Dr. Richard Kurin
Under Secretary for History, Art, and Culture
Smithsonian Institution
Dr. Cora Marrett
Acting Director
National Science Foundation
Dr. Charles Elachi
Director
NASA Jet Propulsion Laboratory
Diane Austin
Arts Education Expert
Office of Innovation and Improvement
Department of Education
Dr. Jason Rhody
Director for Digital Humanities
National Endowment for the Humanities
Joyce Ward
Education Coordinator
United States Patent and Trademark Office
Cristin Dorgelo
Assistant Director for Grand Challenges,
Office of Science and Technology Policy,
The White House
Marjory S. Blumenthal
Former Executive Director
Computer Science &
Telecommunications Board
"ITCP" & IT as Glue

This presentation is supported by the National Science Foundation, Grant No. 1142510, Collaborative Research: EAGER: Network for Science, Engineering, Arts and Design (NSEAD) IIS, Human Centered Computing. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.
Dr. D. Fox Harrell
Associate Professor
Comparative Media Studies Program;
Computer Science and
Artificial Intelligence Laboratory
Massachusetts Institute of Technology
MIT Imagination, Computation, and Expression Laboratory
Outcomes of the NSF-NEA Alliance

On September 15\textsuperscript{th} and 16\textsuperscript{th} 2010 a series of three joint workshops of the NSF and NEA was initiated with:

\textit{Re/Search: Strategies for Arts + Science + Technology Research}
Workshop Objectives

• **Identify** intersecting points between the Fine, Applied, and Performing Arts and Cognitive Science, Human-Centered Computing, and Computer Science and Engineering

• **Develop** a gap analysis about opportunities and challenges in the field.

• **Foster** a dialogue between the National Science Foundation and the National Endowment for the Arts
CURRENT STATE

DISCIPLINE SILOS

Drivers & Trends

CREATIVE INNOVATION ECONOMY
Regional development through transformative discoveries and innovations.

INFORMAL LEARNING FOR PUBLIC AUDIENCES
STEM aptitude through creativity-based activities, and vice versa.

OPEN-SOURCE THINKING
More creative minds inventing with new open-source tools and methods.

GAP ANALYSIS

What are THE BIG QUESTIONS being asked about work, research, and institutions right now?

INTERDISCIPLINARY RESEARCH

ENGAGES diverse approaches ELICITS challenging ideas EVOLVES new paradigms

INTERCHALLENGES & OPPORTUNITIES

Disciplinary Values

DIVERGENT

Real and perceived differences in how we validate what we value.

OPPORTUNITY
Create frameworks and forums for sharing, discussing, and understanding the differences and similarities across cultures of knowing.

Educational Institutions

SCHOLARSHIP

Demonstrating impact of AST research in hard as scholarly archives across disciplines are not linked.

OPPORTUNITY
Build a repository for citation and archiving AST research to study the history and evolution of the field.

21st Century Learning

EDUCATIONAL INSTITUTIONS

CHALLENGE

Traditional silos and unlinked playing fields in resources, infrastructure, support, teaching to research retic to creative disparities.

OPPORTUNITY
WRITE mission statements that emphasize interdisciplinary programs as a principle goal.

OPPORTUNITY
RESOLVE silo mentality with sustained dialogues across the institution.

OPPORTUNITY
ESTABLISH tenure review guidelines that reward experimental collaboration.

OPPORTUNITY
COLLABORATE with non-profit institutions to the benefit of all.

Resources

DIVERGENT

Change in the art + science + technology research landscape.

OPPORTUNITY
ALIGN AST pedagogies with 21st century learning skills.

OPPORTUNITY
SCAFFOLD skills needed for engaging STEM and the Arts from PK–12 to lifelong learning.

OPPORTUNITY
REWARD creativity, curiosity, and problem solving with tolerance for alternative points-of-view.

OPPORTUNITY
BENCHMARK best practices that create critical thinkers and leaders for the ever changing job market.

FUTURE STATE

TRANSFORMATIVE BREAKTHROUGHS

ARTISTIC EXCELLENCE

Resources

FUNDING PROGRAMS FOR
- Inter-agency crosscutting initiatives.
- Multi-staged project support.
- Faculty exchange program.
- Research opportunities for non-STEM students.
- Travel grants for festivals and conferences.
- Academic and non-profit partnerships.
- Scientist-in-Studio and Artist-in-Residence programs.

BROADER IMPACT

OPPORTUNITY
CONNECT a distributed community of stakeholders.

OPPORTUNITY
INFORM about the impact of AST research on national STEM education priorities.

OPPORTUNITY
PRODUCE diversity of perspectives, approaches and people in the creative innovation economy.

OPPORTUNITY
FORGE partnerships between international, federal, state and local arts, research, and industry institutions.

INTELLECTUAL MERIT

OPPORTUNITY
WRITE mission statements that emphasize interdisciplinary programs as a principle goal.

OPPORTUNITY
REWARD creativity, curiosity, and problem solving with tolerance for alternative points-of-view.

OPPORTUNITY
BENCHMARK best practices that create critical thinkers and leaders for the ever changing job market.

21st Century Learning

CHALLENGE

There has been enrollment decline in traditional Computer Science programs while programs that integrate computational thinking and the Arts have increased.

OPPORTUNITY
ALIGN AST pedagogies with 21st century learning skills.

OPPORTUNITY
SCAFFOLD skills needed for engaging STEM and the Arts from PK–12 to lifelong learning.

OPPORTUNITY
REWARD creativity, curiosity, and problem solving with tolerance for alternative points-of-view.

OPPORTUNITY
BENCHMARK best practices that create critical thinkers and leaders for the ever changing job market.

NETWORKS OF EXCELLENCE

CHALLENGE

AST networks in the U.S. tend to be part of academic clusters. They are vibrant yet yet do not connect to those outside of these networks.

OPPORTUNITY
CONNECT a distributed community of stakeholders.

OPPORTUNITY
INFORM about the impact of AST research on national STEM education priorities.

OPPORTUNITY
PRODUCE diversity of perspectives, approaches and people in the creative innovation economy.

OPPORTUNITY
FORGE partnerships between international, federal, state and local arts, research, and industry institutions.

As we cross boundaries our cultures of knowing merge.
Dr. Thanassis Rikakis
Vice Provost of Design, Arts & Technology
Professor, School of Design
Professor, School of Music
Courtesy Professor of Bioengineering
Carnegie Mellon University
XSEAD Principal Investigator
Community creation and understanding

Advocacy for culture and economic development, research and creative work, learning and education, collaboration and partnership
XSEAD
An arts/science community platform

Thanassis Rikakis
Vice Provost For Design, Arts & Technology
Carnegie Mellon University

Supported by the National Science Foundation, Grant No. 1141631,
Developed at ASU’s School of Arts, Media + Engineering

http://www.xsead.org
A Community Platform for Art/Science

Showcase
Canon and Archival of high quality exemplars

Community
Process, Discourse, Critique + Resources

Knowledge
Multimodal peer-reviewed scholarly outcomes
Showcasing Impact & Value

**Distill**
- Large, Rich Archives

**Curate**
- Curation Board
- Selected Works

**Disseminate**
- Diverse Audience

Supported by the National Science Foundation, Grant No. 1141631,
Developed at ASU’s School of Arts, Media + Engineering

http://www.xsead.org
Curators from leading art/science forums

Donna Cox
ACM SIGGRAPH

Jacki Morie
ACM SIGGRAPH

Meredith Tromble
Leonardo

David A. Shamma
ACM SIG Multimedia

Theresa Reid
a2ru / Arts Engine

Bruce Mackh
a2ru / Arts Engine

Andrea Polli
ISEA

Ed Finn
Center for Science + Imagination NAS

Pamela Jennings
National Academy of Sciences

Sheldon Brown
Art Science Museums

Alicia Gibb
Maker Community

Juan Diaz Infante
Mexico Space Collective

.... and on-going discussions with IEEE Multimedia + ACM SIG CHI

Supported by the National Science Foundation, Grant No. 1141631,
Developed at ASU’s School of Arts, Media + Engineering

http://www.xsead.org
Authoritative Resource for the Community
Valuing Process and Product

Community / Process Challenges

There are weekly challenges given to the community. One challenge is made available on a Monday with 3 days to complete it. A challenge is selected at random and open for contribution. Any member of the community may contribute to a challenge and collectively it helps us to explore the diverse methods, tools and techniques people employ to negotiate collaboration across arts/science towards the development of integrative works.

Current Challenge

“Show off your workspace - upload a photo of your studio, office or place where your practice takes place”

Past Challenges

What does “interdisciplinary” mean to you? Add a description of your interpretation of this all too often divisive word.

What does your desktop look like?

Projects

- Bierenga Gallery Exhibition
- Ashley Kramer
- Your title here

American science continues to fall short of meeting with the standards, often aiming for a "fail craft" in many of the fields they have no excuse existing to say they have failed. (details)

- Social Media Based Writing
- The Protection Suite
- 1765 27 15 1 day ago

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Supported by the National Science Foundation, Grant No. 1141631
Developed at ASU’s School of Arts, Media + Engineering
http://www.xsead.org
### Participatory Resources

#### Curation / Resources

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Building Community Participation

Supported by the National Science Foundation, Grant No. 1141631,
Developed at ASU’s School of Arts, Media + Engineering

http://www.xsead.org
New forms of Arts/Science Scholarship

Knowledge
We’re rethinking academic scholarship

Reporting your work through plain text and static images and graphs doesn’t truly represent the vibrant work we produce. We want to provide an interactive, dynamic and exciting mode for you to present and describe your work through.

Later in 2013 we’ll be inviting our first authors to publish within this section. Sign up to our newsletter to get updates on this section.

Supported by the National Science Foundation, Grant No. 1141631
Developed at ASU’s School of Arts, Media + Engineering

http://www.xsead.org
XSEAD ... will enable anyone to understand the evolution and potential of collaborative research across science and arts.
Carol LaFayette, MFA
Director, Institute for Applied Creativity
College of Architecture
Associate Professor,
Department of Visualization
Texas A&M University
NSEAD Principal Investigator

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Network for Sciences, Engineering, Arts, and Design
Advocacy for culture and economic development

Advocacy for research and creative work

Advocacy for learning and education

Advocacy for collaboration and partnership
Dr. Carol Strohecker

Director, Center for Design Innovation
Faculty, University of North Carolina system
Co-Chair, SEAD White Papers Group
Culture and Economic Development
mobile technologies aiding farming and animal husbandry, incubator, tourism, cultural development, arts entrepreneurship
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- Detroit, Flint, Dayton, Toledo: automobiles
- Youngstown, Pittsburgh, Baltimore: steel
- Cleveland: iron, steel, shipping, rail

+ Youngstown:

Additive Manufacturing

Innovation Institute

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http://cba.mit.edu/events/13.03.scifab/
Ruth West
Associate Professor and Director XREZ lab
College of Information/Information Science
College of Visual Art & Design/New Media
College of Arts &Sciences/Biological Science
College of Engineering/Computer Science
iARTA Research Cluster
University of North Texas
Research and Creative Work
ATLAS in silico

Ruth West, Todd Margolis, JP Lewis, Iman Mostafavi Joachim Gossmann, Ben Hackbarth, Jurgen P. Schulze, Alex Horn, Weizhong Li, Treveor Henthorn, Rajvikram Singh, Javier Girado, Sam Fernald, Toshiro Yamada
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The competencies gained from engaging in art-science research include:

- Simultaneous mastery of many different and rapidly changing fields
- Ability to work in diverse teams
- Mastery of non-routine creative, scientific, technical and entrepreneurial practices
- Self-directed learning
**rePhoto for Science**

Science seeks to understand the world, and important data comes from cataloguing what is happening in different places and measuring changes. rePhoto helps imagery more accurately contribute to tasks such as measuring tree growth, snow depth, or stream erosion. We are excited (and funded) to support the use of rePhoto in any scientific discipline and welcome inquiries.

**rePhoto for Personal Use**

rePhoto lets you track changes around you, and you can rephoto your own pictures, and save them locally to see how downtown, or your garden, or your mustache have changed in the last year. rePhoto saves then-and-now pictures in a variety of formats that we have fun posting to facebook, twitter, and in family holiday letters.
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Projects

Scenic Overlooks (266)
Trees on the Loop (27)
Trees Near Calit (6)
USDA Vermont (5)
Queens (416)
Gordon Home (3)
Fort Totten (203)
Gowanus (155)
Olmsted Center (2)
USDA Vermont (5)
Queen (416)
Gordon Home (3)
Fort Totten (203)
Gowanus (155)
Olmsted Center (2)

Queens

Subjects

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Download

(RePhotos from the last year)
Dr. Brian K. Smith
Dean, Continuing Education
Rhode Island School of Design
Co-Chair, SEAD Learning and Education Group

Katherine Moriwaki, Parsons
The New School for Design

Lucinda Presley, ICEE Success
Learning and Education
ICEE Success
Scrapyard challenge
PARSONS THE NEW SCHOOL FOR DESIGN
Morse code-o-Matic
By Charles Teissonnier
season 43

STEM + A = STEAM

When art meets science, technology, engineering and math.

In season 43 of Sesame Street, the show continues its focus on STEM education, adding the arts to the equation, creating STEAM. The cornerstone of the curriculum remains the connection between the four main domains: science, technology, engineering and mathematics, but the updated approach integrates the arts. This helps students in STEM, revealing how creativity joins hands with innovation, making STEAM an educational approach to teaching, learning and inspiring.
STEAM by Region

Northeast

Selected Examples of STEAM in Action

IBM
Annual R&D investment
$6B

As top US patent recipient
20 yrs

CEOs who identified creativity as the number one leadership competency of the future (Yale IBM Global CEO Study)
1,500

Crayola
Partnership for 21st Century Skills
P21

Creativity, Critical Thinking, Communication, Collaboration
4Cs

Champion Creatively Alive Children, a program designed to empower school leaders, teachers and communities with inspiration, knowledge and tools that can unleash the imagination and develop the originality in every child.

United Technologies Corporation
16th Largest U.S. manufacturer
$3.9B Annual R&D investment

“We are a company founded on innovation and believe the arts, like science and engineering, both inspire us and challenge our notions of impossibility.”
– George David, CEO (psychologytoday.com)

Rhode Island School of Design

General Electric
301,000 Employees
$66.7B Gross income

“What designers do is to integrate, they are the ultimate integrators and I think that’s a critical part of innovation, and that’s why more designers are becoming part of innovation teams.” – Beth Comstock, CMO (forbes.com)

Blue School
Blue School’s educational model integrates a progressive approach to education that balances academic rigor and academic enchantment. Students approach learning through a project-based curriculum that puts inquiry, play, art and creative thinking at its core.

“The promise of Blue School is to face the changing global landscape with a vision for education, ... to launch our next generation’s change-makers, innovators, artists, thinkers and inventors.” – Allison Gaines Pell, Head of School

STEAM represents the economic progress and breakthrough innovation that comes from adding art and design to STEM (Science, Technology, Engineering and Math) education and research. STEM + Art = STEAM. The tools and methods of design offer new models for creative problem-solving and interdisciplinary partnership, introducing innovative practices of design thinking into STEM education and research. To realize this potential, scientists, artists and designers must develop new ways of working together and new modes of research and education. This will keep America at the forefront of innovation, ensuring our sustained global leadership and cultural prosperity in the 21st century.


RISD Office of Government Relations
Bekir Beyten, Director
Carly Ayres (BFA ID ’13)
Sarah Pearce (BFA FRN ’13)
Ryan Murphy (BFA ID ’13)

www.stemtosteam.org

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Dr. Noah Wardrip-Fruin
Associate Professor, Computer Science
Co-Director, Expressive Intelligence Studio
Baskin School of Engineering;
Director, Playable Media group;
Director, Digital Arts and New Media program
Division of the Arts
University of California Santa Cruz
Collaboration and Partnering
This presentation is supported by the National Science Foundation, Grant No. 1142510, Collaborative Research: EAGER: Network for Science, Engineering, Arts and Design (NSEAD) IIS, Human Centered Computing. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.
Bioinformatics + Computational Media = Computational Media
This is Doug. Doug originally had big plans for Prom Week, and is kind of alarmed to discover it's already Thursday.
Francesca Samsel, MFA
Visualization Artist
Los Alamos National Laboratories
Dr. Greg Abram, Texas Advanced Computing Center, University of Texas at Austin
Dr. Roger Malina
Distinguished Professor of Art and Technology; Professor of Physics, University of Texas at Dallas
Executive Editor, Leonardo Publications, ISAST and MIT Press
White Papers Study
Roger Malina, Chair
Carol Strohecker, CoChair
35% Non-academic
65% Academic
64% Arts/Design
16% Science/Engineering
20% Hybrid
Domains needing attention to achieve SEAD ambitions

**Translating**
Problem-driven connections among academic, commercial, and civil societies
1. Project formation and translational value

**Convening**
Overcoming transdisciplinary thresholds
2. Conferences, workshops, camps

**Enabling**
Sustaining balanced S-E-A-D relationships
3. Establishing safe places for hybrid individuals and practices
Domains needing attention to achieve SEAD ambitions

Including
Creating a dynamic, varied network
4. Global communities and local diversity

Embedding
Public engagement and negotiation
5. Outreach, dissemination, “citizen science”

Situating
An emerging ecology of creative places
6. “Alt spaces”
Domains needing attention to achieve SEAD ambitions

**Sense-Making**
Multi-modal knowledge and ways of knowing
7. Integrating understandings through the SEAD perspectives

**Documenting**
Recording and transmitting
8. Capturing, publishing, curating, archiving

**Learning**
Tapping into the passion and creativity of lifelong curiosity
9. Sharing blended experiences
Domains needing attention to achieve SEAD ambitions

Collaborating
Methodologies working across disciplines and institutions
10. Collaborations between individuals and disciplines
11. Partnerships across organizational boundaries

Thriving
SEAD ingredients as essential contributors to healthy communities
12. Ethics and values
13. Well-being and joyfulness
Networking Sciences, Engineering, Arts and Design to Confront the Hard Problems of our Time