

Engineering and Computing in Afterschool





Today's Speakers



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Jen Joyce

Director of Professional Development Techbridge





Today's Speakers



Andrew Coy

Executive Director Digital Harbor Foundation

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Director of the Learning Lab at Santa Fe Institute Project GUTS





What's the challenge?

- Engineering and computing are unfamiliar to students and adults
- Little exposure to topics during school day
- Roadblocks to offering STEM are amplified, especially with computing
 - Qualified staff, PD, curriculum, access to expertise
 - Consistent access to computers/internet





What is Engineering?

The Engineering

Design Process

ASK

IMAGINE

PLAN

IMPROVE

CREATE

- Finding solutions to problems under constraints
 - Applying science & math knowledge in context
 - ° Hands-on, project-based
 - Real-world problems
 - ^o Teamwork, 21st century skills
 - ° Persisting through failure
- Increasing importance with Next Generation Science Standards



What is Computing?

- "Computing" reflects a wide range of computer-related pursuits
 - Students learn how to create technology, not just how to use it.
- Computational Thinking
 - Problem-solving process specific to computing
 - Builds confidence in dealing with complexity, persistence in working through challenges, ability to deal with open-ended problems, etc.
- Several free graphical applications—<u>Scratch</u>, <u>Kodu</u>, <u>Alice</u>, <u>StarLogo TNG</u>, <u>MIT App Inventor</u>
 - Tutorials and some support available, but not OST curriculum specifically.



Afterschool STEM Impact Awards

- Looked for programs that demonstrate the potential of the afterschool space and its impact on participants.
- Received 200+ applications in two categories:
 1. Partnerships with STEM-rich organizations
 2. Computing and/or engineering







Visit the awards webpage!



Inspiring Girls in Science, Technology and Engineering



A Multifaceted Approach

Girls	 After-school & summer programs Girl Scout programs Career exploration Professional development Summer Institute 			
Teachers				
Families	Family eventsFamily resources			
Role Models	Role model trainingsResource guide and toolkit			
Partners	CurriculumTrainings and resources			

What's engineering? Why do it?

An engineer is a person who designs and builds products, machines, systems, or structures. Engineers want to know how and why things work.

- Build Knowledge
- Build Resiliency
- Build Confidence





The Engineering Design Process



Elements of a Engineering Lesson

- Spark an Interest
- Engaging Handson Activities
- Connection to
 Careers
- Reflection and Application





- Curriculum
- Role Models
- Field Trips



Visit the Afterschool Alliance's STEM Storybook for a program profile on Techbridge!



Career Exploration Strategies

- Career icebreakers/ activities
- Highlight relevant careers during activity
- Highlight academic path and skills needed for this career
- Role-playing different careers
- Role model career
 cards/bios and videos
- Invite a STEM role model





Sample Ice Breaker – Career Step-Up



As a Mechanical Engineer, there's no limit to the kinds of projects you might work on. You could design a bike that's easy As a mechanical engineer, there's no limit to the kinds or projects you might work on, you could be sign a like that seasy to pedal up hills, a car that doesn't pollute, or you might create a mechanical game for blind children. The annual salary is

\$80,580, which is about \$38 per hour.



Judy Lee Degree in Mechanical Engineering

Judy's Biography: As a kid, I loved taking things apart and trying to put them back together. I was always curious about what made things work. Having the chance to tinker helped me decide to study Mechanical Engineering. Today I have my dream job. As a Mechanical Engineer, I work in Product Design at IDEO, a creative design company. I have the chance to design a range of products—from toys to laptop sleeves. It never feels like work, it feels like fun!

all sorts of products and machinery. We specialize in building things that move in complicated ways. My friends from college (North Carolina State University) work in all different industries—some of them build bikes, some design large machines that are used in factories, and others work on medical tools.

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A Techbridge Role Model Interaction Includes:

Positive STEM messaging via:

- Icebreaker
- Role model's personal stories
- Hands-on STEM activity
- Reflection

Techbridge's <u>Role Model Guides</u> offer tips to recruit and train STEM professionals to volunteer in afterschool and summer programs.





Bringing Engineering to Life

Puff Mobile you can connect to? make? creative during brainstorming? Materials Needed 3 straws 4 Lifesavers 1 piece of paper 2 paper clips 50 centimeters of tape process? Instructions 1. Make a car out of 3 straws, 4 Lifesavers, 1 piece of paper, 2 paper clips and 50 centimeters of tape. redesign. 2. Racethem. 3. Here's the catch: you can only blow on them to make them move! connections to the kids' lives? others about their work. stc).

How would you introduce this activity?

Are there career or real life connections or issues

What science or engineering connections can you

How will you encourage the kids to explore and be

Troubleshoot where kids might run into trouble -Have them draft designs on paper or work collaboratively to review each other's designs.

How can you help them work through their challenges? What questions could you ask?

How could you highlight the engineering design

Set up different testing situations. See which car moves the furthest, fastest, or with the least effort.

After getting feedback from others, make time to

How would you help the kids connect this activity to a real world experience? How will you make

Provide opportunities for kids to share and talk with

What part of this experience or process is important to reflect upon? (Thinking creatively, learning from mistakes, working collaboratively,





Sent in by: Reba and Lee Anne of Medfield, MA

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South Baltimore Recreation Center



@andrewcoy



Digital Harbor Foundation Tech Center







"Anyone who says failure is not an option has also ruled out innovation"

- Prizes reliability and productivity
- No surprises
- Replication of what it did yesterday, but faster and cheaper
- Avoids failure at all costs

@andrewcoy

•	Searching	for	а	breakthrough

Factory

Accepts that the cost of new insights is failure,

 You find out what doesn't work on your way to figuring out what does

- Not focused on exploiting all value of an idea
- Embraces failure

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Seth Goden

"Anyone who says failure is not an option has also ruled out innovation"



The only failure is failing to improve.



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"I think what you can make is a far better measure of your value to society than what you can buy."

- Passive activity
- No value-add
- Entitlement

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- Usually accompanied by rapid and sometimes senseless disposal
- Learning attempts to be "final"



- Creativity / act of creating
- Requires substantial investment
- Conserves resources
- Learning leads to more learning

Maker Camp



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Technology Education Ecosystem









Mentors & Tech Coaches





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Funding & Partnerships









Questions? Thank You

Visit the Afterschool Alliance's STEM Storybook for a program profile on Digital Harbor





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Project GUTS Growing Up Thinking Scientifically

Visit the Afterschool Alliance's STEM Storybook for a program profile on Project GUTS!













Population Served













Project GUTS goals:

- 1. <u>Attract</u> diverse student populations
- 2. <u>Prepare</u> students for careers in STEM & computing fields
- 3. <u>Retain</u> student interest in STEM & computing disciplines

Addressed by combining:

- Locally relevant scientific investigations
- Computer modeling and simulation
- Meeting youth's developmental needs





Project GUTS Afterschool Club Meetings







Project GUTS Units:

- Ecosystems
- Emergency egress
- Epidemiology
- Opinion dynamics
- Climate change

- Pollution
- Shared resources
- Social networks
- Traffic patterns
- Water resources

Request an account at info@projectguts.org





Example of a student investigation:

- Learn about spread of disease by playing the "Virus Game".
- Create a computer model of a contagious disease spreading through their school.
- Try different strategies to mitigate the spread of the disease using their computer model as a test bed.



Students learn about virus spread by playing the Virus Game on PDAs



Students model of the spread of a virus in a school.





StarLogo TNG

- A block-based language and 3D simulation environment.
- Create models by writing simple rules for individual "agents" then run simulations using the model as an experimental test bed.
- No sophisticated mathematics or advanced programming skills are required



Free download at http://education.mit.edu/starlogo-tng





Best Practices

- 1. Combining scientific inquiry & computer modeling
- 2. Studying locally relevant topics
- 3. Communities & schools as context for student research
- 4. Human scale phenomena
- 5. Using StarLogo TNG, an easy-to-use engaging tool
- 6. Providing back-up technology assistance
- 7. Flash drives and laptop loans





Program structures & systems that minimize obstacles and maximize the benefits

- Strong ties to districts
- Comprehensive online resources
- Regional coordination of clubs and professional dev.
- Partnering with other STEM/Computing programs
- Ongoing PD for teachers/club leaders
- Back up support for club leaders during club meetings
- Mentor pipeline continuation opportunities for youth





Project GUTS sponsors and funders:

- National Science Foundation (2007-2010)
- Bengier Foundation (2008-2011)
- NM EPSCoR (2009-2014)
- Frost Foundation (2012)
- Google RISE and Google CS4HS (2009-2013)
- Lockheed Martin Foundation (2011-2013)
- Santa Fe Community Foundation (2012-2014)
- Spaceport funds (2011-2014) *through NMSU STEM Ed.

Panel Questions

Curriculum Resources



Developed by the Museum of Science, Boston



code.org







SCRATCHED

learn | share | connect











Click2SciencePD.org

- <u>Online professional development resource</u> for out-of-school time providers.
- Focuses on 20 research-based skills and provides video-based learning modules.
- Offers guides for staff training, meetings and coaching pieces to further opportunities for professional development.



Thanks for attending!

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