separately unless you believe embodiments deterministically influence outcomes

DBR involves iterative implementations:

- Sometimes iterations involve “mid-course corrections”
- Usually, you treat each iteration as a quasi-experiment against baseline or against prior iterations
- Sometimes iteration takes place across contexts
- Much information is gathered; it is used opportunistically both to advance the research and the design assumptions
    - Data can serve as an “early warning system” to orient the design activity
    - Data can ensure conceptions of context and design match reality
    - Implementation fidelity is a duty not to prior decisions, but to the spirit of the design (c.f., Brown 1992 "lethal mutations")

Evaluating design conjectures against data:

- Improve understanding of how the design functions in context:

    - Use planned comparisons to test design conjectures
    - Check that intended and enacted design align
    - Use induction and post-hoc iteration analysis to disconfirm alternate explanations of what happened and why
- The design is suspect:
    - "We believe, but are not sure, that embodiment x represents the class of interventions X."
- The mediating processes are contingent:
    - On context (“your mileage may vary”)
    - On implementation (we were trying to make X and we did so through intervention x, x’, x”…)
- Agency and perspective are acknowledged:
    - The designer, and design partners in context, help ensure implementation fidelity at the cost of blinding and arms-length objectivity, so design assumptions, revisions, and rationale need to be documented and inspectable.

What it means to do design research vs. design-based research:

- Design itself is a knowledge-producing activity (e.g., Simon, Argyris & Schön)
- Design research generally produces
    1. a refined conception of the *problem*,
    2. the *design moves* available to address the problem
    3. an idea of *if* and *how something works* in a particular context
- "The design" is an outcome
- Knowledge for designers is an outcome (tactics, strategies, tacit knowledge)
- Design research does not attempt to make generalized claims about the natural world or human psychology
- DBR is design in service of research

Similarities with other methods:

- Like Participatory Action Research, treats intervention as both an outcome and a way to interpret results
- Like formative evaluation research, aims to improve interventions
- Like ethnography, involves a dual role as participant observer
- Like positivist experiments, believes in making predictions and falsifying them

DBR is odd to many:

- Things that make positivists nervous:
    - Weaker objectivity of researchers
    - Changing protocols mid-experiment
    - Weaker claims about causation
    - Less generalized claims
- Things that make interpretivists nervous:
    - Agency in context is not minimized but maximized

    - Researchers often try to make quasi-positivistic (more generalized) claims
- Things that make designers nervous:
    - The designs may be deliberately suboptimal (to gain info)
    - Evaluation isn't always informing the design itself

DBR has important advantages:

- Not just "if it works" but "how it works" findings
- Greater theoretical alignment (treatment validity, not just fidelity)
- Built-in applicability (action-oriented, and relevant to at least some contexts)
- May produce design achievements in addition to research achievements
- Can be shared by demonstration as well as explanation
- Really sensitive to unforeseen but critical variables ("dealbreaker" detection)
- Tends to build capacity for future work

When NOT to use DBR:

- If you only care about making and testing a design
- When you believe the treatment unproblematically represents a fair test of the theory in a standardized way (if it's a "pill")
- If you need to eliminate designer perspective and interpretation (e.g., summative evaluation)
- If the goal is description of *what is* instead of an intervention to change *what could be*

Beyond DBR: Design-based Implementation Research

- DBIR is related to DBR, but the focus is on educational systems change (think "reform")
- Research questions come from both researchers and practitioners; power is shared between them
- Interventions are thought of at the systems level and come from persistent partnerships between educational institutions and researchers
- Capacity for continuous improvement is critical
- Iterations typically involve ever widening implementation scales
- Theoretical questions about scaling are "baked in" from the beginning

Summary

- Sometimes design and research can't be neatly separated in educational improvement.
    - A learning theory doesn't specify an instructional design.
    - Interventions are holographic (the whole learning experience) and contingent (they change based on where they are).
    - We don't have a theory of context to "control" for relevant differences.
- DBR is a way to do research in context on theories that hinge on designs.
- DBR helps generate useful designs, but more importantly, tentative generalizations about how, not just if, they work in real use.

Thursday June 1, 2017: 1:30 PM – 2:45 PM

Models for Building Relationships with Students and Communities That Support Science Learning and Success

Facilitator: Ann Chester, PhD, Assistant VP for Education Partnerships, Director of HSTA, Director of HCOP, Deputy Director of the Center of Excellence in Women's Health.

Panelists:
Sheila A. Caldwell, PhD, Program Director, Center for Research Capacity Building, NIH NIGMS
Maurice Godfrey, PhD, Professor, University of Nebraska Medical Center
Angie Millan, DNP, RN, FAAN, Nursing Director, National Association of Hispanic Nurses
Kelley Withy, MD, PhD, Professor, University of Hawaii

Reporter: Alonzo Fields, Science Museum of Minnesota

National Association of Hispanic Nurses

- There are 3 million people in health care professions, but only 4% are Hispanic, even though Hispanics represent 16% of the U.S. population.
    - Further, by 2050 U.S. population will be 30% Hispanic.
- The purpose of the NIH/SEPA 5-year grant to the National Association of Hispanic Nurses is to increase the number of Hispanic youth in nursing schools.
- We need to reach out to parents and ensure that their children understand the need to gain knowledge in science and math.
- There is a need to engage youth to inspire them to seek a health care career.
- Role Model interviews were delivered via Spanish radio stations.
    - Hispanics get their health and local news via radio and it is a good source to get the message out.

Native American Research Centers for Health (NARCH) Program

- We have a NIH Trans-institute program, NARCH, which provides research training opportunities to AI/AN youth.
- The NARCH awards can be tied to a tribal college to provide research opportunities at the tribal college. Some NARCH awards are partnered with research-intensive institutions which can provide mentoring and bridging from a TCU into a larger university. Some of the bridging programs have seen great success in helping AI/AN students move into STEM terminal degrees.
- The NARCH grant program allows tribes to work within their community or partner with other tribes. However, due to many cultural differences among the various AI/AN tribes, working within their own tribal communities has been beneficial.

- NARCH grants can only be awarded to federally recognized tribes and tribal organizations; not to research-intensive universities. This allows the tribes and tribal communities to be in charge of the research and student development. NIGMS also runs another program in which AI/AN college students are brought to NIH for a week. During the week, students are provided hands-on lab experiences, career development seminars, and seminars on research training opportunities at NIH and outside NIH. AI/AN youth don't often see a variety of STEM role models aside from doctors and nurses. We try to provide them with research role models in a variety of STEM careers.
- The NARCH community feels it is important to engage the youth in the AI/AN communities and encourage them to participate in STEM.

University of Hawaii

- Partner with everyone
    - DOE schools/private schools/all schools in the state can ask for a speaker
    - Good partnerships
    - Private community health care providers
    - Healthcare associations of Hawaii
    - NIH programs such as Step-up and INBRE for research

- Future Goal: To get Cohort students into careers in health sciences
- Provide teacher training to get kids learning more
- Get word out any way they can (teacher talks/youth talks/conference/websites)
- Program has 450 students
- Newsletters give out data and information related to the progress on how the youth are doing in the program

West Virginia University Health Sciences & Technology Academy (HSTA)

- HSTA's main goals are to increase college attendance in Appalachia, improve STEM education in public schools, empower communities through youth leadership, and increase the number of health-care providers and STEM educators in underserved communities.
- To realize these goals, HSTA created a mentorship structure that supports student success and addresses individual educational and social needs.
- The program puts rigorous academic expectations into place that connect learning to students' personal experiences.
- It rewards participants and teachers with generous incentives that recognize their accomplishments. And it offers, through the support of the West Virginia Legislature and state colleges and universities, substantial tuition waivers to successful participants who go on to attend an in-state institution for an undergraduate or STEM-based graduate degree.
- A distinctive piece of HSTA is that its students develop research projects that examine and address health issues faced by their communities. These projects form the core of the HSTA experience and drive the academic learning the program

promotes. The projects turn HSTA students into community advocates who address health and social issues at home even as they prepare to move on to college and beyond. Project results have been published in peer-reviewed journals.
- As of August 2016, HSTA graduates have earned 782 bachelor's degrees, 120 master's degrees, and 74 terminal degrees. Approximately 62% are in STEM disciplines. Over 400 have returned to WV communities to work.

Participants:
Chris Pierret, Mayo Clinic
Sandra Prytherch, University of Nevada
Julie Cary, Boys & Girls Club of the Coastal Plain
Michael Carapezza, Columbia University
Laurie Jo Wallace, Health Resources in Action
Alison Lin, National Institutes of Health
Jennifer Hellier, University of Colorado
Chris Doyle, Montana Tech
Kelly Nguyen, Boston University
Holly Martinson, University of Alaska Anchorage
Jessica Gluck, Discovery Place of Science
Patricia Whitehouse, Chicago Public Schools
Rachel Smilow, Children's National Network
Lead Clapman, PBS NewsHour
Farrah Jacquez, University of Cincinnati
Rhea Miles, East Carolina University
Andrea Panagakis, Salish Kootenai College
Rashade Alexander, National Institutes of Health – NIGMS
Charles Wray, The Jackson Laboratory
Alonzo Fields, Science Museum of Minnesota
Jalisa Ferguson, Georgia State University
Anne Westbrook, Biological Sciences Curriculum Study
Tony Beck, National Institutes of Health - NIGMS
Madison Spier, University of Texas A & M
Shona Ramchandani, Science Museum of Minnesota

Discussion with Christopher Hoadley on Design-Based Research

Facilitator: Judy Brown, EdD, SVP Emerita of Education for the Patricia and Phillip Frost Science Museum

Presenter: Christopher Hoadley, PhD, Associate Professor of Learning Sciences/Education Technology, New York University

Reporter: Ashlyn Sparrow, BS, Learning Technology Director for Game Changer Chicago, University of Chicago

Background: What is Design-Based Research?
Design-based research (DBR) blends empirical educational research with theory-driven design of learning environments in order to understand how, when, and why educational interventions work in the field. DBR researchers work on the intersection of theory and practice, attempting to account for the complex world we live in. This session is a continuation of Dr. Christopher Hoadley's keynote address on design-based research. The following are key questions that were asked during the discussion.

Q. How do you go about reporting out the data collected with DBR methodologies?
First, writing up DBR and getting it published in traditional venues is challenging. For organizations that are foundation-funded or attempting to develop an intervention, it is much easier to make a white paper which can document the progress of the design. The struggle is chopping up the larger narrative arc of a design story and finding a traditional place to publish it. Journals that are friendly towards the DBR approach include the Journal of Learning Sciences, and Cognition and Construction.

However, where you share the data is much harder. Dr. Hoadley recommends packaging your work in a way that is digestible to practitioners and other relevant constituents. One such example is called the Hive Learning Network, funded by the MacArthur Foundation. Hives are city-wide networks of youth-serving organizations focused on practitioners in education. Dr. Hoadley is connected to Hive NYU and he works collaboratively with the Hive Research Lab to develop practitioner-friendly methods of dissemination such as white papers, toolkits, blog posts, workbooks, and more.

Q. Is DBR a type of invention? Is it a type of discovery? Is it both?

One participant works at NASA, where they believe discovery comes first, followed by invention. For example, astronauts cannot spit while in orbit. Engineers had to figure out a way for astronauts to brush their teeth and then swallow it. Thus, toothpaste was invented. NASA would categorize this as an invention and not a discovery.

With design-based research, it is both a discovery and an invention. You are discovering something about the user and you are inventing something that meets their needs. You are refining your social science theories and your designs at the same time. This requires someone who has a discovery mindset on the social sciences side and an invention mindset on the design.

Q. Why isn't DBR considered formative evaluation?

If the deliverable is a new theory or framing of how people learn, it's DBR. If it is just helping to fix what is broken, then it's formative evaluation. The point of formative evaluation is to give the designers something they can work with. However, there isn't a sharp line between the two. DBR requires iteration of design and theory. For example, play-testing an educational board game with students could be considered a method of formative evaluation, since the information gained will improve the game's design. However, it is quite possible that information gathered during a play test session might uncover new theories of student engagement that might be beneficial to other audiences.

The rest of the discussion consisted of participants asking for advice on their current SEPA projects of potential education technologies. To learn read more about DBR, check out dbr.coe.uga.edu.

Participants:
Judy Brown, Patricia & Phillip Frost Museum of Science
Ashlyn Sparrow, University of Chicago
Leslie Schneider, Tufts University

Evaluating Teacher Professional Development: Insights From Three SEPA Projects

Facilitator: Dina Drits-Esser, PhD, Senior Research Associate, University of Utah

Panelists:
Paula Cupertino, PhD, Associate Professor, University of Kansas Medical Center
Berri Jacque, PhD, Assistant Professor, Tufts Medical School
Karina Meiri, PhD, Professor, Tufts Medical School
Michele Shuster, PhD, Associate Professor, New Mexico State University
Christopher Villa, MBA/MPA, Helix Solutions

Karina and Berri, Tufts Medical School, described their project, along with a description of their evaluation methods. They have developed and refined high-quality instruments throughout this multi-year project.

Michele and Christopher, New Mexico State University, described their program and high-quality evaluation practices.

Following each presentation, panelists fielded questions about specifics of their evaluation methods. Discussions included methodologies (qualitative versus quantitative data; feasibility of randomized controlled trials).

Participants:
Phyllis Ault, Education Northwest
Chanelle Case-Borden, National Institute of Health
Robin Fuchs-Young, Texas A&M University
Christopher Villa, Helix Solutions
Marnie Gelbart, University of Harvard
Wanda Padula, National Science Foundation
Aaron Kyle, Columbia University
Karina Meiri, Tufts University
Berri Jacqus, Tufts University
Ruchita Patel, Rockman Et Al
Michael Lichtenstein, University of Texas Health Science Center at San Antonio
Michele Shuster, New Mexico State
Dina Drits-Esser, University of Utah

Establishing a Basic Genomic Literacy Framework for K-16 Students

Facilitators:
Beth Tuck, MA, Genomics Education Specialist, NIH/NHGRI
Carla Easter, PhD, Chief, Education and Community Involvement Branch, NIH/NHGRI
Laura Bonetta, PhD, Director of Educational Media, Howard Hughes Medical Institute
Neil Lamb, PhD, VP for Educational Outreach, HudsonAlpha Institute for Biotechnology
Pat Miller, PhD, Retired Teacher, Poolesville High School
Daphne Rickard, Biomedical Instructor, Irving High School
Bryony Ruegg, PhD, Director of the Bio-Rad Explorer Program, Bio-Rad Laboratories

Reporters:
Christine Gou, National Human Genome Research Institute (NHGRI)
Beth Tuck, MA, Genomics Education Specialist, NIH/NHGRI
Carla Easter, PhD, Chief, Education and Community Involvement Branch, NIH/NHGRI

The National Human Genome Research Institute (NHGRI) recently convened a Strategic Visioning Meeting for a proposed new initiative called the Genomic Literacy, Education, and Engagement (GLEE) Initiative, which aims to enhance genomic literacy commensurate with the pace of genomic advances. This initiative is proposed to target three major audiences: K-16 students and educators, communities and members of the general public, and healthcare professionals. The GLEE K-16 Working Group recognized the need to convene a diverse group of stakeholders to define a framework for "basic genomic literacy" that could be used to inform education policy-makers and curriculum developers.

Building from existing state and national science education standards and prior work on genetic literacy, this breakout session engaged 36 participants from formal and informal education organizations and nine members of the GLEE K-16 Working Group to develop a working draft of the Basic Genomic Literacy Framework.

Co-chairs Bryony Ruegg (Bio-Rad Laboratories) and Beth Tuck (NHGRI) presented previous K-16 Working Group efforts, including the K-16 GLEE White Paper and outcomes of the March 2017 Strategic Visioning Meeting. Session participants then engaged in a World Cafe discussion to identify the knowledge and skills needed for adults to become informed patients, citizens, and professionals regarding modern genomics uses, including:

- Recreational genomics (e.g., genetic ancestry testing)
- Genomic medicine (e.g., non-invasive prenatal screening)
- Genomics careers (including genomics outside of traditional academic careers)
- Ethical, legal, social implications of genomics (e.g., forensic DNA analysis)
- Genomics beyond medicine (e.g., genetic engineering of foods)

Participants used a list of existing standards (from NGSS, AP Biology, and other sources) to map, refine, and identify missing concepts for genomics education for each topic above.

For example, participants discussing themes related to genomic medicine expressed that an understanding of DNA structure/function, variation, inheritance/transmission, and probability/statistics is necessary for patients to interpret genomic information to assess disease risk. In addition to identifying science concepts, participants emphasized that genomic engagement outside the biology classroom is essential for genomic literacy due to its rich ethical, legal, and social implications and the interdisciplinary nature of the science.

The K-16 Working Group intends to draft a literacy framework incorporating the session's takeaways and present to other partners and GLEE Working Groups. They aim to publish a position paper by Spring 2018.

Participants:
Douglas Starr, Stanford University
Amy J Hawkins, University of Utah
Mary Kay Hickey, Cornell University
Ella Greene-Moton, University of Michigan
Renee Bayer, Michigan State University
Kelly LaRue, The Jackson Laboratory
Stephanie Dumont, Brunswick High School
Diane Munzenmaeir, Milwaukee School of Engineering
David Petering, University of Wisconsin-Milwaukee
Krista Glazewski, Indiana University
Scott Woody, University of Wisconsin-Madison
Sean Freeland, West Virginia University
Louisa Stark, University of Utah
Jamie Dohopolski, NIH/NHGRI
Marisa Pedulla, Montana Tech
Rebecca Smith, University of California San Francisco
Nancy Morono, Baylor College of Medicine
Marisa Bowers, City of Hope Beckman Research Institute
Martin Weiss, New York Hall of Science
Pat Miller, GLEE
Donna Cassidy-Hanley, Cornell University
Lorna Gitan-Mugambi, Georgia State University
Michelle Ventura, Georgia State University
Barbara Baumstark, Georgia State University

Science of Learning: How do SEPA Projects Incorporate Theories of Learning into Curriculum?

Facilitators:
Jennifer Ufnar, PhD, Senior Research Associate/Director, Vanderbilt University
Kristin Bass, PhD, Senior Researcher, Rockman Et Al
Rob Rockhold, PhD, Deputy Chief Academic Officer, University of Mississippi

Panelists:
Tim Herman, PhD, Milwaukee School of Engineering, Teachers FIRST
Emily Kuehn, PhD, US Army Medical Research and Materiel Command, In-Classroom Biology Internships for Students and Teachers in Underserved Schools
Loran Parker, PhD, Purdue University, This is How We "Role." Inspiring Future Researchers through Veterinary Medicine
Jayatri Das, PhD, The Franklin Institute, Neuroscience in your World: A Partnership for Neuroscience Education Across the K-12 Spectrum
Idit Adler, PhD, Michigan State University, A New Genomic Framework for Schools and Communities
Lisa Marriott, PhD, Oregon Health and Science University, Let's Get Healthy! (CHIDR Chatter: Translating Community Research Data for Classroom Use)
Katherine Richardson Bruna, PhD, Iowa State University, Young Scientists, Ambitious Teachers Improving Health in an Urban Ecosystem

Reporter: Susan Hershberger, PhD, Director of the Center for Chemistry Education, Miami University

This session featured two formats for greater presenter/audience interaction. First, individual presenters described their SEPA project and how teachers and students learn through it. After brief introductions, presenters moved to individual tables for small group and presenter interactions. After a short interval, participants were prompted to move to new tables for new discussions.

Tim Herman began by describing and sharing how physical models can promote deep thinking and reveal the molecular bases for phenomena. His project is connected to student learning though engaging teachers who hope to engage students.

Emily Kuehn described how training and teaching near peer mentors was central to Washington, D.C. area biology and STEM training, although curriculum, awareness, mentorship, and skill building were all part of the program of biology and STEM modules for teachers and students. The near peer mentor is a very effective way to influence 9th and 10th graders. Students in one part of the program have stayed engaged and continue to be involved in other parts of the program.

Loran Parker described how the after-school outreach project focusing on the health science of animals and role models in veterinary medicine was using Self Determination Theory as the model of changing young student interest in medicine, biology, and STEM.

Jayatri Das described the teacher interest in professional development connected to science museum exhibits about neuroscience and the brain. Debunking commonly held myths was another tool of engagement for teachers, their students, and the public.

Idit Adler described how project-based learning was central to student learning in A New Genomic Framework for Schools and Communities. The practices and three-dimensional learning of the NGSS helped students pursue solutions to meaningful questions. Learning occurred through collaboration, question boards, and creating artifacts. Lessons were structured from guided to open inquiry.

Lisa Marriott, of "Let's Get Healthy," described exciting results of student and community participants in health assessments. The look at impulsivity of about 2500 students opposes the STEM mindset. The results are a strong argument for STEM mindset interventions for students.

Katherine Richardson Bruna described the ambitious science pre-service teachers and in-service teachers in engaging 10-13-year-old citizen scientists in "How and Why Do Mosquitos Buzz and Bite." The recording of students' emerging knowledge is central to student learning.

The discussions of all projects increased during the rotating discussions at different tables around the room.

Participants:
Juan Lopez-Garcia, University of Puerto Rico
Bret Hassel, University of Maryland
Ellen Chenoweth, University of Alaska
Julia McQuillen, University of Nebraska
Amy Spiegel, University of Nebraska
Sany Sanmiguel, Purdue University
Christopher Burnett, Baylor College of Medicine
Jason Dupuis, Museum of Science and Industry
Patrice Saab, University of Miami
Charlie Geach, American Physiological Society
Brinley Kantorski, Duquesne University
Barbara Hug, University of Illinois
Amanda Jones, Seattle Children's Hospital
Rosemary Riggs, University of San Antonio
Renee Hesselbach, Miami University
Elizabeth McMillan, Sanford Research
Laura Tenenbaum, Walter Reed Army Institute of Research
Margery Anderson, Walter Reed Army Institute of Research
Kristin Bass, Rockman Et Al
Katherina Bruna, Iowa State University
Michael Boyd, Iowa State University
Idit Adler, Michigan State University

Big Data in STEM Learning

Facilitator: Mike Wyss, PhD, Professor, University of Alabama at Birmingham

Presenters:
Patrice Capers, PhD, Postdoctoral Fellow and Director, University of Alabama at Birmingham
Bruce Nash, PhD, Assistant Director for Science, DNA Learning Center, Cold Spring Harbor Laboratory
Chuck Wood, PhD, Professor, Wheeling Jesuit University

Reporter: Christine C. Ziese, New Braunfels Independent School District

Big Data Can Make Inquiry-Based Education More Accessible to Youth - Bruce Nash, DNA Learning Center
Microbiome Project (NIH BD2K) DNA Barcoding Project on Long Island, NY

Data science requires different skills and different approaches than what previous biologists are used to. Previously, scientists did not have data science available to them on the level that it is present and available today. Scientists need these skills or people who possess these skills to do these current jobs. High school students are potential future bio-informaticians.

- Tools were adapted for high school students to be able to use them to DNA barcode.
- Students collected environmental samples of their choice.
- Teachers trained for a week last summer, then they went with their students and collected samples, and then in the fall they ran sequencing.
- 10 Schools involved, with 21 teams (63 Students), 220 samples, 11 billion bp (passed quality control). Students chose where to sample (various places).

The goal of the project was to study microbiomes of invertebrates, water, vectors for disease, crops, plants, and boat hulls. They also came up with hypotheses to test the effects of pollution, pesticides, salinity, plant density, and transportation. Skills and reasons that microbiomes were chosen: scalable project, integrates molecular biology and ecology, combines lab work with data science, allows for original research, discovery, publication, and is accessible and relevant to the students (they get to choose what they are doing), affordable with multiplexing.

- Students used Jupyter Notebooks (web-based notebook that runs on a server, can put in text, or run on code. You can access files and see the output. All open source, and very flexible, can run in command line) that ran Qiime (microbiome suite For the Data).
- Students will be presenting this summer at the BLI Symposium.
- Teachers were trained to mentor student teams; support was offered to students and mentors during project.
- Online tutorials and videos were made available to students to learn remotely.

Students learn about challenges, reproducibility, controls, multiple samples for each location in the state, check statistically is their samples clustered together, take data, organize it,

create metadata files, get them into Qiime to visualize their results in order to come to a conclusion.

- Students did struggle, but the struggle made them proud that they surmounted these barriers. More reported back that they enjoyed it than any other group. Conceptually they got what was going on; they mostly struggled on detail. Students can do a lot more than what people give them credit for.

Most common problems were typos in the command. Jupyter helps by predicting the code you want to type.

Responses to questions:
10 different districts on Long Island, all high school students (mostly grades 10-11 but a few from grade 12); the districts tended to be near the lab, however, they had schools from Queens all the way to Shelter Island (on the opposite side of L.I.)

SEEC (Science Education Enabling Careers) Big Data – Patrice Capers, University of Alabama at Birmingham

This is a professional development program that is a yearlong project, and allows teachers and students to review primary scientific literature and larger data sets with the purpose of extracting the data and deciphering the meaning. Teachers were trained and then taught their students how to identify and extract specific data from primary science research papers (Obesity in Mice), teachers and students utilized a web portal, generated and tested hypotheses, competed against fellow students/classes by looking at factors such as reliability, validity, creativity, and interpretations of data.

The Objectives of SEEC Big Data were to:

- Train teachers to understand data sets so that they could guide their students in the use of these data sets.
- Train students how to read primary scientific literature so they could extract data from these readings, and to be trained to test these large data sets for hypotheses that they generate.
- To train both the teachers and students in the importance of scientific rigor in collecting and entering data from research studies (for things like meta-analysis).
- To analyze the relationship between obesity in lab mice and dependent local factors that are not intended experimental variables.
- Understanding the need of computer science in the area of modern/current biomedical research.

Students were asked to identify a problem, what do they already know, what do they need to know, what is the difference between an abstract vs. the entire paper.
The web portal was used for the facilitating of massive coding of scientific papers.

- Goals for web portal: To have flexible project definitions. Accurate and accessible data. Intuitive user base that is user-friendly to middle and high school students.

- Teachers could create as many classes as they wanted, and gave students the code to access the web portal. There were no limits as to how many students could have access.
- Teachers could access when the last time was that the student logged in, their progress, and what the student was logging in, etc. 66% of students used content as grades. Students received paper names, progress, and button to get to coding page to enter their data.
- Tutorial videos were also present in the portal to help the students, located in the dashboard. Majority of students did like it, and most teachers liked the appearance.
- 9 teachers and 341 students participated; 5 assignments, 1 final assignment.
- Final assignment was to see if they understood how to code and analyze by the end.
- Students rated that this program was better than what they did in class.
- They chose variables that most people could understand.
- All teachers said that their understanding of primary literature increased by participating in the program.

Outcomes:

- Pros: teachers were able to view the progress of their students, helped them incorporate it into their classroom, liked the content, liked the tutorial, liked the ability to access using phones; kids said they liked learning about new experiments because they got the chance to read these articles.
- Cons: Teachers had to contact the program to reset their passwords, could not remove students (sometimes friends would give out the code so there would be extra students in a "class"), difficulty in adding study arms, problems logging in, some thought the text was too small and plain (for example, adding a statement or progress bar, "compared to others, you have completed 8% more").

Teachers were given an example to show how to extract all the information, a code book that described all the variables, and told exactly what they were to extract and how to extract it (for example, age, numerical vs. words). 70% of students said they would participate again. Participants said at first it was a bit overwhelming, but then simple.

Suggested changes to make: Timing implementation, ability to analyze the data, better prizes, more information in the text about the tutorials (highlight text in top to state remember to view tutorial if you need help), an app with assignments, and a help section. Most teachers thought if they had it earlier in the school year, it would be better for next year, and all teachers wanted to use the portal again for other purposes.
Answers to questions after presentation:

- Activities were done during class time.
- Did not compare middle school vs. high school, but hope to do that next year.
- Recruited teachers by contacting curriculum specialists in mass emails and with flyers.

Pandem-Sim Students – Chuck Wood, Wheeling Jesuit University
In Pandem-Sim, students act like CDC epidemiologists trying to interpret data coming in from the field about diseases and figure out what the pathogen was, who is susceptible to this disease, how it could be treated, and how it could be controlled. They do an excel model of the spread of diseases, but wanted to expose students to a professional level of analyses of large amounts of data.

The Pandem-Sim is a suite of three programs focused on infectious disease epidemiology outbreaks, epidemics, and pandemics. The three programs are: Pandem-Sim (live simulation), Pandem-Data (uses big data to model outbreaks), Pandem Disease Center (collection of PBL and case-based learning activities with career information for high school students.)

- Big data's V words: volume (side), variety (complexity), velocity (speed), veracity (quality), visualization (increasing understanding), value (usefulness)
- Here are some real-world examples of big data: YouTube (uploads 48 hours of data every minute), email (200,000,000 messages per minute), Google (receives over 2,000,000 search queries per minute)

The modeling on the spread of infectious diseases is called SIR (Susceptible Infectious Recovery). Students can use these equations relating to epidemiology. Then students can use FRED (Framework for Reconstructing Epidemiological Dynamics) which displays interactive videos that show the spread of measles both with and without herd immunity levels of vaccination. Then GLEAMviz can be used (Global Epidemic and Mobility Model) can use as a client to select the parameters you want to model (like closing schools, transportation, etc.).

This program has written a 28-page tutorial for students and teachers on how to set up these models and use them. A website was put together to introduce these concepts to teachers and students (including a scope and sequence for the teachers). This can be used by computer science teachers and biology teachers. There is also a section explaining big data and epidemics, and how we can improve the modeling. There is also a section associated with careers. There are 97 careers relating to the big data side that specifically associate with how they can be used with the life sciences. Evaluation will not be with students, because there is not enough time. They are doing a developmental evaluation in which they work with individual teachers as a case analysis to talk about what they think of it and how they can use it in the classroom. The next stage is to take that information and figure out what they learned and refine it.

Answers to Discussion Questions:
U.S. Department of Education did a big study a few years ago on what student interests are, and 25% of students on the survey were interested in math but not science. It was thought the math in Pandem-Sim would be a way to grab those students' interests because of the math-modeling present. It is believed it is an opportunity to build on this as it fits into biology); it is a bit harder to work with computer science faculty.

One things that is emphasized on the website is that not one single person has all the different types of knowledge needed. You need specialists. You have content experts, then a variety of computer science skills, and you have to have a statistician (to figure out what you really discovered).

Overall key takeaways from all presentations:

- Big data can be used with real world applications with students for studying anything.
- Students are more capable than given credit for (you may have to generalize statistics for the students to understand, but they are able to analyze and make decisions on that information). They might need some background information, tutorials (for reminders or background information), or examples to help get them started. Students appreciate the struggle; they gain self-gratification in overcoming obstacles.
- Current and future students are the next generation of workers, and will be needed for these new and emerging jobs in current science. Such jobs will require some/more knowledge on bio-informatics and big data. It is important to capture their interest in these fields before they become college bound. Teachers can help build this interest in such jobs by involving them in projects like these, and educating them on big data, how it can be used, and how it is used in the real world (which makes it relevant to the students).
- The use of simulations, software/coding, and web based/apps is helpful to both student and teacher to reach the goal of the project.

Participants:

Christine C Ziese, New Braunfels Independent School District
Jackie Shia, Wheeling Jesuit University
Alana Newell, Baylor College of Medicine
Preeti Gupta, American Museum of National History
Maureen Munn, University of Washington
Bette Schmit, Science Museum of Minnesota
Stephanie Tammen, Tufts University
Elizabeth Genne-Bacon, Tufts University
Patricia Ward, Museum of Science & Industry

Planning Competitive National Science Foundation Proposals

Presenter: Robert Russell, PhD, Program Director, National Science Foundation
Reporter: Kayla Pritchard, University of Georgia

Established after WWII, the National Science Foundation (NSF) is an independent agency aimed at increasing STEM engagement. Their mission is to increase excellence in STEM education, prepare a competent STEM workforce, and help create well-informed citizens who can take part in science and make educated decisions. The goals of many NSF-funded projects include developing new knowledge about how people learn STEM, under what conditions and processes, as well as researching new ways of engaging people in learning STEM.

The presentation opened by detailing a series of NSF programs that would be most applicable to SEPA attendees. Broad overviews, proposal requirements, learning contexts, and common project types were briefly outlined for seven programs including ECR, DRK, ITEST, STEM-C, AISL, EAGER, and CAREER. New program announcements with modifications and deadlines should be out soon. Following was an overview of the proposal review process and timeline. There are two broad review criteria. One is “Intellectual Merit,” which is the potential the project has to advance knowledge, including a good basis in research for the project that guides the rationale and research design. The other is “Broader Impacts,” which describes the practical value of your project, as well as extending to underrepresented and marginalized groups in STEM education. In the discussion that followed, Russell made it a point to tell attendees that if they are unsure if their project or proposal is a right fit for NSF, to reach out to a program officer to discuss their idea before deciding not to apply.

Participants:
Kayla Pritchard, University of Georgia
Gwen Stovall, University of Texas of Austin
Claudeen Denning, Rose Park
Cherilynn Shadding, Washing University
John Pollock, Duquesne University
Scott Rawls, Temple University
Theresa Gaines, Georgia State University
Elizabeth Danter, New Knowledge Organization
Kristina Yu, Exploratorium
Tony Ward, University of Montana
James Cotner, University of Minnesota
Victoria Coats, Oregon Museum of Science & Industry

Thursday June 1, 2017: 3:00 PM – 4:15 PM

STEM Relationship Pipelines: A Core Component of Long-Term Impact

Panelists:
Lisa Marriott, PhD, Assistant Professor, Oregon Health & Science University
Peter Crown, PhD, Multimedia Collaboratory Producer, University of Arizona Health Sciences
Marlys H. Witte, MD, Professor of Surgery, University of Arizona College of Medicine
Michael Kennedy, PhD, Director/Research Professor, Northwestern University

Reporter: Juan Ruiz, University of Arizona

This presentation about partnerships within the pipeline included three presentations from three different institutions.

Dr. Lisa Marriott introduced her program, a health fair for students called Let's Get Healthy!, which is designed to teach about different factors of health. This fair consists of various stations for students to engage in varying topics like sleep and genetics. Dr. Marriott mentioned her partnership with the Great Lakes Science Center and Bangkok Clinical Center in the effort to fund and be able to afford new modules.

The second presentation consisted of Dr. Marlys Witte and Dr. Peter Crown presenting the Summer Institute on Medical Ignorance Research Program for high school, undergraduate, and medical students who are considered disadvantaged. The program focuses on questioning and curiosity-building with students working as full-time researchers and attending seminars two times a week. Students can start this program during their high school years and continue on through their medical school years. With aid from multiple institutes, this summer program has been active for more than 30 years.

Dr. Michael Kennedy was the third and last presenter for this session, speaking about his science club for kids in grades 5-8. The program works by charging entry to kids from high income families in order to provide the same opportunities to lower income kids who would not otherwise be able to participate. Students take part in a biotechnology lab with high quality learning experiences for all using a biobuilder curriculum.

After these presentations finished, the session was opened up to questions.

Participants:
Juan Ruiz, University of Arizona
Peter Crown, University of Arizona

Marlys Hearst Witte, University of Arizona
Aaron Kyle, Columbia University
Debra Yourick, Walter Reed Army Institute of Research
Elizabeth Genne-Bacon, Tufts University
Bret Hassel, University of Maryland
Lisa Marriott, Oregon Health & Science University
Julie Cary, Boys and Girls Clubs of the Coastal Plain
Alison Lin, National Institutes of Health – NCI
Mike Kennedy, Northwestern University

Bilingual Exhibitions and Community Leader Dialogues in Rural Colorado Libraries

Presenters:
Anne Holland, MS, Community Engagement Manager, Space Science Institute
Jennifer Hellier, PhD, Director of Colorado Health Professions Development Program, University of Colorado
Robert Russell, PhD, Senior Science Education Advisor, Space Science Institute

Reporter
Lindsay Barone, PhD, Program Evaluator, Cold Spring Harbor Laboratory's DNA Learning Center

This session dissected the process of developing the *Discover Health/Descubre la Salud* exhibit in Colorado libraries. Anne Holland began by explaining the model for the *Discover Health/Descubre la Salud* project. Emerging from the STAR Net library education network, *Discover Health/Descubre la Salud* was designed for libraries because they are free, visited by approximately 70% of the U.S. population, and visitor composition tends to be demographically representative of the local community. The STAR_Net model includes interactive STEM exhibits and kits, active learning resources that librarians can facilitate for patrons, staff training, and the development of a community of practice that includes librarians and STEM professionals.

The *Discover Health/Descubre la Salud* program had the goal of increasing patron knowledge and participation in health sciences in communities which are traditionally underserved in STEM. By collaborating with Colorado Area Health Education Centers (AHECs), the *Discover Health/Descubre la Salud* project was able to begin creating an exhibit which would engage the community in culturally inclusive ways (including ensuring that libraries offer a welcoming environment for all community members). Jennifer Hellier then picked up where Anne left off, delving into the AHECs in more detail. She explained that AHECs tend to be very community-focused and have a mandate to focus on public health. As a result, they are excellent partners for building health-focused programs for the community.

Bob Russell devoted his time in the session to exploring the media strategy for getting the word out to Spanish-speaking residents about the programming available at their local libraries. They took an "air and ground" approach because many individuals may not have been able to read in Spanish. Social media, TV, radio, and print were all used for advertising the program and bombard people with health-related messaging. One particularly important point that Bob made was that although most of the messaging would be targeted towards adults, this would in turn encourage parents to consider taking their children to the library when they perhaps hadn't done so before.

Finally, the session wrapped up with Anne discussing the importance of engaging in community leader dialogues. For the *Discover Health/Descubre la Salud* project, they

made a point of hosting two types of feedback-gathering sessions. More traditional project staff-led focus groups were used to gather feedback on the exhibit. However, Anne stressed that of equal importance to the project were the community dialogues they hosted. They were semi-structured and led by community members while project personnel looked on. The community dialogues were undertaken with three goals in mind: 1) to involve community members in the design process; 2) to introduce library staff to community members to help build partnerships; and 3) to determine regional health concerns. The dialogues were also a useful tool for identifying individuals who perhaps were missing from the design process but should be consulted. One final point Anne made was that community dialogues were also helpful for helping to convey health messages to people who had heard them time and again but perhaps had not internalized them.

Participants:
Anne Westbrook, Biological Sciences Curriculum Study
Michelle Venture, Georgia State University
Rachel Smilow, Children's National
Lindsay Barone, Cold Spring Harbor Lab
Tiffany Nuessle, Denver Museum of Nature & Science
Marnie Gelbart, Harvard University
Mary Sladek, NASA
Tony Beck, NIH

Engaging a Pipeline From SEPA to IDeA Programs

Facilitators:
Tony Ward, PhD, Professor Public Health, University of Montana
Krishan Arora, PhD, Program Officer, NIH/NIGMS

Panelists:
Ann Chester, PhD, Assist VP for Educational Partnerships, West Virginia University
Maurice Godfrey, PhD, Professor of Psychology, University of Nebraska Medical Center
Marisa Pedulla, PhD, Professor of Biology, Montana Tech
Rob Rockhold, PhD, Professor of Health Sciences, University of Mississippi Medical Center
Michele Shuster, PhD, Associate Professor Biology, New Mexico State University
Kelley Withy, MD, PhD, Professor Complementary and Alternative Medicine, University of Hawaii

Reporter: Krishan Arora, PhD, Program Officer, NIH/NIGMS

Summary
This session began with a brief introduction of panel members, followed by Dr. Arora outlining the IDeA programs (INBRE, COBRE and IDeA-CTR) and their goals. Panel members then shared examples of how the SEPA helps or could help feed the pipeline of students entering into the IDeA programs including challenges and opportunities.

Below is a summary of key points and resources shared during each presentation.

- The Institutional Development Award (IDeA) program broadens the geographic distribution of NIH funding for biomedical research and enhances the competitiveness of investigators at institutions located in states that have historically received low levels of funding from the NIH. There are 23 states and Puerto Rico that are IDeA-eligible states.
- The IDeA program currently supports the three following initiatives:
    - *IDeA Networks of Biomedical Research Excellence (INBRE)* enhance, extend, and strengthen the research capabilities of biomedical research faculty in IDeA states through a statewide program that links a research-intensive institution with primarily undergraduate institutions. INBRE supports institutional research and infrastructure development; research by faculty, postdoctoral scientists and students at participating institutions; and outreach to build science and technology knowledge in the states' workforces.
    - *Centers of Biomedical Research Excellence (COBRE)* support thematic, multidisciplinary centers that augment and strengthen institutional

biomedical research capabilities through three 5-year phases of infrastructure and faculty development.
    - *IDeA-Clinical and Translational Research (IDeA-CTR)* centers support network infrastructure and capacity to conduct clinical and translational research focused on health concerns that affect medically underserved populations and/or that are prevalent in IDeA states. The awards support mentoring and career development activities in clinical and translational research.
- NIGMS hopes to increase synergy and link SEPA and IDeA programs wherever possible. SEPA program will be highlighted at IDeA 2017 Regional conferences, 2018 National IDeA Symposium and Annual INBRE Principal Investigators' meetings.
- Some examples of SEPA-INBRE interactions:
    - Michele Shuster (NM): funded via an INBRE pilot project to get preliminary data for a SEPA that uses bioinformatics as a hook to get mathematics into classrooms (via teacher professional development).
    - Ann Chester (WV): WV HSTA students are also INBRE students. About 70 WV HSTA students, since 2009, have gone on to work on biomedical research projects in WV-INBRE-funded laboratories. Also have teachers who get training from the INBRE and take their experiences back to their schools and students. Have had over 100 INBRE representatives attend HSTA club meetings and have visibility. Also have a HSTA-SEPA liaison, and a person in the office who handles tracking. Some of the HSTA students are also grad students who have come back to engage with students.
- INBRE options to reach high school students: INBREs often do this via their Outreach Cores and at their annual career fairs. While not being a specific item in the FOA, many INBREs use this path.
- SEPA and IDeA program placement: There are 13 SEPA awards in 10 IDeA states. The NIGMS goal will be to have at least one SEPA in every IDeA state.
- There are opportunities for students (AI/AN high school, potentially TCU students) to work in COBRE and INBRE funded labs. There are currently 24 INBREs and 122 COBREs.
- The new INBRE funding opportunity announcement encourages engagement with SEPA, which can help build links between these programs to develop a continuous pipeline of biomedical workforce in IDeA states. Due to this language in the FOA, Hawaii INBRE is now re-engaged in partnering and mentoring students from SEPA (Kelley Withy).
- Additionally, collaborations between SEPAs with IDeA-CTR Community Engagement and Outreach Cores, COBREs and other NIH programs are strongly encouraged.
- An NIGMS initiative, "Innovative Programs to Enhance Research Training (IPERT) (R25)," supports creative educational activities with a primary focus on Courses for Skills Development, Mentoring Activities, and Outreach. For

details see: https://grants.nih.gov/grants/guide/pa-files/PAR-17-070.html. This funding opportunity announcement should be marketed to the SEPA community.

Participants:
Chris Doyle, Montana Tech
Rebecca Fisher, Ochsner Health System
Holly Martinson, University of Alaska Anchorage
Brenton Deboef, University of Rhode Island
Charles Wray, The Jackson Laboratory
Jessica Gluck, Discovery Place Science
Emily Kuehn, Walter Reed Army Institute of Research
Christopher Villa, Helix Solution
Michele Shuster, New Mexico State University
Andrea Panagakis, Salish Kootenai College
Maurice Godfrey, University of Nebraska
Sandra Prytherch, University of Nevada
Marisa Pedulla, Montana Tech
Kelley Withy, University of Hawaii
Sean Freeland, West Virginia University
Ann Chester, West Virginia University
Christopher Sistrunk, City of Hope
Melani Duffrin, University of California
Laura Romo, University of California in Santa Barbara
Jackie Shia, Wheeling Jesuit University
Robin Fuchs-Young, University of Texas A & M

The Evolution of the "How We Role" Evaluation: Lessons Learned From Four Iterations of Learning Assessments

Presenters:
Loran Carleton Parker, PhD, Associate Director, Purdue University
Sandra San Miguel, PhD, Associate Dean for Engagement, Purdue University
Lindley McDavid, PhD, Research Associate, Purdue University
Wilella Burgess, MS, Director of Evaluation and Research Center, Purdue University
Adrianne Fisch, BS, Program Manager, Purdue University

Reporter: Patrice Capers, PhD, Postdoctoral Fellow and Director, University of Alabama at Birmingham

The "This Is How We Role" program is a two year old program with the goal of developing K-4 curriculum for an out-of-school setting for children to generate interest in animal health and science careers through collaboration with community partners. The goal of this session was to show the productive struggles encountered with content assessments and discuss next steps of scaling up the program to distribute to colleges in the fall in the United States. Two limitations to the program are: 1) limited time (one day per week for 45 minutes) and 2) attendance (children not there for consecutive lessons). Another goal of the program is to provide a nurturing atmosphere that promotes positive peer and mentoring relationships. To help facilitate the program, they have a Vet School Ambassador Certificate Program where vet students are asked to serve as role models as well as teach six lessons per semester. The lesson format includes an introduction to content → brain games → ice breaker → lesson content → hands on activity. The goal of this format is to create a nurturing atmosphere to help create a rapport with the students so they can have clear expectations. They have developed 18 lesson plans that cover various topics (e.g., skeletons, small animals (puppy, kitten), large animals, medicine, and careers, etc.) while incorporating math. Assessments have been created to assess the effectiveness of the program. In general, they developed assessments for the program to identify:

1. How the program helps students develop confidence (fidelity of implementation)
2. How the program is meeting the needs of parents and staff
3. Students' perception of the program, attitude about science, and career aspirations

Over the span of the program the timing and structure of assessments have changed based on feedback. It is agreed that good assessments should:

- Align with the goals of the program
- Be tailored to your audience
- Allow you to tell if students clearly achieved the objective and if not, why (formative)
- Be practical (in the sense that kids will do it)
- Provide variation
- Have diversity in measures

- Be aligned with available resources

With these points in mind, prior to creating assessments you need to know who your assessment will inform (stakeholder audience, e.g., project team, NIH, policy-maker) as that may change the topic and type of questions asked in the assessments. The pros and cons of the four approaches to content assessments were then discussed as a group (see table). The value of the progressive struggle helped them develop assessments tailored to their audience. The assessments revealed that the program has a positive impact on the children involved leading to the idea of scaling up the program to include other veterinary schools. These schools were asked to reply to an RFP. Once the schools are included in the program, they will be given all the previously created lesson plans and assessments to distribute to their children. Like the initial program, the participating veterinary schools need to partner with the community and perform the activities outside of school. Schools will be allowed to create their own assessments but they must use the same paper-based assessments that have already been created. They will also have iPads which can be used for sorting (versus physical cards). Every semester they will have different assessments.
In the end, we were reminded to not assume positive and respectful relationships, to embrace limitations and be realistic, to not hesitate to try something new, and to align evaluations with program values.

Evaluations	**Type of Assessment**	**When Administered**	**Pros**	**Cons**	**Experience**
Pre-Post Lesson Assessment	Open Ended Questions 1. What did you learn? Provide an example	After each session	- Hand transcribers - Phrasing of questions - Short length - Open questions aligned with program goals - Helps target assessment	- Hand transcribers - Phrasing of questions - Short length Children must be reigned back in at the end of the lesson	- Gained nothing from the assessment
Research-Led Card Sorting Activities	Card Sorting (matched, sorted, gave open responses, labeled, ordered) in age stratified groups with 1 researcher. There were 11 activities aligned with curriculum,	At the end of the program	- More aligned with program	- Length - Student input varies (dominant students took over) - Children took cards - Not all material addressed in activities were covered	- Noticed a significant change - Attention span was an issue via data and observation (hard to keep them engaged) - Used these assessments

	they recorded final arrangements and conversations.				to revamp lesson plans
Activity Station Assessment	A carnival where children were given passports to collect stamps at various stations. Kept basic activity from card sorting; they just made it more active.	At the end of the program	- Multiple centers - Engaging	- Reading level of children (possible issue with comprehension) - Some activities to complicated - Preconceptions and misconceptions present that made it hard to judge what they gained from the program	- Everybody got through all the stations - Children given the freedom to choose activity order and they completed the activities themselves.
Pre-Post Lesson Assessment	Closed response questions with assistance with reading if needed	After each session	- Structured questions, targeted to lesson	- Not as fun - Length	- Able to assess knowledge gained from the lesson

Participants:

Patrice L Capers, University of Alabama at Birmingham
Sarah Singer, Hezel Associates
Alana Newell, Baylor College of Medicine
Kristin Bass, Rockman Et Al
Sandy San Miguez, Purdue University
Richita Patel, Rockman Et Al
Phyllis Ault, Education Northwest
Michael Lichtenstein, University of Texas Health Science Center of San Antonio
Leslie Schneider, Tufts University
Laura Tenenbaum, Walter Reed Army Institute of Research
Berri Jacque, Tufts University
Karina Meiri, Tufts University
Patrice Saab, University of Miami
Tony Beck, NIH

A Discussion of Science Identity Formation: Methods by Which Persons Find Their Space in STEM

Facilitator: Rob Rockhold, PhD, Deputy Chief Academic Officer, University of Mississippi Medical Center

Presenters:
Namandjé N. Bumpus, PhD, Associate Professor, Johns Hopkins University School of Medicine
Jon Deventer, BS, Director of School Engagement for DE, MD, and VA, Project Lead the Way

Reporter: Christine C. Ziese, New Braunfels Independent School District

STEMI Science Teaching and Science Medical Interest (Rob Rockhold)
"Promoting a professional identity in teachers will advance student persistence in STEM."
If we promote a professional identity to teachers, this will advance student persistence in science. So, teachers are a driver and multiplier of what we are trying to bring to the education process. This program worked with teachers in a series of grant writing; those teachers were encouraged to submit grants. 200 teachers with 159 formal applications were initiated and submitted; 124 were funded.

Cultivating a Positive Scientific Identity Through Building Mentor/Mentee Relationships – Namandjé N. Bumpus

A lot of graduate students did not see themselves advancing in academia because of negative attraction with their mentors. This allowed for designing of programming around trying to teach mentors how to build mentee relationships that would instill a positive scientific identity in trainees, and teaching mentees how to be mentees. They have diversity in their seminar series (have people who look like them); it must be made sure that there is diversity in the courses. The mentor/mentee relationship is a critical place to build. A workshop has been started to show that being a mentor is more than just showing someone how to do an assay in your lab, or ultimately help get a paper published.

Mentor/Mentee Relationship and Identity:

- They need to think of this relationship with the student (high school/grad/postdoc) as a developmental partnership which will provide a reflective space for the mentee (a place where they can decide who they are and want to be), not just a technical interaction.
- Also, to emphasize to the mentor that their job is to build confidence to the mentees, they need to be a source of their own confidence.
- Mentors also can help by providing an impartial view when navigating situations, and clarifying the mentee's perspective (even if they don't "look" like you, or

share the same personal identity, they can still help with this, by showing empathy).
- Building a structural (successful) partnership (based on confidentiality and trust)

Goals of Mentoring in the Context of Scientific Identity:
- Knowledge and skill development
- Nurture creativity (need to let mentee take the lead); if their idea is not feasible, there are ways to discuss and work around that without completely shooting them down.
- Motivate and support
- Advising
- Encouraging the pursuit of academic goals (realizing that no matter what your feelings are of the person's capabilities, your job is to encourage the pursuit of their goals; you can give more reflective criticism about things that will lead to strengthen themselves to get towards that; your job is not really to tell them what they can and cannot do).
- Establish standards for integrity (should be mirroring to them what it is to be a scientist, to be a professional, in the field)

Mentor/Mentee Relationship Phases:
- Building a rapport with them
- Setting expectations
- Direction setting
- Progress/learning
- Maturation (leading the relationship)
- Transition (helping them transition out of the mentee role)

Establishing the Relationship:
For those mentors who don't know how to make the connection, or have such a different background from their mentee, it is suggested that they just share their personal experiences. There is a better relationship after building rapport.
- Expectations of guidance to be offered and participation of the mentee
- Training educational needs
- Frequent/regular contact
- Follow through on commitments
- Caring yet honest feedback
- Build trust (particularly important in underrepresented mentees)

Effective mentors can really end up having mentees that have a positive scientific identity; they are mentors who challenge and motivate but also really inspire and encourage their mentees.
Mentors can encourage identity development:
- Hand on guidance (how and why)
- Challenging probing

- Provide effective feedback
- Modeling behavior

Effective Mentees:

- Take responsibility for your part in the relationship
- Be committed to development
- Be open to different perspectives and ideas
- Be willing to explore opportunities that arise and new experiences.

Individual Development Plan (IDP) (A tool of Identity Development):
(Used to encourage the mentor and mentee to really reflect on what the mentee needs during their developmental stages. See maturation in mentees when they take responsibility early; it helps them develop more responsibility.)

- Tool used to identify approaches to help mentee reach their developmental stages
- Includes activities that help build skills and improve "professional competencies" that improve and strengthen performance
- Helps to prepare the mentee for more leadership and responsibility
- Carried out in collaboration with mentors
    - Discussion of goal and needs for development
    - Mentor and mentee work together to set goals and establish a plan to achieve goals, while gaining feedback. (good to compare what mentor thinks the mentee's goals are vs. what the mentee's goals actually are, and it is good to compare and have that conversation).
- IDP Components
    - Goals to be successful at current stage (become more confident in speaking, improve writing skills, build research tool belt)
    - Personal mission statement (what you want to do, what you would like out of this experience)
    - Short-term career goals
    - Long-term career Goals
    - Areas of interest and knowledge/competencies needed
    - Strengths to leverage (Identify 1 to 2 strengths to build upon; goals, action steps, role of mentors, result/outcomes) (Don't emphasize weaknesses, but strengths that can be made stronger).
    - Areas to develop (Identify 1 to 2 areas to develop that are most important to the mentee to help achieve their goal; same considerations as previous bullet)
- IDP Responsibilities of the Mentee
    - Collect feedback from mentors
    - Make a priority list of strengths (that will be built upon) and areas to develop more (improve on)
    - Make it a daily habit (work on it every day) – high school students should keep a journal and write about how they work on it every day

- Create a dedicated time that is set aside to think about and implement your plan (be disciplined); high school students use the journal to do this.
- Confront barriers you encounter (give skills during workshop on how to do that; engaging mentors)
- Consistently translate the discussion into next steps; acting on the feedback (high school students write in the journal how they are doing that)
- Are able to utilize the assessment tool (to think about how they are developing)

The workshops have helped make mentors really engaged and understand what it means to be a mentor, and to be deliberate. It has also helped the mentee understand what it means to be a mentee, but also the tools help establish those relationships and help the mentee understand what it means to be a scientist, and what can they can do to get there.

Answers to Questions:
Real possibilities to get some actual evaluation assessments of some aspect of identity at the beginning of sessions and after; using the IDP format will show true progression, just some quantitation that could be done easy. There are questions on a survey and questions on identity.
These partnerships are set up in lab environments ("meet and pair" has been tried in the past but it falls apart). Working in the lab for the summer/rotation sets up more continuity and provides an automatic relationship and some investment on both sides. It is easier to engage faculty as mentors in this way.

Q: How do you match up your mentors and mentees so that the interaction is beneficial to all parties?
A: They have the high school students meet with five faculty and they try to match them based on what they know of the faculty, but it is still difficult because of the short interaction. It is suggested for graduate students that they need a team of mentors. The fear is that it could be overwhelming to the high school students, but it seems a better plan.

Q: How do you effectively deal with students who are perhaps otherwise distracted by outside factors such as home life?
A: The response was that sharing personal experiences of the faculty with the students so that they can see "we all" must overcome barriers, and every story is different, but we all have a diversity story. It is really important for trainees to see that too.

Project Lead the Way – Jon Deventer
"Scientia Potentia Est"
Science is using knowledge to empower yourself to others; work in teams, educate others, find the science in everyday activities to activities to broaden your perspective. Scientist try and understand how the world actually works while engineers try to

understand how it could work. In order to create the future, you need to understand science. Finding everyday examples of what a scientist is and does is key to show kids. We should embrace the other sciences and not fear them (for example: computer science, social science). The hard sciences (as well as social sciences) are looking for: 21st century skills, persistence, creative problem-solving skills. By embracing those sciences, we have more opportunities to bring more people into a world where they think about things in a scientific way. They don't have to be scientists, but if they respect science and understand, that is what would make them transition. You don't have to be either a psychologist or an engineer; you can be part of a team where they work together. Curiosity and a sense of "wow (unexpected phenomena), I really understand this" are key to getting students interested in science (example of a penny through a copper tube). If we can take what their natural interests are and highlight the application of life sciences, we can move them along, and we need to be doing that constantly and finding new ways to do it.

What Can We Borrow From Engineering?

- Focus in rigor and challenging math and science courses if you want to be an engineer
- Engineers work in Teams, use creativity, in order to improve the lives of others
- The power of doing (vs. reading, seeing, hearing, etc.)
- Exploration and the design process (labs are still recipes)
- Consumer vs. creator (empowerment)
- Near-peer mentors and personal connection
- There are no "right" answers in engineering
- The old mindset of "weed out" courses in college

The Power of Exploration – "What If?"

Most valuable thing you can do in class is ask questions (to go deeper); "I own what I learn." If you are inquisitive and curious throughout the course of your life, you can quadruple the quality of your life, the amount of knowledge that you have. Encourage students to write two columns: "What I learned/How I learned it." Some of what they learn is from you, some will be from trial and error, some will be from classmates, some they will look at online. They start to realize knowledge comes from everywhere.

Rigor:

Sometimes we make assumptions. Rigor is valuable, not dangerous. Once kids really struggle and then make it to the other side, they have a real sense of accomplishment (we have to scaffold and provide resources). After this is when kids decide they can do this on their own.

Conclusions Drawn From 1,173 Studies on Science Identity:

- Did you have a healthy dose of skepticism?
- Were you searching for insight by looking at the details?
- Did you need proof of evidence to support this claim?

- Were you curious and open-minded about new perspectives?
- Did you utilize what you already knew to discover new insight?

Discussion:
"How does your program promote positive images of scientists or counteract negative stereotypes?"
"What types of evidence are you or have you tried collecting to examine participants' perceptions of scientists or identification with science?"
"What challenges have you encountered as you try to promote positive science perceptions and identities or document those outcomes?"

Q: Are you using a formal document/learning contract, and how does that compare with an IDP?

Jon Deventer: Field trips vs. regular programing (field trips were more popular), but what was interesting what that it was especially true that there is a bigger difference statistics of participants of the females. During field trips, female participants would gravitate towards each other (because during field trips they could hang out with whomever they wanted to hang out). The peers and near-peers would have evening talks (sometimes 2-3 hours long) that created a safe space where graduates, undergraduates, and high school students were able to have real discussions, which was a very powerful thing.

Namandjé N. Bumpus: After giving a talk to the first-year students, they replied that no one ever told them they had to do anything, they thought it was passive and that you sit there and just get mentored, it is something that just "happens" to you. So it is important to establish they have an active role to play too.

Q: What do you mean by positive image of scientists (who are the scientists)?
A: Scientists of all walks of life, all races, females, etc. We want to establish that girls can be scientists too. The goal is to erase the predominate stereotypes in science of underrepresented groups not being able to be scientists. Popular culture also doesn't help (stereotypical characters in games, movies, popular culture, music), so those stereotypes must be combatted before even getting to the science aspect. It is also a stereotype that scientists cannot or do not have a life, especially if they have other commitments (family, spouses, etc.).

Participants:
Jalisa Ferguson, Georgia State University
Theresa Gaines, Georgia State University
Michael Carapezza, Columbia University
Rebecca Smith, University of San Francisco
Christopher Burnett, Baylor College of Medicine
Michael Boyd, Iowa State University

Gwen Stovall, University of Texas of Austin
Amy Spiegel, University of Nebraska
Ashley Roseno, East Carolina University
Farrah Jacquez, University of Cincinnati
Cherilynn Shadding, Washington University
Shona Ramchandani, Science Museum of Minnesota
Jayatri Das, The Franklin Institute
Margery Anderson, Walter Reed Army Institute of Research
Christine C Ziese, New Braunfels Independent School District
Maureen Munn, University of Washington
Charles Wood, Wheeling Jesuit University
Leah Clapman, PBS NewsHour
Douglas Coleman, Duke University
Laurie Jo Wallace, Health Resources in Action
Erin Hardin, University of Tennessee

Connecting Current Research to the Next Generation Science Standards

Presenters: Hilleary Osheroff, PhD, Staff Biologist, Exploratorium
Kristina Yu, PhD, Director, Living Systems, Exploratorium

Reporter: Amy J. Hawkins, PhD, Postdoctoral Fellow, University of Utah

Dr. Osheroff and Dr. Yu from The Exploratorium (https://www.exploratorium.edu) began the session by explaining their institution's practice of running workshops that enable teachers to develop "Teaching Boxes"—annotated collections of resources teachers can use to teach a particular topic. The Exploratorium is in the process of moving from facilitating the creation of analog resources to digital ones, and as part of this current project will select and host new resources at https://www.exploratorium.edu/education/teacher-institute/digital-teaching-boxes, which will allow more teachers access and the ability to assemble their own collection of "Digital Teaching Box" resources. The Exploratorium workshops bring together teachers and research scientists to facilitate teachers' access to current research and resources, and to show teachers that three-dimensional science learning derives from "scientists acting like scientists," in that like lessons prescribed by NGSS, scientists are primarily driven to understand phenomena. In turn, scientists come to understand aspects of NGSS and are better prepared for educational outreach by learning to focus on communicating the practices they use in research, and to show that their research is grounded in phenomena-based experience.

Drs. Osheroff and Yu then led the session in an example of inquiry-based classroom activity developed during one of these workshops. Session participants viewed short microscopic videos of various unlabeled eukaryotes and attempted to articulate their distinguishing characteristics, after which they broke into smaller groups to ask each other of each organism, "What is it? How do we know? Do we think it's a collection of single-celled organisms, or a microscopic view of a part of a larger organism? What are the distinguishing characteristics of fungi, animals, and plants?" The session came back together to review each group's reasoning, eventually locating the various unknown organisms on a "eukaryotic family tree."

Participants:
Chanelle Case-Borden, National Cancer Institute (NIH)
Amy J Hawkins, University of Utah
Anja Scholze, The Tech Museum of Innovation
Sarah Eales, Emory University
Stephanie Messina, Ochsner Clinic Foundation
Juan Lopez-Garcia, University of Puerto Rico – Mayaguez Campus
Rosemary Riggs, University of Texas
Stephanie Tammen, Tufts University

Renee Hesselbach, University of Wisconsin-Milwaukee
Susan Hershberger, Miami University
Wanda Padula, National Science Foundation
Amanda Jones, Seattle Children's Hospital
Margaret Sheben, American Physiological Society
Charlie Geach, American Physiological Society

Friday June 2, 2017: 8:30 AM – 9:45 AM

Tried and True Evaluation Instruments

Facilitators:
Lisa Marriott, PhD, Assistant Professor, Oregon Health & Science University
Kristin Bass, PhD, Senior Researcher, Rockman et al

Reporter:
Lindsay Barone, PhD, Program Evaluator, Cold Spring Harbor Laboratory's DNA Learning Center

Before this year's SciEd meeting, a survey was disseminated to gather information on what people are doing for evaluation. The results of this survey can be found at Tinyurl.com/y84emog7. This session builds off of those results. Because there are so many existing devices for measuring different aspects of STEM development and persistence, Lisa and Kristin emphasized that there was no point in "reinventing the wheel." Instead, they decided to guide session participants through a discussion of what has worked and what has not in an attempt to help people explore options for evaluating their SEPA projects.

Before breaking into small groups, the whole group discussed what they felt would be an ideal outcome for the session. Of all of the ideas put forth, most people seemed to like the idea that there would be a discussion of strategies for linking outcomes (for example, graduation rates, STEM majors, etc.) to assessment results. There was also the goal to explore what kinds of outcomes were really considered important.

Although several measurable items were proposed as breakout groups, most people clustered to just three areas: measuring literacy, measuring self-efficacy, and measuring attitudinal changes. With respect to measuring literacy, the consensus was that it's very hard to measure scientific literacy. It was suggested that literacy should perhaps not be the primary focus of assessment, instead focusing more on attitudes, interest, and other factors associated with persistence in STEM. In the self-efficacy group, a number of tested devices were suggested (SETAKIST, STEBI, TSES). However, it was agreed that in certain populations, self-efficacy is actually very tricky to measure. If the people being assessed really have no idea about something, they may rate themselves very highly at the start and then it will come down at the end (essentially, it's the Dunning-Kruger effect in action). As a result, the best way to assess self-efficacy may be to observe the group rather than having them take a survey. Other people suggested, too, that a retrospective pre-post test may be a solid alternative to a standard pre-post test.

Finally, the group tackled measuring attitude shifts in projects. Overall, the consensus was that they don't really work. One of the problems is that many (most) projects have multiple components, and it's very difficult to tease out which aspect of the intervention

is driving any change in attitude over time. The session then closed with a brief discussion on the best way to balance program evaluation with outcome evaluation. Ultimately, participants concluded that you should never just use one source, and a mixed-methods approach is critical. They also concurred that continuous assessment is key as data helps guide iterative revision of projects.

Participants:
Ruchita Patel, Rockman Et Al
Lindsay Barone, Cold Spring Harbor Lab
Jawed Alam, Ochsner Clinic Foundation
Michael Lichenstein, University of Texas Health Science Center at San Antonio
Maureen Munn, University of Washington
Rob Rockhold, University of Mississippi
Alana Newell, Baylor College of Medicine
Christopher Burnett, Baylor College of Medicine
Bret Hassel, University of Maryland
Patrice Capers, University of Alabama at Birmingham
Gloria Burnett, University of Alaska Anchorage
Christopher Villa, Helix Solutions
Sandra Prytherch, University of Nevada
Dina Drits-Esser, University of Utah
Tiffany Nuessie, Denver Museum of Nature and Science
Liz McMillan, Sanford Research
Loran Parker, Purdue University
Laura Tenenbaum, Walter Reed Army Institute of Research
Sarah Singer, Hezel Associates
Gwen Stovall, University of Texas of Austin
Elizabeth Genne-Bacon, Tufts University
Phyllis Ault, Education Northwest
Ashley Roseno, East Carolina University
Julie Cary, Boys and Girls Clubs of the Coastal Plain
Melani Duffrin, East Carolina University
Lisa Marriott, Oregon Health & Science University

Personal Data Trackers in STEM Education

Presenters:
Carla Romney, DSc, Principal Investigator, Boston University and Fordham University
Donald DeRosa, EdD, Principal Investigator, Boston University
Carl Franzblau, PhD, Principal Investigator, Boston University
Kelly Nguyen, BS, CityLab Education Coordinator, Boston University
John Craven, PhD, Co-Investigator, Fordham University

Reporter: Amy Hawkins, PhD, Postdoctoral Fellow, University of Utah

The research and development team comprised of faculty and staff from CityLab, Boston University, and Fordham University described their experience with the first year of their innovative project: engaging an under-served student population with a STEM education project that centers around the students' collecting their own physiological data with personal fitness trackers. By teaming up with the Boston chapter of the national organization Urban Squash (http://www.nationalurbansquash.org), researchers have the opportunity to work with a pre-existing, comprehensive youth development program that combines the sport of squash with mentoring, community service, and college placement for students from under-served urban communities.

Members of the research team discussed their motivations to design the study, including their own experiences with fitness trackers, and then delineated the criteria they used to select which fitness tracker was distributed to their student-athlete participants: the kinds of data collected by the fitness tracker, access and ownership to the generated data, data analysis performed by the software accompanying the device, and security of the students' personal information. During the pilot year of the study, squash coaches and researchers jointly recruited high school student volunteers, and researchers distributed pins to the participants that said "NIH researcher" to emphasize their willingness to play an active role in a kind of citizen science. Dr. Franzblau expressed another viewpoint, paraphrased:

"We're not recruiting science volunteers, we're getting a group of kids who already like to play squash. It's our job to create a science experience without them knowing. We frame it as, 'Would you like to be better squash players?' These kids have already been indoctrinated into playing squash, they know that squash is going to get them into college."

The students collected their own heart-rate data via fitness trackers worn on the wrist during their squash workouts. Researchers asked students to predict their cardiac efforts during their workouts, showing that most students initially overestimated their efforts, but wearing the trackers over time correlated with students becoming more aware of their cardiac effort during their workouts. For the second half of the pilot study, researchers asked students to generate their own research questions (a practice

strongly encouraged by NGSS) involving their own heart-rate data. Students' questions showed that they were thinking critically and exhibiting healthy skepticism; for example, they wondered if they were tracking their own heart rate accurately, and tried to design ways to test that question.

The research and development team then facilitated a discussion with session attendees, exploring best practices and personal or research experiences with fitness trackers. One attendee asked if anyone had tried to measure if wearing a personal data tracker enhanced students' data literacy and numeracy skills; others shared their experience in running a 4-5 month research trial using fitness trackers as a health intervention. In this study design, researchers didn't analyze the data generated from the participants' fitness trackers; instead they examined participants' biometric measures (cholesterol levels, A_1C, body mass, height, weight, etc.) at the beginning and end of the trial, asking participants to choose their own fitness goals and use the trackers in ways that were most useful to them. As part of the study design, participants shared these goals and other struggles and achievements with each other on private social media platforms, providing each other with encouragement and social support. The investigator describing the study said [paraphrased], "The real power of that study was the sharing between other people. It showed that social media can be really solidifying, even in rural communities."

Dr. Franzblau concluded the session by saying, "The next generation of what you put on your wrist or on your chest or paste on is going to be really phenomenal. And it's definitely going to affect the dimensions of learning."

Participants:
Carla Romney, Boston University
John Craven, Fordham University
Don DeRosa, Boston University
Carl Franzblau, Boston University
Amy J. Hawkins, University of Utah
Kristina Yu, Exploratorium
James Cotner, University of Minnesota
Debra Yourick, Walter Reed Army Institute of Research
Ann Chester, West Virginia University
Sean Freeland, West Virginia University
Michael Wyss, University of Alabama Birmingham
Michelle Ventura, Georgia State University
Renee Bayer, Michigan State University
Louisa Stark, University of Utah
Wanda Padula, National Science Foundation

Have a BLAST with DNA Subway's Blue Line

Presenters:
Bruce Nash, PhD, Assistant Director for Science, DNA Learning Center, Cold Spring Harbor Laboratory
Sharon Pepenella, PhD, Educator, DNA Learning Center, Cold Spring Harbor Laboratory

Reporter: Alonzo Fields, Science Museum of Minnesota

Introduction
- Work in a learning center with labs and meet often with different scientists
- Work with DNA Barcoding
    - Use variation in DNA sequence to identify species
    - Based on microbial identification with ribosomal RNA sequence
    - Can help measure biodiversity and figure out relationships between organisms

Why It's Useful
- Can identify cryptic species
    - Example: Skipper Butterfly – discovered in the 1700s and studied since, as their caterpillars eat many plants
    - DNA barcoding identified 12 species, with caterpillars of each consuming one species
- Can track changes in biodiversity and identify endangered species
- Can guide conservation efforts by measuring biodiversity of the millions of species on Earth

How It Works
1. First find out what you want to study, determine if it's a big or small project
2. Collect and document organism(s)
3. Isolate DNA from tissue
4. Amplify variable barcode regions and confirm by gel electrophoresis
5. Determine DNA sequence
6. Compare to other DNA sequences to identify/classify species

Develop Method
- We tested multiple DNA extraction methods to develop the most affordable, robust method possible
- We developed bioinformatic tools to make analysis more approachable (Blue Line of *DNA Subway*)

Why We Think It's Great
- Students get research experience and cover a lot of areas in biology
- Combines wet lab and bioinformatics, engaging students in bioinformatics

- Students like doing it and get excited about science
- Engages students in authentic research, leading to learning and engagement
- Students become connected to doing science and careers in science
- Scalable: class, local, regional, or worldwide efforts are all possible
    - Example: Barcode Long Island (Funded by NIH SEPA)
- Students learn about biological diversity and their environment

Evaluation

- Students are enjoying science course
- Materials are more relevant to students than other learning experiences, leading them to feel good about themselves and future careers in biology
- Metabarcoding (microbe analysis) introduces computer science and data analysis while doing authentic research: hard but very rewarding to participants

DNA Subway

- Part of NSF's CyVerse
- Complex analysis with five bioinformatic "Lines"
- Helps us to decode DNA within or between species
- Blue line works to:
    - Do quality control on DNA sequence
    - Find related sequences
    - Compare sequences with alignments and trees
        - Mitochondria control region (within-species comparisons)
        - Barcoding (between-species comparisons)
        - Any other sequences
- Red line works to:
    - Naked sequences (for example, a new genome)
    - Identify and annotate genes
        - Where are genes, what is their structure, and what do they encode?
        - Where are repeats?
    - Students can contribute to genome annotation while learning the structure of genes and genomes
- Yellow line works to:
    - Find gene families (linked to Red line to search for gene families after defining a gene)
- Green line works with
    - RNA sequences from high throughput sequencing
- Purple line (in development) works with
    - Microbiomes
    - eDNA
    - Other "metabarcode regions"

Demonstration:
Ran through sequence analysis in the Blue Line, including viewing trace files, trimming low quality sequence, combining sequence reads to create a consensus, identification of related sequences using Basic Local Alignment Search Tool (BLAST), sequence alignments, and phylogenetic trees. Showed DNA Barcoding 101, a website to support DNA barcoding projects. Discussed submission of sequences to DNA Barcoding 101 sample database and publication to Genbank.

Participants:
Kelley Withy, University of Hawaii
Rachel Smilow, Children's National Health System
Jackie Shia, Challenger Learning Center
Chuck Wood, Wheeling Jesuit University
Anja Scholze, Tech Museum of Innovation
Mandana Sassanfar, Massachusetts Institute of Technology
Robert Sege, Health Resources in Action
Marisa Bowers, City of Hope
Christopher Sistrunk, City of Hope
Stephanie Dumont, Brunswick High School
Alonzo Fields, Science Museum of Minnesota
Lorna Gitari-Mugambi, Georgia State University
Jalisa Ferguson, Georgia State University
Idit Adler, Michigan State University

Game-Based Learning 101: Introduction to Game Design, Formal Systems, and Rules

Presenter: Ashlyn Sparrow, MA, Entertainment Technology, University of Chicago
Reporter: Kayla Pritchard, University of Georgia

Game Changer Chicago (GCC) Design Lab

Game Changer Chicago (GCC) Design Lab, part of the Center for Interdisciplinary Inquiry and Innovation in Sexual and Reproductive Health (Ci3) at the University of Chicago, focuses on giving youth agency over their bodies and future. The GCC works on building games and projects that seek to increase youth involvement in and understanding of social and health issues. Currently they have three games focused on this goal. Bystander is a computer-based game aimed at high school students to help prevent sexual assault. The game mechanics model appropriate behavior when interacting with someone who has been sexually assaulted, including discouraging victim blaming. The Test is a mobile game created for young homosexual men to increase testing behaviors. Players pick their character then take on the phone of that person. From this perspective, they have conversations with players and play mobile games that map the social behaviors they face in everyday life. The design lab also has a large-scale narrative alternate reality game. In this game, a young female actor plays a daughter whose father went missing and left clues for her to find him. Players help her decode the messages and clues to ultimately find her father.

While games have been a useful tool in engaging youth in their social and physical health, the GCC currently has a SEPA project that engages high school students in the process of game design. Hexacago Health Academy is a three-week summer program that teaches students game design. In the program, the students work in teams of peers, public health professionals, doctors, lawyers, and other professionals to design a game focused on sexual/reproductive health or alcohol and drugs.

Why Games

Games are overwhelmingly popular in the U.S. For youth between the ages of 12 and 17, 97% play video games. Game spaces innately allow for students' agency. Students get to make choices and experience the consequences of those choices. They also allow for trial and error, which can provide great scaffolding opportunities, and when players do fail, they are able to try again, thereby relieving the pressure of failing. Games are also a great medium to present systems, making abstract concepts concrete for players. Game mechanics have meanings through the environments, characters, and situations presented. This meaning makes games a conduit for social change, as they can support social and cultural positions as well as disrupt common social positions and cultural limitations. In this way, games can provide an opportunity to represent marginalized groups in social positions they don't often feel they can associate with.

Why Game Design

Great game designers are great teachers. They must consider player difficulty so the game environment produces productive struggle. Additionally, they must consider who the player is, what they are capable of in terms of motor and cognitive skills, and their enjoyment of the experience. As a designer's background and culture affect the way they design their game, there is an opportunity for designers to become aware of their own cultural identities and ideals and choose to support or disrupt them in their iteration of design.

Participants:

Yukari Okamoto, University of California Santa Barbara
Anne Westbrook, Biological Sciences Curriculum Study
Claudeen Denning, Rose Park Magnet School
William Folk, University of Missouri
Tony Ward, University of Montana
Barbara Baumstark, Georgia State University
Theresa Gaines, Georgia State University
Kayla Pritchard, University of Georgia
Patricia Whitehouse, Chicago Public Schools
Revati Masilamani, Tufts University

Stories From the Field: Institutional Challenges in IHE-ISE Partnerships

Facilitators:
Judy Brown, EdD, SVP Education, Phillip & Patricia Frost Museum of Science
Robert Russell, PhD, Program Officer, Division on Research & Learning, National Science Foundation

Reporter: Anne Holland, Space Science Institute/Discover Health

Session Description/Purpose/Format

This session was attended by a wide variety of professionals across the IHE-ISE spectrum. There was a good mix of professional informal educators and health professionals who are fairly new to this arena.

Dr. Russell and Dr. Brown started the session with descriptions of these two different arenas and shared brief examples of the struggles these institutions may face in partnering with other organizations. Institutions of higher learning (IHE) often have bureaucratic hurdles to even the simplest or most beneficial partnerships that must have buy-in from the highest levels. Informal science education (ISE) organizations (such as museums, educational non-profits, or even after-school providers) often have a harder time funding pre-award activities, which can limit partnership opportunities, and do not have the same resources as IHE organizations.

The presenters stressed that the main differences that may lead to strife in IHE-ISE partnerships are:

- Slightly different definitions of problems and goals
- Different set of skills or activities that each institution excels at
- Different institutional priorities as well as individual interests

Session Discussion:
Session participants shared examples of their challenges with partnerships. Examples included:

- Grants and contracts are complicated with partners!
- Preconceived notions about what an organization does (from a children's museum)
- Agreements can move slowly through business offices
- Overhead rates can limit participation, or limit who can partner on programs
- There are practical issues that may be viewed differently between organizations (what requires an IRB, how IRB is obtained, how changes are made)
- Museum environments are very chaotic and not necessarily conducive to set meeting schedules that partnerships may require
- IRBs can collide across federal agencies, not even just organizations (SEPA vs NSF vs NASA)

- There are issues with schools wanting to “let go” of student data, which limits participation
- Partnerships can often be seen as diversions, or “off mission,” and can be disallowed from the highest levels of organization
- Museums and other ISEs don’t often publish in peer reviewed journals which makes them “lesser partners” from an IHE perspective
    - Museum professionals don’t often have the credentials to publish (or they feel they don’t)
    - Are non-peer reviewed journals an acceptable substitute? (Such as Informal Learning Review or CAISE?)
    - It’s hard to turn project participants into research participants. You don’t always know what permissions you should have gathered, or what “simple” museum program will end up being worthy of a paper!

Session participants broke into small groups and answered the prompt: “Drawing on your knowledge of existing ISE-IHE collaborations, what would be the critical success factors (what must be included, what can’t be missing) in order to have a successful collaboration?” Selected answers are below:

- Getting to know the partner, who you will be working with, who is your contact?
- Don’t just partner with your “friends” at an organization. Find the best project match, not the best personality match.
- Embrace the creativity of partners. They may bring a fresh idea or innovation to your long existing programs. This is good!
- Your partner may help you cultivate a shared interest that you weren’t sure how to move forward with.
- You need to move beyond an “on paper” partnership to an “interactive” partnership. Rather than “parallel play,” you need to actually work together.
- Spending the time to develop a shared language is key. Oftentimes people work together for months (even longer!) before realizing they weren’t talking about the same thing. Invest in prepping for the work.

Participants:
Emily Kuehn, Walter Reed Army Institute of Research
Anne Holland, Space Science Institute
Bette Schmit, Science Museum of Minnesota
Jennifer Hellier, University of Colorado
Jessica Gluck, Discovery Place of Science
Patrice Saab, University of Miami
Katherine Bruna, Iowa State University

Best Practices in Professional Development: What SEPA Grantees Have Learned From K-12 Teachers and Students

Presenters:
Georgia Hodges, PhD, Assistant Research Scientist and MAT Coordinator, University of Georgia
Marissa Pedulla, PhD, Professor, Montana Tech
Barbara Hug, PhD, Clinical Associate Professor, University of Illinois
Karina Meiri, PhD, Professor, Tufts University School of Medicine
Charles Wray, PhD, Director, The Jackson Laboratory
Mary Jo Koroly, PhD, Research Associate Professor, University of Florida

Reporter: Christine C. Ziese, New Braunfels Independent School District

Georgia Hodges, PhD, Assistant Research Scientist and MAT Coordinator, University of Georgia

The SYSTEMS project

- Finishing year 3
- Elementary grades 3-5
- Addresses the human body system
- Integrates nutritional literacies

SYSTEMS Project has designed a game, with teachers in the middle at every single point (in the visual aide). The game is still in the design phase (not yet in the testing phase). The PD being discussed is what do we do with teachers while we are building something and testing something and using it to develop the game. It is a little different because teachers are being worked with every few months.

Kids start by building their avatar. Students collect data and then analyze and interpret the data. There is a component piece of math literacy: The common core strategies taught by teachers.

<u>5 Things I Wish Someone Had Told Me About PD:</u>

Helpful hints to planning productive, scalable professional development (Professional Learning):

1. Start now if you are in year 1 (if you want to scale); make connections with administrators and teachers BEFORE you need something from them.
2. Innovate within the context regarding curriculum, school vision, and resources.
3. Recognize the strengths of elementary teachers regarding pedagogical content knowledge: they know how to teach! (Realize that most elementary teachers have taken one “easy” science class for their degree and keep that in mind, but realize they have true pedagogical strengths and can teach if you give them the tools they need. These skills tend to be more present in elementary school teachers than in high school teachers.)
4. Understand content limitations of many elementary teachers in science.
5. When possible, go to the teachers’ school for PL so you understand the context.

BRIC: Bringing Research Into the Classroom – Marissa Pedulla

Educational Research Questions:

- Do university scientists providing three-day, in-classroom, research experiences change student and teacher knowledge as well as dispositions towards science?
- Do intensive teacher-training workshops cause impacts greater than those measured in classroom-visits-only groups?

The Rollout Plan:

- 30 Teachers (Grades 6-12)
- All 30 will get classroom visits for four years (to reach thousands of students)
- 15 Cohort 1 teachers will attend workshops in 2015 and 2016
- 15 Cohort 2 teachers will attend workshops in 2017 and 2018
- All 30 will attend wrap-up workshop in 2019 and disseminate project

So far: First cohort has gone through two summer trainings; part of their professional development was that they were able to develop a research question, plan an experimental design, conduct the study, and write it all up.

Reality:

- There was some attrition. We started with 30 and are currently at 22; reasons included technology phobia, health, family/personal issues, graduate school, laid off, retiring, changing jobs to elementary level.
- Consideration of the teacher's comfort became paramount (level of science/content, time to absorb content, food, lodging).

Recommendations by Participants:

- Better lab facilities and better food
- More background information and resources, pre-readings prior to the academy
- Start with hands-on, lab research earlier during the academy; provide more guided instruction for lab time
- Include more repetition and practice of lab-work such as DNA sequencing, and using pipettes
- Allow more time for teachers to collaborate in job-alike groups
- Limit what tests teachers could do in order to make the workshop more focused
- Add opportunities for reflection time between small group work

Lessons Learned:

- Wide range of teacher backgrounds and comfort levels with science content, technology, and research process
- Challenges with research question development and experimental design
- Extra time was needed for developing testable questions, research plan, and writing research report.

- Being flexible to accommodate busy teacher school schedules was critical (most needed one more semester more than expected).
- Progress occurred in stages with more mentoring and time than expected needed at each step of the process.
- With perseverance, projects and reports were completed.

Cohort 2 Adapted Plan:
Academy:
- *More and better food is planned*
- *More time in university lab rather than off-site lab*
- *More time for daily feedback and reflection*

Online graduate course:
- *More emphasis on project development, testable research questions, and earlier literature review is planned.*

Project NEURON and PAGES – Barbara Hug
Project NEURON
- Ended in 2014
- Focused on high school biology
- Curriculum and PD project linking NSES and UIUC basic science research focused on neuroscience.

PAGES
- Started 2016
- K-12
- Curriculum development and professional development project linking NGSS and UIUC basic science research focused on evolution, climate change, and societal well being.

Professional Development for Neuron
- 2 Week summer institute
- PD during the year

What actually happened:
- Initially did the 2-week summer institute, started locally, and eventually became national for teachers
- Became a 2-3 week modular institute: teachers could come for 1-2 units
    - Partnered with other projects on campus and different institutes (i.e. Genomics for Teachers)

Professional Development for PAGES:
- Proposed
    - Year 1: Two-week summer institute focused on learning about NGSS and unit development
    - Year 2: Continued unit development and unit specific workshops
    - Continued professional development during the school year

- What happened:
    - It is still a little too early to say
    - Currently working to complete multiple units (one week returning teachers); paired elementary with high school teachers to learn from each other, and it worked
        - Not all units continued: some shifted radically
    - Units have changed as development continued based on unit development, team, and teacher needs.

Lessons Learned:

- Collaboration takes time, patience, and flexibility (and is often painful)
    - Different people, different goals, and different views
- Need to connect PD to what is needed in the classroom
    - NEURON: broadly set a definition of neuroscience to include connections to NGSS and local standards
    - PAGES: targeting NGSS in ways to align to both the NGSS and local /district/teacher/school
        - Go beyond the content and address shifts in instruction
    - Need to be flexible planning PD
        - Negotiate based on program and teacher needs (time)
    - Need to be flexible in unit development and implementation (be flexible and patient)
        - Growth over time
        - Address any and all concerns around data collection
    - Importance of being explicit with expectations (teachers are busy and have restrictions, so teachers need to fully understand exactly what you need)

Questions:

Q: Do you think that sometimes you need to say no to a teacher because of constraints?

A: You do need to say no, and ask what are your goals for this project and what are the goals of my beliefs as the teacher/educator. Teachers don't like giving pre-tests. Bigger issue is in the post-test: it is too long; it doesn't align with district test. Being able to collect the types of data or being flexible in how you collect data is important. If we can't make connections to what teachers need or what they are told they need, there is no hope for sustainability.

The Great Diseases Bringing Biomedical Science to High School Classrooms – Karina Meiri

- *Curriculum development:* yearlong modular high school Biology II curriculum, aligned to NGSS and focused on biomedical science
- *Curriculum implementation:* used by over 100,000 students and over 1,500 teachers

- *Teacher training development:* includes in-service workshops (CEUs) and formal pre-service training in-person and online

Things We Learned From Teachers and Students:

Curriculum Development:

- Trust-based partnerships with distributed leadership are necessary.
- Social network analysis indicates that the quality of the interaction is more crucial than the absolute frequencies.

Curriculum Implementation:

- Students really engage with real life topics; multiple approaches keep students on their toes.
- Classroom observations and teacher interviews show teachers struggling with certain approaches (like authentic inquiry).
- Stand-alone, student-centered curriculum materials can circumvent these problems in some circumstances.

Teacher Training:

- We never underestimate how little teachers have been exposed to cutting edge bioscience.
- We received the best results when content-focused PD was directly linked to pedagogical modeling (teach with their standards as much as possible).
- Best results are also obtained when teachers could contact an assigned mentor for real-time interactions during implementation.

***Teaching the Genome Generation* –** Charles Wray

Program Goals:

- Offer teacher PD in genomics, bioinformatics, and bioethics in CA, CT, ME
- Provide extensive support, laboratory equipment, reagents, consumable supplies, and lesson plans in bioethics to all teachers trained in the PD
- Make genomics accessible and energize students and teachers by linking program content to personalized medicine and health, ethical decision making, and everyday life

PD overview:

What we learned in the pilot phase was that we asked teachers to bring a lesson plan where they teach genetics, and then they work in small groups to talk about adapting their lesson plans. We also bring alumni back to find out what happened once they had this rolling in their classrooms. Equipment is shipped out to these schools and becomes implemented. It is flexible to grade-plan. We try to adapt the lessons to target various levels and learners.

Bioinformatics Exercises

- NCBI gene and genome resources
- DNA sequencing analysis

Molecular Laboratory Exercises

- DNA extractions

- Standard PCR
- Restriction digests
- DNA sequencing.

Bioethics (pgED collaboration)

- Informed consent
- Ethics and reproductive biology
- Ethics and athletics
- Genetics, behavior and criminal activity

Lesson Plan Development

- TtGG teacher alumni who have implemented
- Implementation assistance

This project pre-tests and post-tests the teachers using the college level genetics literacy assessment tool that is out there. It has been found that the teachers' content knowledge is solid.

<u>School and Classroom Implementations</u>

- 132 classrooms implemented
- 2458 students
- All biology levels from grades 9-12 electives

What teachers really need is confidence to execute the lab work. There are near-peer mentors, back and forth, and hand-holding that is useful (telephone and other communications). What we learned is that having things fail in the lab is actually a great learning experience.

<u>Lessons Learned:</u>

- Teachers have content knowledge but can lack confidence with lab demonstrations.
- Failure and troubleshooting is extremely valuable as learning activity.
- Integration of genetics/genomics across biology curricula is highly desirable.
- Student engagement is highly correlated to content implementation.

Responses to Questions (after presentations):

- Teachers feel better having an example in front of them.
- Providing videos over lessons, with actual content, and then one on the pedagogical lesson (including learning objectives, misconceptions) was helpful to the teacher for preparation.
- There are some teachers who go to workshops just to go but never implement the information in their classes.
- There are issues with getting teachers to read the detailed lesson plans made available but not necessarily covered during training.

- For the Maine Lab, they hired a sabbatical teacher to run the experiments and time them, so there was an accurate account of how long the labs would realistically take.
- Vertical Integration is key.

Teacher Comments:

- Some things that were understood during all presentations was that flexibility is something you are applying to your programs and teacher support, in multiple ways.
- Teachers don't always read the supporting materials; however, knowing that they are there is a very important concept.
- Teachers need to be engaged, they need to be listened to, they need to feel as if they are part of the program development – this is so critical.
- What we have learned in our program, by pairing up the elementary with the secondary, is that the secondary are great at content but not pedagogy, and elementary is great at pedagogy. Bringing those two together is a powerful thing, especially for the elementary teachers.
- The lessons learned that you have shared are incredibly important.
- Teachers need that connection to other adults and professionals (remember that teachers tend to be isolated, and rarely see another adults during the school day).

Participants:

Kelly LaRue, The Jackson Laboratory
Erin Hardin, University of Tennessee
Melinda Gibbons, University of Tennessee
Madison Spier, University of Texas A & M
Tania Jarosewich, Censeo Group Inc.
Leslie Schneider, Tufts University
Chris Doyle, Montana Tech
Michael Boyd, Iowa State University
Michael Carapezza, Columbia University
Rosemary Riggs, University of Texas
Christine C Ziese, New Braunfels Independent School District
Laurie Jo Wallace, Health Resources in Action
Juan Lopez-Garcia, University of Puerto Rico
Krista Glazewski, Indiana University
Sarah Eales, Emory University
Margaret Stieben, American Physiological Society
Christopher Pierret, Mayo Clinic
Rebecca Fisher, Ochsner Health System
Susan Hershberger, Miami University
Lori Elmore-Staton, Mississippi State University
Holly Martinson, University of Alaska Anchorage

Denise Ekberg, University of Texas at Austin
Diane Munzenmaeir, University of Milwaukee
David Petering, University of Wisconsin
Jennifer Ufnar, Vanderbilt University
Julie Parker, Michigan State University
Charles Wray, The Jackson Laboratory
Barbara Hug, University of Illinois
Georgia Hodges, University of Georgia
Marisa Pedulla, Montana Tech
Berri Jacque, Tufts University
Karina Meiri, Tufts University

Diabetes, Obesity, and Cardiovascular Disease (DOC) Working Group

Facilitators:
Melani W. Duffrin, PhD, Professor, East Carolina University
Ann Chester, PhD, Assistant Vice President, West Virginia University

Reporter: Patrice Capers, PhD, Postdoctoral Fellow and Director, University of Alabama at Birmingham

This working group was created for people to share ideas since they all had similar projects. Most of the projects were focused on behavioral outcomes. The goal of this group was to help foster collaborations and write collaborative grants. The goal of the session was to provide an update on science tools developed with DOC input, discuss tools used by the West Virginia SEPA program, and to have a group discussion to create a new DOC agenda. Four years ago, they created Science Attitudes Survey, and they shared the final product of the survey. We then discussed our individual programs to determine possible collaborations.
Our individual programs include:

- East Carolina University
    - FoodMASTER initiative has a series of hands-on and virtual programs that teach math and science using foods for various grade levels.
    - Family and Consumer Science programs
    - Food Science can count as a science credit in some states
- University of Alabama at Birmingham
    - Big data program has students extract data from published articles (focusing on obesity studies performed on C57BL6 mice) and input data into an electronic database. Classrooms then use this database to generate hypotheses and examine data reliability.
- PBS NewsHour
    - Broadcast on Type 1 and Type 2 diabetes; students reporting labs – factual journalism, doctors in the kitchen
- Michigan State University
    - Genomics education focuses on community, students, and family
    - Discuss health careers and type 2 diabetes in 6th grade in Flint and Detroit schools.
    - Students conduct inquiry projects examining gene and environment interaction (ex: weighing trash at school cafeteria). They have district wide presentations.
- Bio Bus – Georgia State University
    - Target K-12 to teach science; teach DNA as a language; and they have a health module
- Texas A&M University
    - Basic research in obesity, hyperglycemia, and breast cancer susceptibility

    - SEPA program geared at students, teachers, and families at the Texas-Mexico border. They partner high achieving magnet schools with not-so-high achieving school to share resources. They train students to be health ambassadors for their own communities.
- University of Miami
    - RCT virtual world for middle school girls focused on obesity
    - Summer science enrichment programs
    - Nutrition and physical activities focused on knowledge, efficiency, and behaviors
    - Food truck with feedback on quantity and quality
    - Kiosk to grade your plate
    - Pedometer program
- West Virginia University
    - Underserved backgrounds do not go to science unless it is relevant, thus they aim to use self as the subject
    - 46% overweight or obese in food desert
    - Goal is to increase education (not measuring health impact)
    - HSTA kids' biometric measures where my 1st patient experiment (using self as the experiment) but it was hard to keep patient aligned
    - Started 10th grade Facebook group where they talk about wellness goals that they set for themselves and they share their experiences.
        - These groups are given guidelines about what is acceptable language in the Facebook group and in the group monitored by program staff.
        - They noticed that people in the group were providing others with encouragement and praise for completing various tasks.
        - Teachers were also allowed to participate and share their stories

After introducing ourselves and our programs, we shared common concerns and best practices. Some common concerns included food deserts, unsafe recreational centers, and curricula to assist with yearlong training, among others. Two best practices mentioned to engage the community were community science nights and top healthy chef competitions. When conducting programs with children, it was mentioned that the ability to unlock incentives because of active participation in the program as it progresses provides effective motivation. Children like competition.

We then discussed considering opportunities to incorporate SEPA program into other models by:

- Possibly having more research presentations at SEPA conference
- Participating in the Deep South Network
- Look for opportunities for support based on the needs mentioned in the Keynote Addresses from the NIH directors.
- Examining the impact of dietary exposures as it changes epigenetics regulation with focus on genetic literacy and early on care

- Examining programs geared at youth empowerment (e.g., Virtual Sprouts, school gardens, SPAN food frequency) or math curriculum (e.g., Mathematics and You, RMR, calories, BMI).

Overall, we discussed the need for community involvement and assessment of behaviors and attitudes as a part of motivation and accountability. A need for previously developed curricula in one central location and near-peer mentorship was also mentioned to help spark collaborations on existing and future projects and grants.

Participants:
Ann Chester, West Virginia University
Sean Freeland, West Virginia University
Melani Duffrin, East Carolina University
Patrice L Capers, University of Alabama at Birmingham
Lorna Gitari-Mugambi, Georgia State University
Maureen Munn, University of Washington
Julie Cary, Boys & Girls Club of the Coastal Plain
Ashley Roseno, East Carolina University
Patti Parson, PBS NewsHour
Robin Fuchs-Young, University of Texas A & M
Patrice Saab, University of Miami

Monitoring the Alignment of Program Objectives to Instruments: How to Be an Evaluation Auto Mechanic

Presenters:
Kristin Bass, PhD, Senior Researcher, Rockman et at
Dina Drits-Esser, PhD, Senior Research Associate, University of Utah

Reporter: Kristin Bass, PhD, Senior Researcher, Rockman et at

The session's objectives were for participants to learn: (a) why alignment of outcomes and measures is an important, ongoing evaluation practice; and (b) how to address cases of under- or over-alignment. The presenters were the internal and external evaluators for the Genetic Science Learning Center's NSF-funded project, *Evolution: DNA and the Unity of Life*, a 5-module, 8-week curriculum unit for high school biology courses.

Alignment should be a part of your ongoing evaluation practice. Periodic review of your program objectives and related instruments ensures that you're measuring what really matters.

Presenters introduced a three-step process for determining alignment:

1. Identify hypothesis and data
2. Compare program objectives to assessment
3. Analyze results and take action

They also provided worksheets for documenting each step.

Step 1: Identify your hypothesis.
Before you even start looking at your program and its evaluation, it's important to remind yourself of the big picture. You expect that your intervention will have an effect on a specific set of outcomes or objectives. These objectives guide your intervention and your assessment. A typical hypothesis for evaluating an intervention will use some form of an if/then statement: if we do this project with these particular components or underlying philosophies, then we will accomplish a specified set of outcomes.

Step 2: Compare program objectives to assessment.
Presenters explained that in their project, separate teams developed the curriculum and assessment from a shared set of objectives. On other projects, the same team may be developing all of the materials. In either case, it's possible for teams to drift from their original objectives, and that's why it's important to check alignment.

The presenters demonstrated their comparison process, and provided the audience with a paper copy of the spreadsheet they used (Table 1). They started by gathering all of the curriculum learning objectives, some of which related to the overall module, and others which were specific to individual lessons or activities. Next, they reviewed the

assessment items. In some cases, an objective could have more than one item, or an item could address more than one objective. They each rated twenty-five percent of the other's items to check reliability.

Table 1. Sample Alignment Chart

Objective Number	Objective	Item	Rater
NS.A.1	If an individual has an advantageous trait, then it is more likely to reproduce.	EN21-3	KB
NS.A.1	If an individual has an advantageous trait, then it is more likely to reproduce.	EN22-3	KB
NS.A.5	Natural selection requires variability, heritability, and reproductive advantage.	EN22-3	KB

There's more to alignment than just matching objectives. Items can be over-aligned when they assess the exact same phenomena that's covered in the intervention. This is an issue that reviewers consider when evaluating curriculum for inclusion in the What Works Clearinghouse. Items can also be under-aligned if they address the content of the objective but not the exact point that's covered in the curriculum. For example, in one case, an item asked students to evaluate a source of evidence for common ancestry that was barely touched upon in the materials. Finally, some learning objectives may be higher priorities for assessment than others.

Step 3. Analyze results and take action.

In their report, evaluators created tables for alignment with specific objectives, identified cases of objectives without items, and vice-versa. They suggested asking the following questions:

Alignment Analysis

(1) How many assessment items do you have for each objective? We generally advise having at least three items for each specific objective.
(2) Which objectives have no items?
(3) Which items have no related objectives?
(4) Are there any cases where items appear to be over- or under-aligned with the objectives?
(5) {If applicable} How closely do multiple raters agree on the alignment? For instance, compare the number of items per objective.

You can use your findings to negotiate across curriculum and assessment teams to make meaningful changes to enable successful measurement of objectives. The evaluators shared their report with the curriculum team and assessment teams. The curriculum team identified some objectives that no longer matched the curriculum, and

which needed to be modified. The evaluators also requested additional assessment items to fill the gaps in coverage. The following questions can help you take action:

Alignment Action Steps

(1) How can you resolve discrepancies between your objectives and your items? Consider:
   - Adding, eliminating, or modifying items
   - Adding, eliminating, or modifying objectives

(2) Are there other members of your project team who should be made aware of the alignment results, or otherwise be involved in this process?

In conclusion, monitoring alignment takes time and staff resources, but is critical for ensuring evaluation quality. Consider it a formative evaluation of the evaluation itself!

Participants:
Leslie Schneider, Tufts University
Rosemary Riggs, University of Texas
Christopher Villa, Helix Solutions
Lori Elmore-Staton, Mississippi State University
Julie Parker, Mississippi State University
Gloria Burnett, University of Alaska Anchorage
Alison Lin, National Institute of Health – NCI
Charles Wray, The Jackson Laboratory

Approaches to Evaluating Authentic Research Experiences

Presenters:
Lindsay Barone, PhD, Program Evaluator, Cold Spring Harbor Laboratory's DNA Learning Center
Preeti Gupta, PhD, Director of Youth Learning and Research, American Museum of Natural History

Reporter: Kayla Pritchard, University of Georgia

Lindsay Barone, the program evaluator at Cold Spring Harbor Laboratory's DNA Learning Center, had previously used the SURE III Survey to measure attitudinal shifts after student experience in summer programs. Through its use, the team realized this tool was not well aligned with their needs. They needed to make it more adaptable for high school students both in literacy and content, and wanted more raw data for more in-depth analysis of students. So they revamped the evaluation program emphasizing five aspects of course-based research experiences. These included the use of science practices, discovery, relevance, collaboration, and iteration. Their new survey includes pre and post assessments, exit surveys, focus groups, and case studies. The team also received the BD2K supplement, which led to the inclusion of reflexive journaling, allowing real time observation of how students and teachers went through material. In the end, the team managed to measure major concepts and are awaiting results from their recent year test. Currently the team is grappling with how to follow these students long-term to gain better longitudinal data.

Preeti Gupta works for the American Museum of Natural History. Her program, Staying in Science, brings 1,270 high school students at 20 sites in NYC into authentic mentored research work in science. Before entering the lab environments, students are required to complete 75 hours of free coursework to prepare their basic science skills. At the end of this experience, students will have to create a poster and can write a paper. Students who enter the program are highly motivated and come from resource-lacking schools who claim they are interested in entering STEM fields as they move to college. The participants who do not end up pursing STEM careers, however, are of particular interest to the program researchers.

Currently they are using a variety of instruments to collect data on the students, including annual surveys administered to current students in the program as well as alumni, social network surveys, and public school data from standardized test work. From the analysis of these sources, researchers have made some early findings. The social network surveys revealed that when a student enters a science experience, their teacher and parent/caregiver is very important in telling them about opportunities in STEM and providing support to pursue those. Based on this, the program is interested in how this community of practice evolves as the student is within the program and moves into individual pathways for college and career. These surveys revealed that support systems evolved, initial mentors replaced with new people or with a different resource as the student progressed through and out of the program.

The session ended with a discussion intended to summarize all of the evaluation sessions in the conference. Evaluating tips were shared, including useful tools like LCAS, SURE, and CURE. Both LCAS and CURE are useful when comparing your students to national scores, however CURE was explained to have more long-term questions, including attributes of self-efficacy and individual attitudes of students rather than questions specific to the experience. In contrast, the LCAS is more about the components of the experience and attributes of the experience not the students. The group also discussed common struggles with evaluation including the anticipation of unexpected results, IRB approval for social mapping, as well as getting consent forms returned from parents. To combat some of these struggles, it was suggested to include forms in both English and Spanish, have a yes or no box for participation, and bring forms to parent-teacher nights at the schools. Overall attendees seemed to have benefited from the evaluation sessions, and evaluators saw the experiences as valuable both to their project and their relationship with research team members.

Participants:
Bret Hassel, University of Maryland
Emily Kuehn, US Army Medical Research and Material Command
Tiffany Nuessle, Denver Museum of Nature & Science
Krista Glazewski, Indiana University
Michele Shuster, New Mexico State University
Jessica Gluck, Discovery Place of Science
Liz Danter, New Knowledge Organization
Ruchita Patel, Rockman Et Al
Kayla Pritchard, University of Georgia
Gwen Stovall, University of Texas at Austin

Strategies for Integrating Disciplinary Literacy into Science and Health Curriculum

Presenters:
Alana Newell, MEd, Instructor, Baylor College of Medicine
Nancy Moreno, PhD, Associate Provost, Baylor College of Medicine
Christopher Burnett, MEd, Project Manager, Baylor College of Medicine

Reporter: Amy J. Hawkins, PhD, Postdoctoral Fellow, University of Utah

The team behind the curriculum design at The Center for Educational Outreach at Baylor College of Medicine (https://www.bcm.edu/education/programs/educational-outreach) has traditionally made literacy a focus of their science education materials (which can be found at http://www.bioedonline.org), but their understanding of what comprises "scientific literacy" and how to effectively integrate it into curriculum is evolving.

This session initially explored participants' understandings of scientific literacy and then broadened into a facilitated discussion to identify unique characteristics of science writing. Dr. Moreno explained that what the team had previously been doing to integrate literacy with science and math had been fairly superficial but was viewed as innovative at the time: using storybooks for younger students and pairing reading with science activities. However, curriculum design teams were limited by the trends in the field of education that viewed text-heavy curricula as coming at the expense of inquiry-driven learning—ideas that are explored in detail in a 2010 review article from *Science* magazine that was distributed and discussed during the session: "Literacy and Science: Each in the Service of the Other," by P. David Pearson and Elizabeth Moje. The article argues that when appropriately framed, reading and analyzing scientific texts are important forms of scientific inquiry and require active learning by students in the form of sense-making.

As a result of the conceptual shifts in the field, the curriculum design team now thinks of literacy in terms of disciplinary literacy, as "a way of using language and writing like a scientist."

Unique characteristics of science writing identified in the subsequent group discussion:

- Uses passive voice rather than active voice
- Is self-critical, and often brings in competing hypotheses
- Has a specialized vocabulary
- Often employs the plural – "we performed" vs. "I performed" (which might signify to novice readers a lack of ownership or responsibility)
- Graphical representations take on a different (and perhaps more complicated) role in communicating information

Participants:
Michael Boyd, Iowa State University
Laura Tenenbaum, Walter Reed Army Institute of Research
Christine C Ziese, New Braunfels Independent School District
Amy J Hawkins, University of Utah
Kelly LaRue, The Jackson Lab
Holly Martinson, University of Alaska Anchorage
Anne Westbrook, Biological Sciences Curriculum Study
Susan Hershberger, Miami University
Elizabeth McMillan, Sanford Research
Stephanie Dumont, Brunswick High School

Student-Produced "Question-Framed Videos" and Science Identity Formation

Presenters:
Peter Crown, PhD, Multimedia Collaboratory Producer, University of Arizona College of Medicine
Marlys H. Witte, MD, Professor of Surgery, University of Arizona College of Medicine
Juan Ruiz, BA, Videographer/Producer, University of Arizona College of Medicine

Reporter: Juan Ruiz, BA, Videographer/Producer, University of Arizona College of Medicine

This was a lively, interactive examination of curiosity as a key component and motivator of research, which has been largely underplayed until the past several years. Now we are seeing a plethora of books, articles, web sites, and even commercial ventures devoted to curiosity. The session addressed the notion of "getting curiosity out of the closet" and the utility of the "ignorance curriculum," in which ignorance represents everything we have yet to discover, curiosity (an addiction to ignorance), a thirst for discovery, and the medical school pedagogy of "see one, do one, teach one." Videos produced by students are framed by beginning and ending questions to reinforce the iterative nature of research.

A video evaluation rubric was tried for three student-produced videos and then critiqued, with several useful comments offered. It was noted that the process of producing a short video, especially with regard to script development and visualization of scientific concepts, contributes to students' identification with the research endeavor and improves their skills in science communication. The session ended with a curiosity exercise in which each attendee wrote down what they were curious about presently, followed by what they were curious about as children. There was a consistent difference between the two, which was acknowledged and discussed.

Participants:
Jalisa Ferguson, Georgia State University
Sandra Prytherch, University of Nevada
Erin Hardin, University of Tennessee
Katherine Bruna, Iowa State University
Jackie Shia, Challenger Learning Center
Robert Sege, Health Resources in Action
Juan Lopez-Garcia, University of Puerto Rico
Stephanie Tammen, Tufts University
Mandana Sassanfar, Massachusetts Institute of Technology
Kelley Withy, University of Hawaii
Leah Clapman, PBS NewsHour
Laurie Jo Wallace, Health Resources in Action
Michael Wyss, University of Alabama Birmingham
Patricia Whitehouse, Chicago Public Schools

Getting Started in STEM Games

Facilitator: Lisa Marriott, PhD, Assistant Professor, Oregon Health & Science University
Panelists:
Georgia Hodges, PhD, Assistant Research Scientist and MAT Coordinator, University of Georgia
Brinley Kantorski, EdD, Director of Education and Curriculum Development, Duquesne University

Reporter: Ashlyn Sparrow, MA, Entertainment Technology, University of Chicago

SYSTEMS is a digital game designed to have students explore different body systems and how they function, which is in development by Dr. Hodges at the University of Georgia. At Duquesne University, Ms. Kantorski is working on BiblioTech, a choose-your-own adventure story which engages players in different learning experiences through reading and interactive media components.

Serious games are defined as games used to educate, train, and promote behavioral and attitudinal changes. Whether you are a scientist, teacher, or game developer, there are many elements to consider when setting out to develop a serious game. In this talk, Dr. Hodges, Dr. Marriott, and Ms. Kantorski highlighted several key elements relevant to those who are trying to get started in STEM games.

Project Planning
Start with the learning objective: what should be learned?; what skills should be practiced? Figure out a learning environment in which to implement the game and collaborate with formal or informal educators.

Reach out to a university game design club or the independent game development community to get a better understanding of game design components.

Refine your game idea with each stakeholder meeting.

Prototype with pen and paper. It will cost a lot more money in terms of development to build out an idea that someone could not visualize using paper and pencil.

Prepare to scale the project from the beginning, if that is the goal. Make connections with administrators and teachers. Innovate within the context regarding curriculum, school vision, and resources. Recognize the strengths of teachers regarding pedagogical context knowledge: they know how to teach! Scaling does not necessarily mean commercialization or involve a business plan.

Build a Strong Team

Dr. Hodges works closely with researchers, teachers, scientists, and game designers. All members of her interdisciplinary team are in-house. She recognizes that while she may be the PI, she knows a lot less than her game developer about game design or her physiologist about the physiology of Type I Diabetes. In order to design a STEM game, she recommends the experts be part of the project team. Team members must recognize the value of each member and the limitations of their own knowledge. Though she leads the project, Dr. Hodges has incorporated a distributive leadership style among her team.

Ms. Kantorski's team, which does not have the coding expertise in-house, has subcontracted an external game studio to develop their educational applications. The company is called Simcoach, a spin-off from Carnegie Mellon University's Entertainment Technology Center. She admits that her organization is in a unique position as Pittsburgh has a thriving game development culture with many universities having game development programs. When looking for an external game development team, Ms. Kantorski recommends shopping around and finding a studio that works with your needs.

Budget

Games are expensive to make. However, this can be mitigated by partnering with other institutions and SEPA projects during development. Another strategy is to write a scope of work and submit a bid request to find a game studio partner. This requires studios to work within the confines of the budget.

Game Updates

Science changes rapidly and it’s important for content to match. However, it takes time and money to add new features into a game. Ms. Kantorski has worked out a contingency plan with Simcoach where they pay for support for the next couple of years. When working out this type of contract, there need to be clearly defined expectations such as content updates, software compatibility updates, or a redesigned game.

Participants:
Ashlyn Sparrow, University of Chicago
Michael Lichtenstein, University of San Antonio
Wanda Padula, National Science Foundation
Adam Smith, National Science Foundation
Charles Wood, Wheeling Jesuit University
Georgia Hodges, University of Georgia

Friday, June 2, 2017: 11:15 AM – 11:45 AM

Town Hall Discussion

Presenter: L. Tony Beck, PhD, Science Education Partnership Award (SEPA), Center for Research Capacity Building, National Institute of General Medical Sciences (NIGMS), NIH

Reporter: Rob Rockhold, PhD, Deputy Chief Academic Officer, University of Mississippi Medical Center

Dr. Beck opened the culminating session of the SciEd 2017 meeting with a gesture of appreciation to Dr. Louisa Stark and her colleagues on the Organizing Committee. He praised that group with his opinion that this was the "best conference ever" for the SEPA community and followed with a request that all participants send to him a list of the new collaborators/collaborations they had established at this meeting.

The involvement of Dr. Jon Lorsch, NIGMS Director, in the conference was highlighted. There exists a high potential for reciprocal value if SEPA grantees interact with other NIGMS grantees. It was announced that Dr. Lorsch spent much of the first day of the conference observing the proceedings, meeting with SEPA PIs, and reviewing the posters. Many of his observations will be shared with NIGMS staff and researchers to engage them in preparation for the 2018 USA Science and Engineering Festival. Dr. Beck indicated that the new IDeA program announcement specifically encourages applicants to collaborate with SEPA awardees and that he would encourage development of regional SEPA conferences akin to or in collaboration with those currently organized by IDeA grantees. This dovetailed with the Keynote comment by Dr. Lorsch to have a SEPA program funded in every state and the potential for the SEPA program now that it is within NIGMS and, in particular, the Center for Research Capacity Building (CRCB).

Marketing of SEPA

Dr. Beck indicated a desire for SEPA to prepare a flyer that could be used when grantees interacted with colleagues at other national meetings, such as NSTA and NABT. Two years earlier, he participated in these conferences with the SEPA exhibit booth and offered a workshop on SEPA funding. He also distributed 1,600 curriculum supplements at the "Bridging the Gap" meeting in North Carolina. It was proposed to develop a pilot program that would allow SEPA to fund travel by grantees to such teacher-rich meetings, where they would distribute the curriculum supplements.

Finally, Dr. Beck reminded the group that the move of SEPA from the NIH Office of the Director to NIMGS occurred because of the advocacy of SEPA grantees, and he encouraged the group to reach out regularly to educators and community leaders including inviting them to presentations/meetings at which SEPA products and

outcomes were presented. He concluded by reminding the conference attendees that the budget outlook for SEPA and NIH was positive, that SEPA was in a secure and stable environment at NIGMS, and that we are positioned to build SEPA into a bigger and better program to support NIGMS-specific workforce diversity goals and federal agency-wide national science education initiatives.

Poster Presentations

Posters are listed alphabetically by Institution within the following topic areas:

- Authentic Research Experiences for Students & Teachers
- Curriculum Development
- Early STEM
- Informal Science Education
- Rural STEM
- Student Science Enrichment
- Teacher Professional Development

Authentic Research experiences for students & Teachers

Poster	Project Name/Poster Title	Institution	PI(s)/Poster Authors	Funder
1	Barcode Long Island: Exploring Biodiversity in a Unique Urban Landscape	Cold Spring Harbor Laboratory's DNA Learning Center	David Micklos	SEPA
2	NeuroLab	Coastal Marine Biolabs Integrative Biosciences Institute	Ralph Imondi, Linda Santschi	SEPA
3	Bringing Real Experiments (REX) about Substance Abuse to High School Students	Duke University Medical Center	Dimitri V. Blondel, Lisa Linnenbrink-Garcia, Rochelle Schwartz-Bloom	SEPA, SEDAPA
4	Let's Get Healthy! (CHIDR Chatter: Translating Community Research Data for Classroom Use	Oregon Health & Science University	Lisa Marriott	SEPA
5	PBS NewsHour Health Literacy and Student Reporting Labs	PBS NewsHour	Patti Parson, Leah Clapman	SEPA
6	BioSTORM	Salish Kootenai College	Regina Sievert	SEPA
7	Western New York Genetics in Research and Health Care Partnership	State University of New York at Buffalo	Stephen Koury, Shannon Carlin-Menter	SEPA
8	Clues from Planarians on Sweeteners: Behavioral Effects of Splenda, Equal and Sucrose	Temple University	Schott Manning Rawls	SEPA, SEDAPA

9	Anxiety in Planarians: Effects of Predator Odor and Prozac	Temple University	Schott Manning Rawls	SEPA, SEDAPA
10	The PARE Project: Introducing a Sustainable Course-Based Research Program to Diverse Classroom Settings	Tufts University School of Medicine	Elizabeth Genné-Bacon, Carol Bascom-Slack	NSF
11	San Francisco Health Investigators	University of California – San Francisco	Rebecca Smith, Katherine Nielsen	SEPA
12	Enhancing Student Trainees' Research, Communication, and Leadership Skills: Mentoring Crystallization and Crystallography Interventions	University of Puerto Rico	Jose Rodriguez-Medina, Juan Lopez-Garriga	NIAID, IDeA Networks of Biomedical Research Excellence
13	Empowering Pre-service Teachers and Students With Environmental Health Research	University of Wisonsin-Milwaukee	Dave Petering, Craig Berg	SEPA
14	Day of Discovery: A STEM Pipeline Program for Middle School Students	Vanderbilt University	Virginia Shepherd, Jennifer Ufnar	SEPA
15	Teaching to Learn: WV-HSTA Students Take CBPR to Their Communities	West Virginia University	Ann Chester	SEPA

Curriculum Development

Poster	Project Name/ Poster Title	Institution	PI(s)/Poster Authors	Funder
16	STEM Foundations: Science Inquiry and Literacy	Baylor College of Medicine	Nancy P. Moreno	SEPA, Blueprint for Neuroscience, NIAID
17	CityLab and Urban Squash: A New Pathway to Achieve STEM Success	Boston University, Fordham University	Carl Franzblau, Donald DeRosa, Carla Romney	SEPA

18	Developing Skills in Health Literacy	BSCS	Anne Westbrook	SEPA
19	Sharing ASSETs: Expanding Science Opportunities in K – 12 Classrooms	Cornell University	Theodore Clark	SEPA
20	The Partnership in Neuroscience Education	Duquesne University	John A. Pollock	SEPA
21	Young Scientists, Ambitious Teachers Improving Health in an Urban Ecosystem	Iowa State University	Katherine Richardson Bruna, Gale Seiler, Lyric Bartholomay	SEPA
22	Fighting with Food	Miami University	Susan Hershberger	SEPA
23	A New Genomic Framework for Schools and Communities	Michigan State University	Joseph Krajcik, Toby Citrin	SEPA
24	Neuroscience in Your World: A Partnership for Neuroscience Education Across the K-12 Spectrum	The Franklin Institute Science Museum	Jayatri Das	Blueprint for Neuroscience
25	SYSTEMS (Stimulating Young Scientists to Engage, Motivate, and Synthesize)	University of Georgia	Georgia Hodges	SEPA
26	PAGES	University of Illinois	Barbara Hug, Becky Fuller, Brian Reiser	SEPA
27	High School Research Initiative	University of Texas at Austin	Gwendolyn M. Stovall	SEPA
28	Genes and Microbes: Engaging Students and Teachers in NGSS-Aligned Curricula and Professional Development	University of Utah	Louisa A. Stark	SEPA

Early STEM

Poster	Project Name/ Poster Title	Institution	PI(s)/Poster Authors	Funder
29	Partnerships to Promote Healthy Lifestyles for Children and Communities	Mississippi State University	Julie Parker	SEPA

30	This Is How We "Role": Inspiring Future Researchers through Veterinary Medicine	Purdue University	Sandra San Miguel, L. Carleton Parker, W. Burgess, K. Cipriani	SEPA

Informal Science Education

Poster	Project Name/ Poster Title	Institution	PI(s)/Poster Authors	Funder
31	Human Health, Biodiversity, and Microbial Ecology: Strategies to Educate	American Museum of Natural History	Preeti Gupta, Rob DeSalle	SEPA
32	San Gabriel Valley SEPA Collaborative	City of Hope Beckman Research Institute	Christopher Sistrunk	SEPA
33	More Than Just a Taste of Citizen Science	Denver Museum of Nature & Science	Nicole Garneau	SEPA
34	Duke Med Activated – BOOST	Duke University School of Medicine	Brenda Armstrong	SEPA
35	Citizen Science HD	Emory University	Adam Marcus, Theresa Gillespie	SEPA
36	DNA Runs in the Family	Georgia State University	Barbara Baumstark	SEPA
37	MedLab: Using Patient Simulation for Student Exploration of Community Health Issues	Museum of Science and Industry, Chicago	Rabiah Mayas, Patricia Ward	SEPA
38	Hispanic Role Models in Health Careers	National Association of Hispanic Nurses	Angie Millan	SEPA
39	Transmissions: Astonishing Tales of Animal-Human Diseases	New York Hall of Science	Martin Weiss	SEPA
40	Weighing the Evidence	Science Museum of Minnesota	Laurie Fink	SEPA
41	Discover Health	University of Colorado Anschutz Medical Campus	Jennifer L. Hellier	SEPA
42	Get in the GROOVE	University of Miami	Patrice G. Saab, Judy A. Brown	SEPA

43	Biology of Human	University of Nebraska	Judy Diamond, Julia McQuillan, Charles Wood	SEPA
44	Resources for Education & Action for Community Health in Ambler (REACH Ambler)	University of Pennsylvania, Perelman School fo Medicine; Chemical Heritage Foundation	Frances K. Barg, Edward Emmett, Jody Roberts	SEPA

Rural Stem

Poster	Project Name/ Poster Title	Institution	PI(s)/Poster Authors	Funder
45	The MENTORS Project	Texas A&M Health Science Center	Robin Fuchs-Young	SEPA
46	Training Rural/Underserved Youth to Understand & Pursue Scientific Careers	University of Montana	Andrij Holian, Tony Ward	SEPA
47	Accelerating Access: Health Science Education in Native American Communities	University of Nebraska Medical Center	Maurice Godfrey	SEPA
48	PIPES: Possibilities in Postsecondary Education and Science	University of Tennessee	Melinda Gibbons, Erin Hardin	SEPA

Student Science Enrichment

Poster	Project Name/ Poster Title	Institution	PI(s)/Poster Authors	Funder
49	CityLab and Urban Squash: A New Pathway to Achieve STEM Success	Boston University, Fordham University	Carl Franzblau, Donald DeRosa, Carla Romney	SEPA
50	Enhancing Secondary School STEM Education For Students and Teachers Through Biomedical Engineering Design	Columbia University	Aaron M. Kyle	SEPA
51	Seeing the Science of Drug Addiction: Conducting Independent Research with a Student Who Is Visually Impaired	East Carolina University	Rhea Miles	SEDA-PA

52	The Importance of Improving Underserved and Underrepresented Minority Youths' Attitudes Toward Science: Validation of a Short Form Attitudes Toward Science Survey	East Carolina University	Melani Duffrin	SEPA
53	Engaging Families to Enhance Science Learning and Interest in STEM Careers	Seattle Children's Research Institute	Amanda L. Jones	SEPA
54	Translating Translation and Scientific Questioning in the Global K-12 Community	University of Arizona College of Medicine	Marlys H. Witte, Francisco Garcia	SEPA
55	HiSCI	University of Hawaii	Kelley Withy	SEPA
56	Medicines and Me: Understanding and Using Medicines Safely	University of Rochester	Dina Markowitz	SEPA
57	In-Classroom Biology Internships for Students and Teachers in Underserved Schools	Walter Reed Army Institute of Research	Debra L. Yourick	SEPA
58	Pandem-Sim: Saving Earth with Biology	Wheeling Jesuit University	Charles Wood	SEPA

Teacher Professional Development

Poster	Project Name/ Poster Title	Institution	PI(s)/Poster Authors	Funder
59	Frontiers in Physiology: Building Communities of Practice	American Physiological Society	Marsha Lakes Matyas	SEPA
60	The Exploratorium Digital Teaching Box Project	Exploratrium	Julie Yu, Hilleary Osheroff, Kristina Yu	SEPA
61	Building Awareness, Respect, and Confidence through Genetics (ARC)	Harvard Medical School, Sanford Research	Marnie Gelbart, Ting Wu, Elizabeth McMillan	SEPA
62	Turning K-12 Environmental STEM Education InSciEd Out	Mayo Clinic, University of Minnesota	Chris Pierret, James Cotner	SEPA
63	Teachers FIRST	Milwaukee School of Engineering	Tim Herman	SEPA

64	Bringing Research Into the Classroom (BRIC)	Montana Tech	Marissa L. Pedulla	SEPA
65	Science Tools in the Classroom	New Mexico State University	Michele Shuster	SEPA
66	Science Club Summer Camp: Training Teachers and Youth in Authentic STEM Practice	Northwestern University	Michael Kennedy	SEPA
67	BEST Science! Bioscience Enrichment for Students and Teachers	Ochsner Medical Center- New Orleans; Louisiana State University Health Sciences Center	Jawed Alam, Paula Gregory	SEPA
68	Teaching the Genome Generation	The Jackson Laboratory	Charles Wray, Gareth Howell	SEPA
69	Modeling for Fidelity: Mentored Dissemination of a Novel Infectious Disease Curriculum	Tufts Medical School	Berri Jacque, Karina Meiri	NIAID
70	The Great Diseases: Biomedical Science in the High School Classroom	Tufts Medical School	Karina Meiri, Berri Jacque	SEPA
71	Science Education Enabling Careers (SEEC)	University of Alabama at Birmingham	J. Michael Wyss	SEPA
72	Biomedical Explorations: Bench to Bedside	University of Florida	Mary Jo Koroly	SEPA
73	T-SCORE: Teachers & Students for Community Oriented Research & Education	University of Kansas Medical Center	Paula Cupertino	SEPA
74	STEMI: Growing a Community for Teacher Innovation in STEM	University of Mississippi Medical Center	Rob Rockhold	SEPA
75	Identifying, Assessing, and Visualizing Competencies for Teaching Science in a Flipped Learning Environment – The STEMI Competency Model	University of Mississippi Medical Center	M. Barnard, C. Copretta, E. Dehon, A. Notebaert, T. Pollard, D. Sullivan, E. Meyer, J. Taylor, S. Stray, R. Rockhold	SEPA
76	Empowering K-12 Teachers Through a Bioscience Academy	UT Health Science Center at San Antonio	Michael Lichentenstein	SEPA

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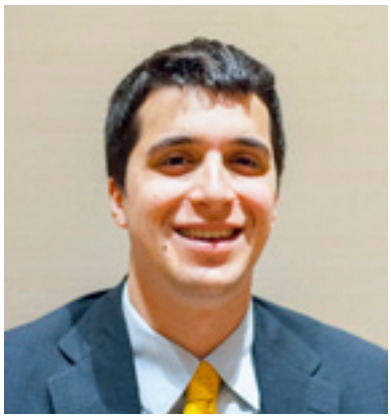

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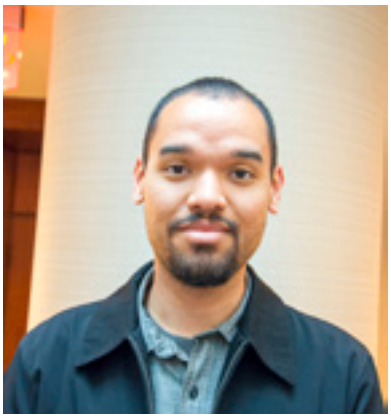

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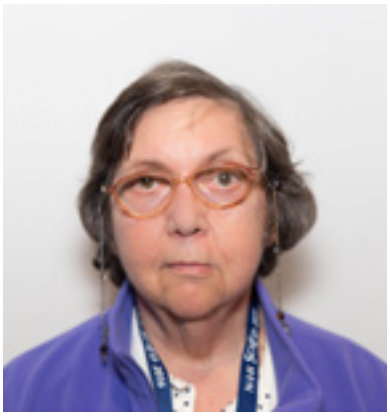

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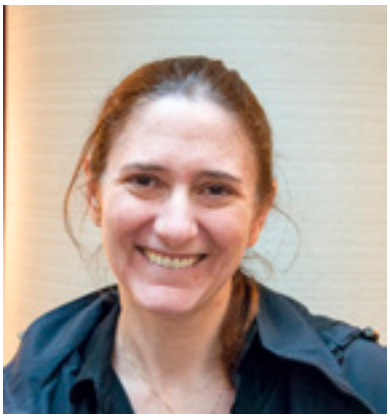

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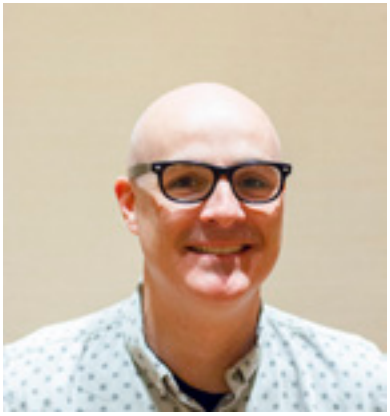

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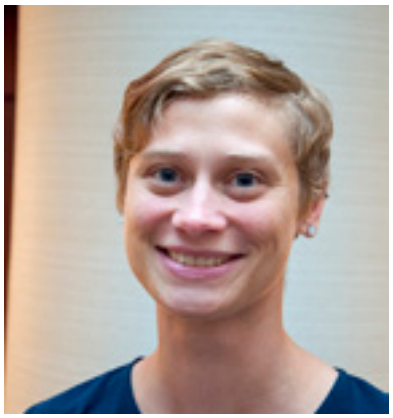

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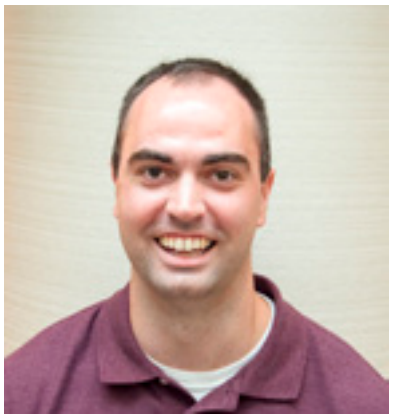

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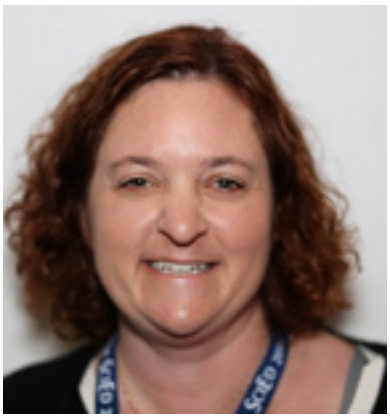

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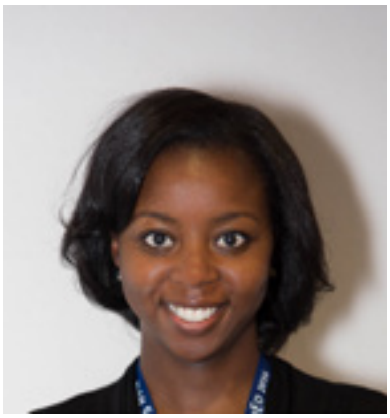

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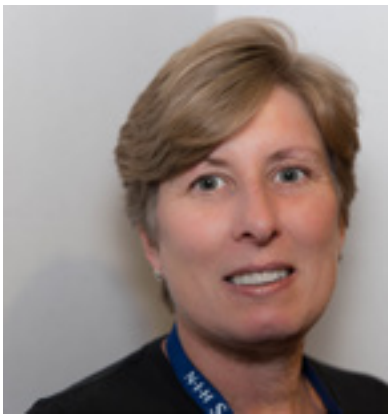

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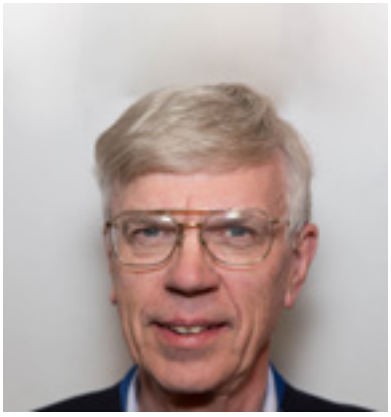

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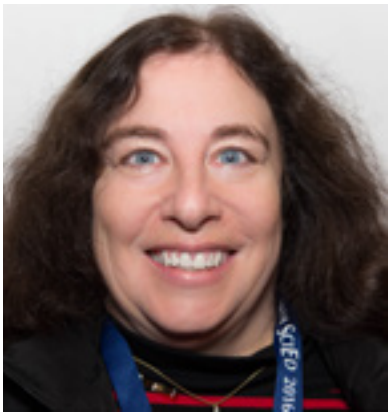

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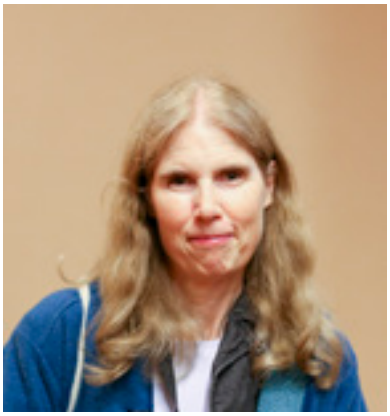

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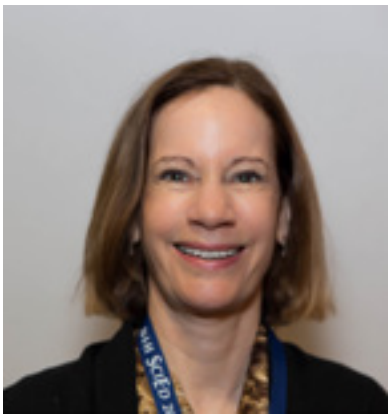

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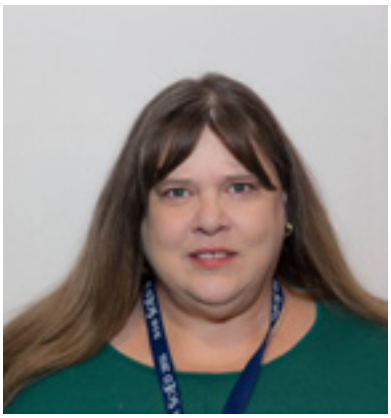

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