Developing High-Quality STEM Experiences at Every Age

Afterschool Alliance

The webinar will begin shortly.

Today's Speakers

Bronwyn Bevan
Senior Research Scientist
University of Washington

Andy Shouse
Chief Program Officer
Washington STEM

Meg Escude
Program Director
Exploratorium

Beth Unverzagt
Director
OregonASK

Afterschool Alliance

Webinar Overview

1. Introduction (Bronwyn)
2. Digging into “Learning Progressions” (Andy)
3. Insights from the Field (Meg)
4. Training Afterschool Educators (Beth)
5. Panel Questions
6. Audience Q&A

Learning Progressions & Afterschool

Learning happens over time, but how do we build, and build on, the foundations?

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Bronwyn Bevan
University of Washington

Science Education Policy

- ~~Inch Deep and Mile Wide~~
- **Build understanding, over time**, of a set of focused core ideas
- **Build on students' observations**, prior understandings, and cultural funds of knowledge

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What Does it Mean for Afterschool?

- **Understanding what students need to know,** so that afterschool can help build foundations that students can draw on
- **Serving as a pivotal resource** within a STEM learning ecosystem and community

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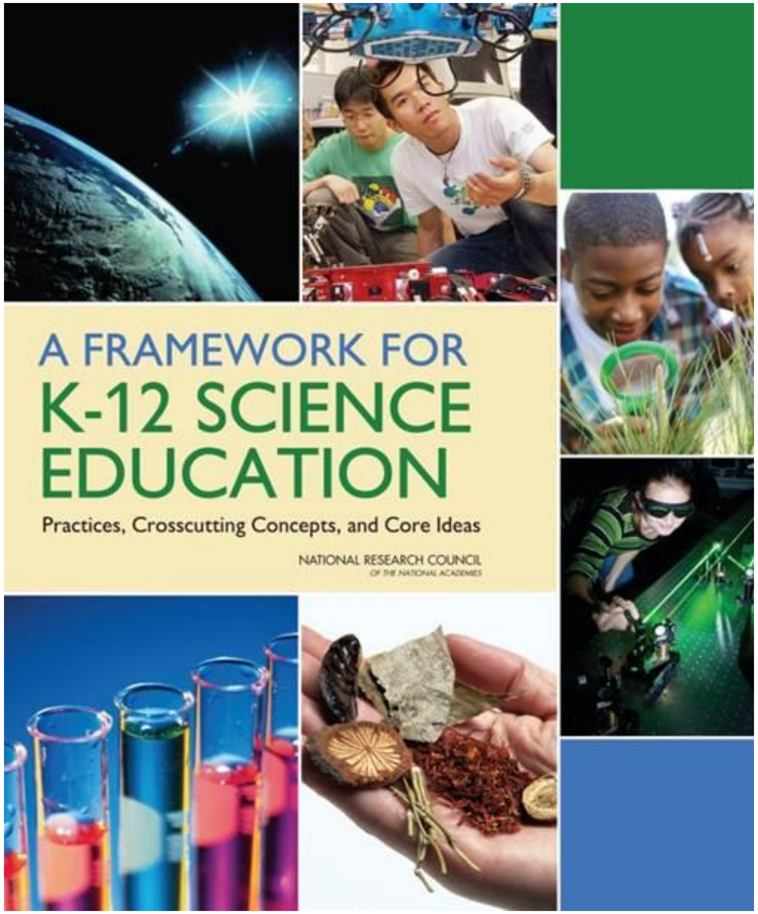
A Brief Example



- Earth & Space Sciences
- Dynamic interactions of systems
- Hydro, aero, geo…

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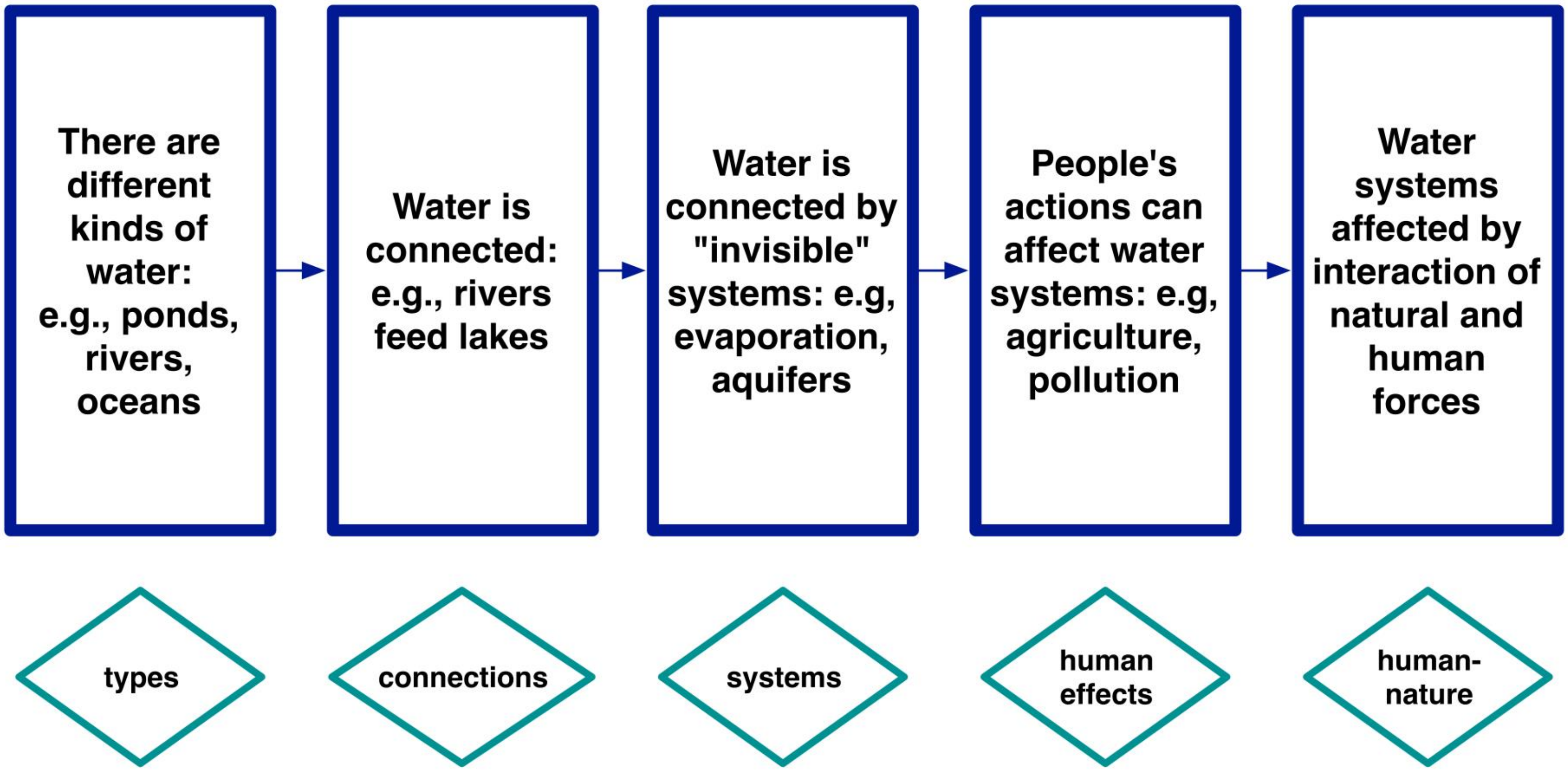
Water and Water Systems

From Observation to Scientific Reasoning



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Gunckel, K. L., Covitt, B. A., Salinas, I., & Anderson, C. W. (2012). A learning progression for water in socio-ecological systems. *Journal of Research in Science Teaching, 49*(7), 843-868.

Digging into Learning Progressions

How did they come about, what's their purpose, and what does it look like?

Andy Shouse
Washington STEM

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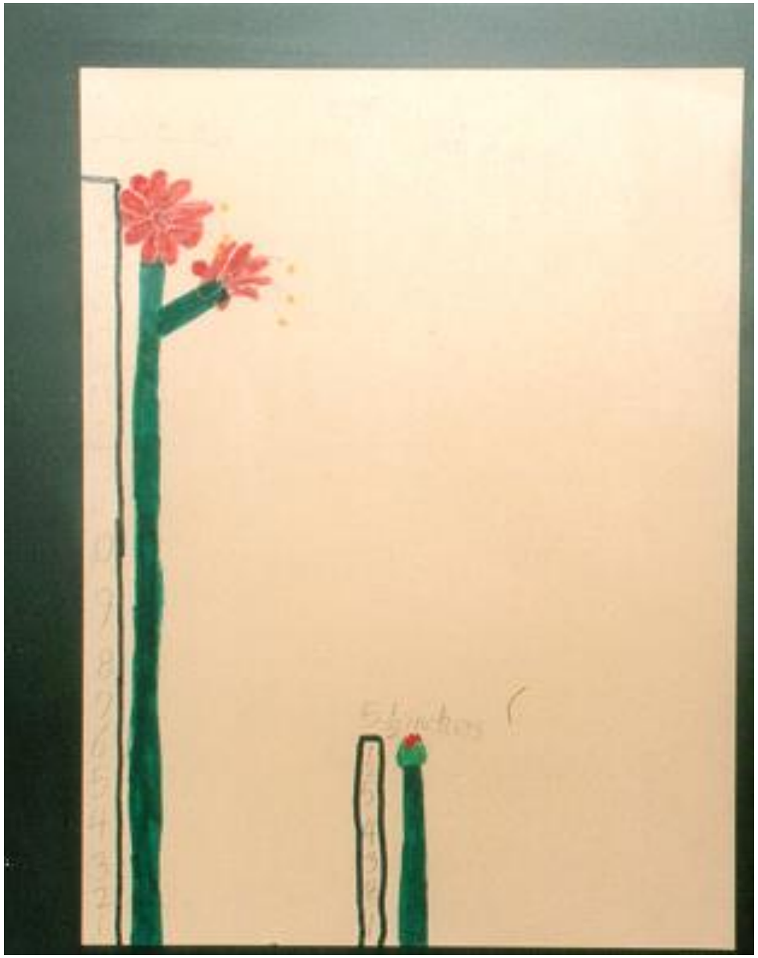
RESEARCH BASIS

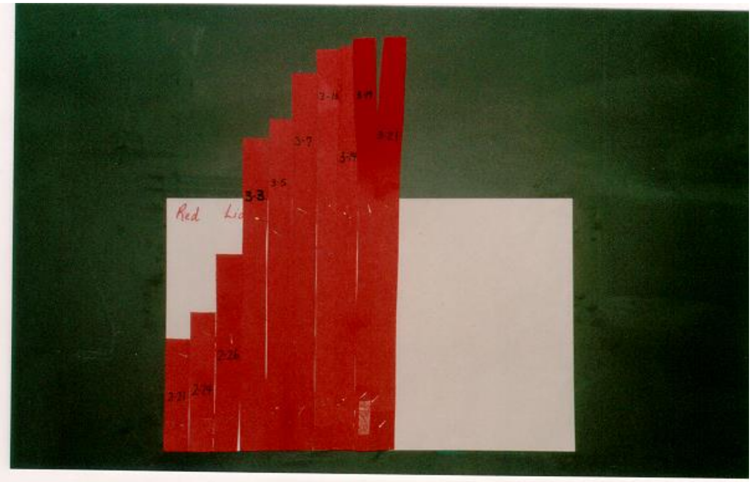
- Children entering school already have substantial knowledge of the natural world much of it implicit.
- Young children are NOT concrete and simplistic thinkers. (Research & standards have often under-estimated what children can do)
- Children can use a wide range of reasoning processes that form the underpinnings of “scientific thinking”

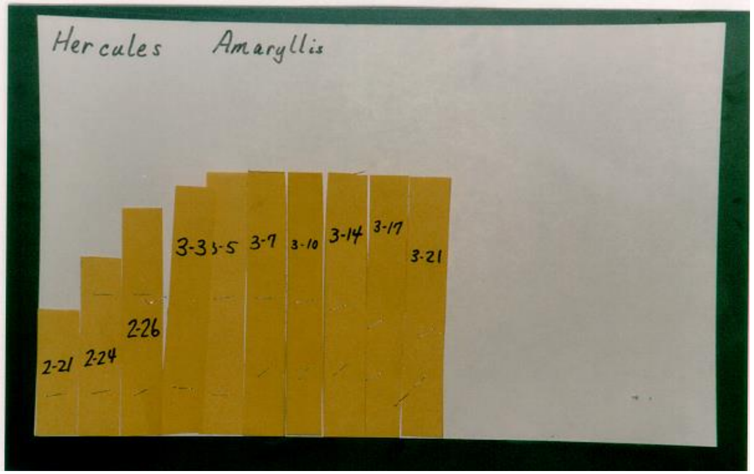
SUSTAINED EXPLORATION: LEARNING PROGRESSIONS

- Findings from research about children's learning and development can be used to map learning progressions in science.
- Steps in the progressions are constrained by children's understanding and ability to "do" science.
- Learning progressions
  - Revisit with increasing depth
  - Illustrate full cloth science – not merely facts/concepts and integrating "content and process"

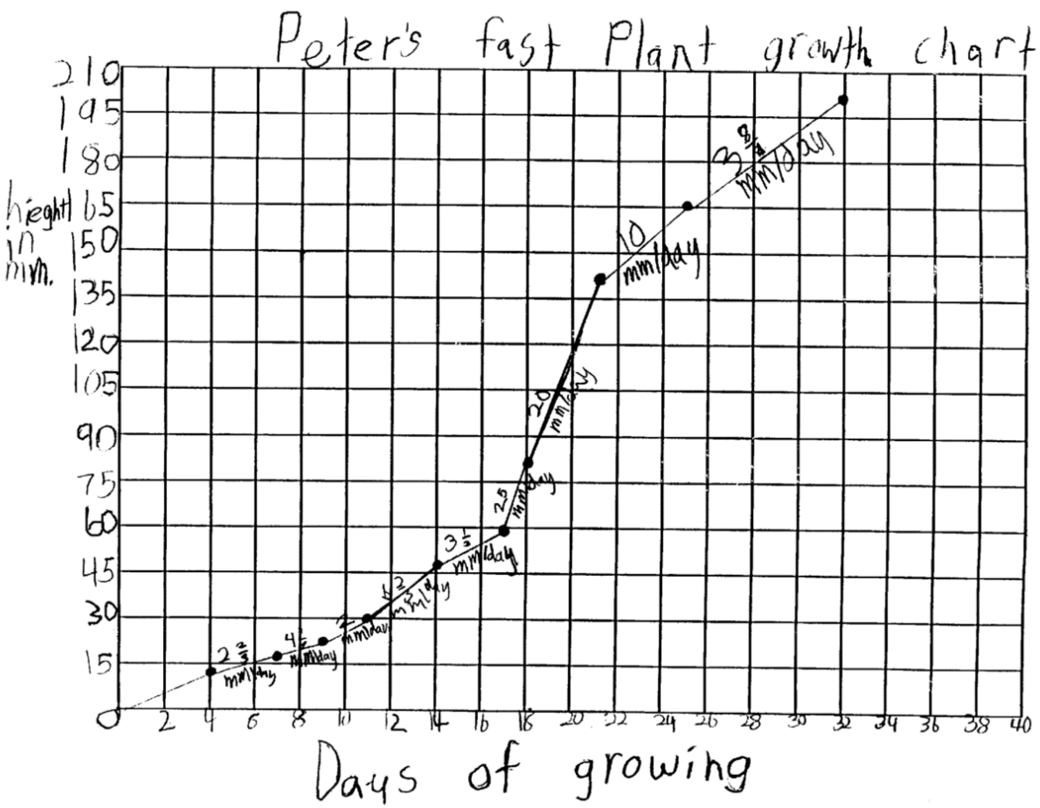
GROWTH: FIRST GRADE

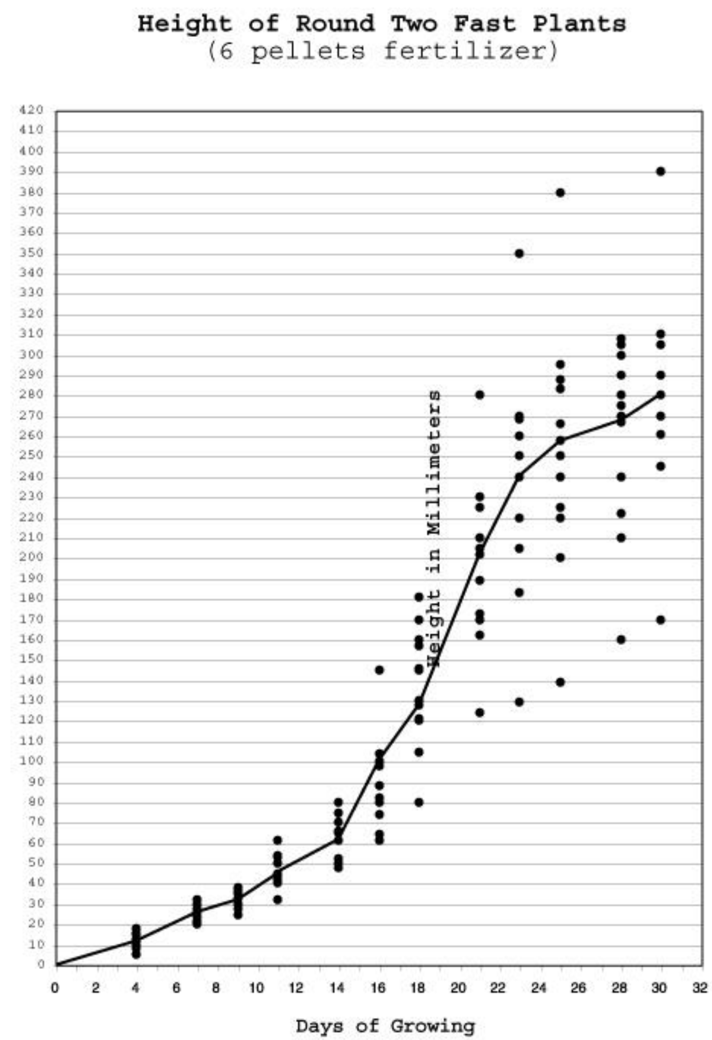






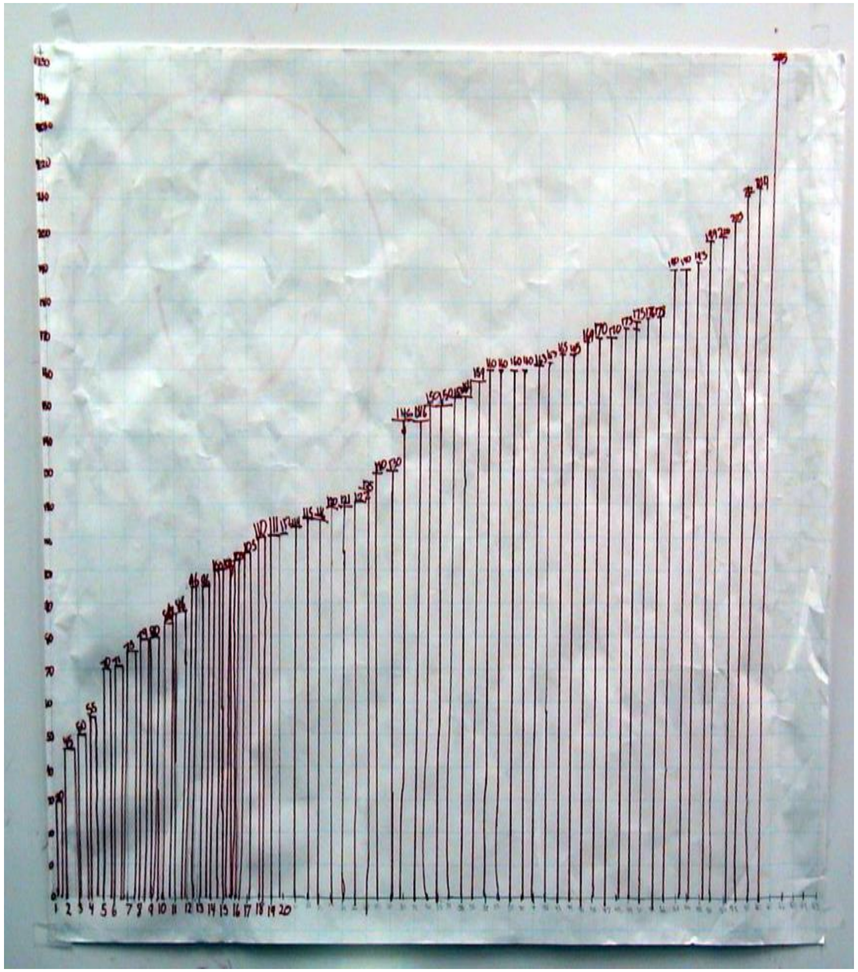
GROWTH: THIRD GRADE





GROWTH: FIFTH GRADE

SHIFTS IN DISTRIBUTION SIGNAL TRANSITIONS IN GROWTH PROCESSES



WHAT DOES THIS MEAN FOR EDUCATORS IN INFORMAL ENVIRONMENTS?

- When we present big problems to children we are inherently engaging them in topics they have knowledge about
- Their development can be deepened considerably with ongoing support and opportunities to engage with big ideas
- **Challenge:** Our opportunities to engage with children are episodic while their learning is continuous

EXAMPLE: CORE IDEAS IN A LEARNING PROGRESSION FOR EVOLUTION

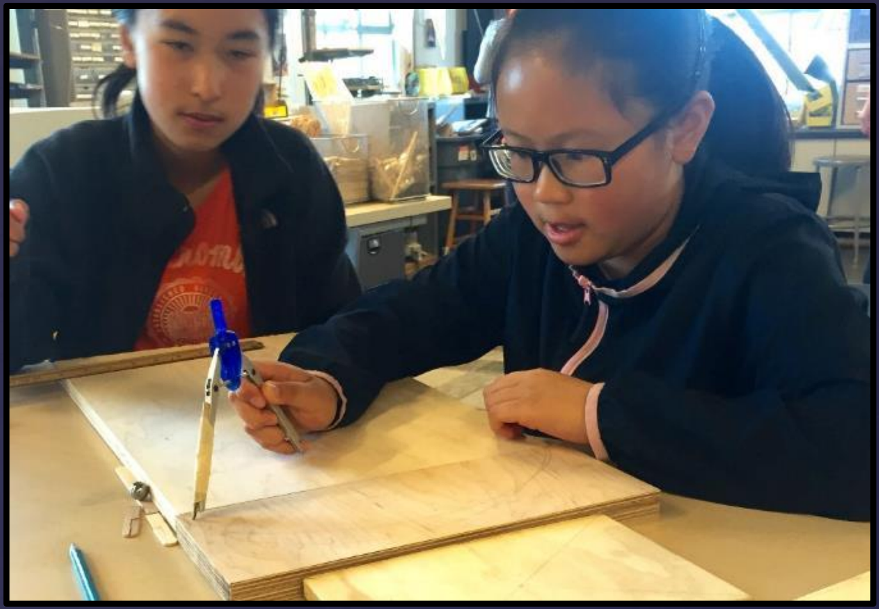
- Biodiversity
- Structure/function
- Interrelationships in ecosystems
- Individual variation
- Change over time
- Geological processes

Insights from the Field

- Engaging youth at every age
- Working with multi-age groups

Meg Escude
Exploratorium

After-School Tinkering Programs



Kindergarten through 6th Grade

Tinkering After-school Program at SF Boys & Girls Clubs

- Weekly workshop focused on STEM & the arts
- Adult & teen facilitators work with 6-12 year old youth

Middle School & High School

Tinkering Summer Program at the Exploratorium

- Weekly workshop focused on STEM & the arts for MS students
- Long-term progression from MS student to HS staff facilitator

exploratorium®

What do the same activities offer different age groups?

- Familiarity with concepts and practices from a very young age makes a deeper dive more accessible later.
- Afterschool is an opportunity for younger children to stretch into concepts not normally introduced until later & for older students to expand their understanding.
- The interdisciplinary of hands-on, creative projects means there are multiple areas of learning possible: tool use, narrative & storytelling, and STEM inquiry.

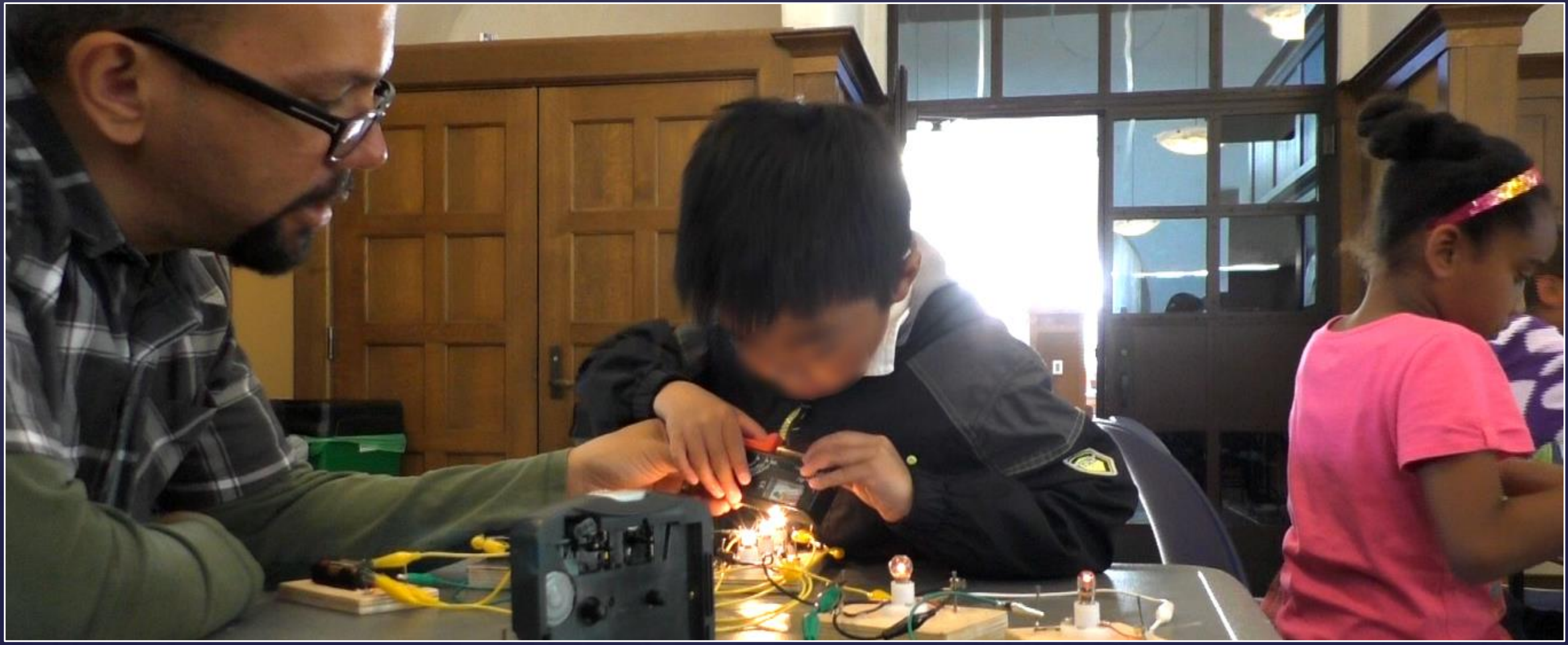
Vignette: Arthur's Circuit Exploration

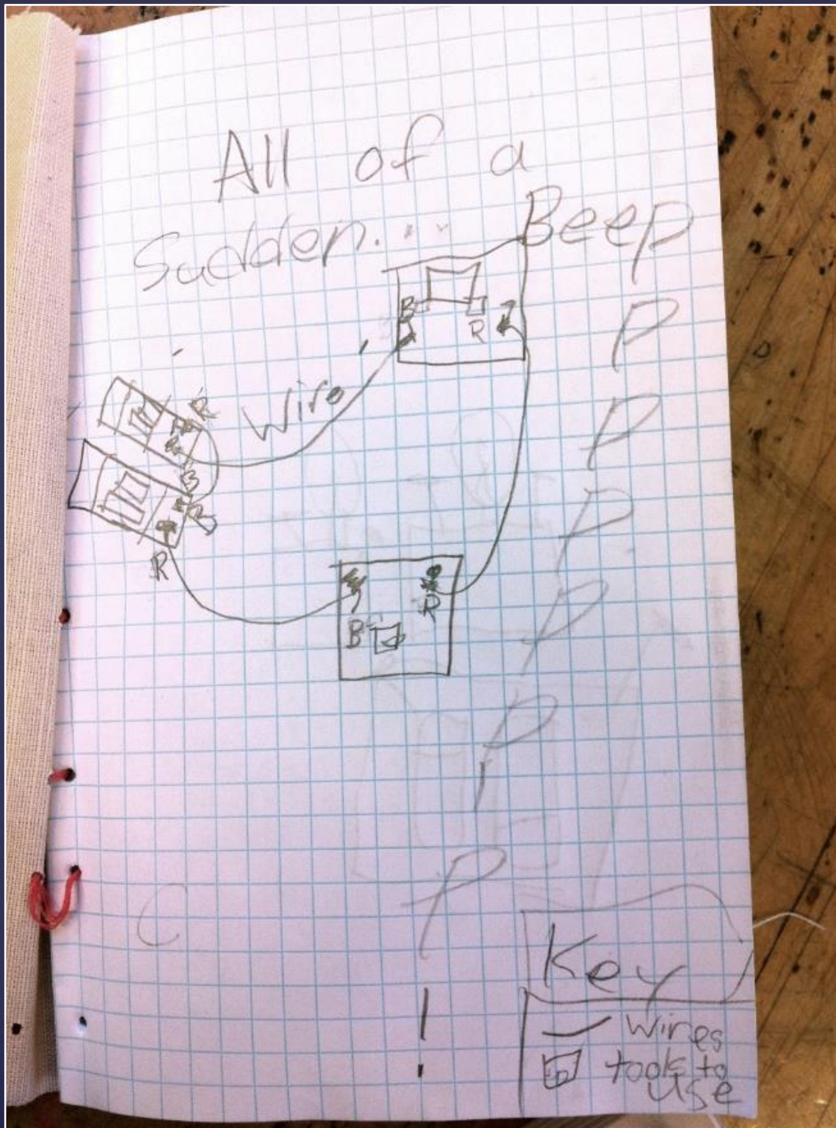
Arthur worked with Walter (a teacher) to explore circuitry. Arthur became excited when he realized that some of his lights were lit even though they weren't directly connected to the battery. **He then called others over to point out that some lights worked "without even batteries."** Using Arthur's own phrasing, Walter affirmed and then re-framed this statement, helping to clarify what was happening, "without even batteries going directly to those light bulbs."

Vignette: Arthur's Circuit Exploration

Arthur then asked Walter about a battery tester that was available on the table. After Walter explained the uses of the tool, **Arthur became fascinated and took a break from his circuit building in order to test all his batteries.** Following this detour, he periodically switched off his circuits and spoke about the need to save their energy.

(Adapted from field notes by Shirin Vossoughi, 2014)

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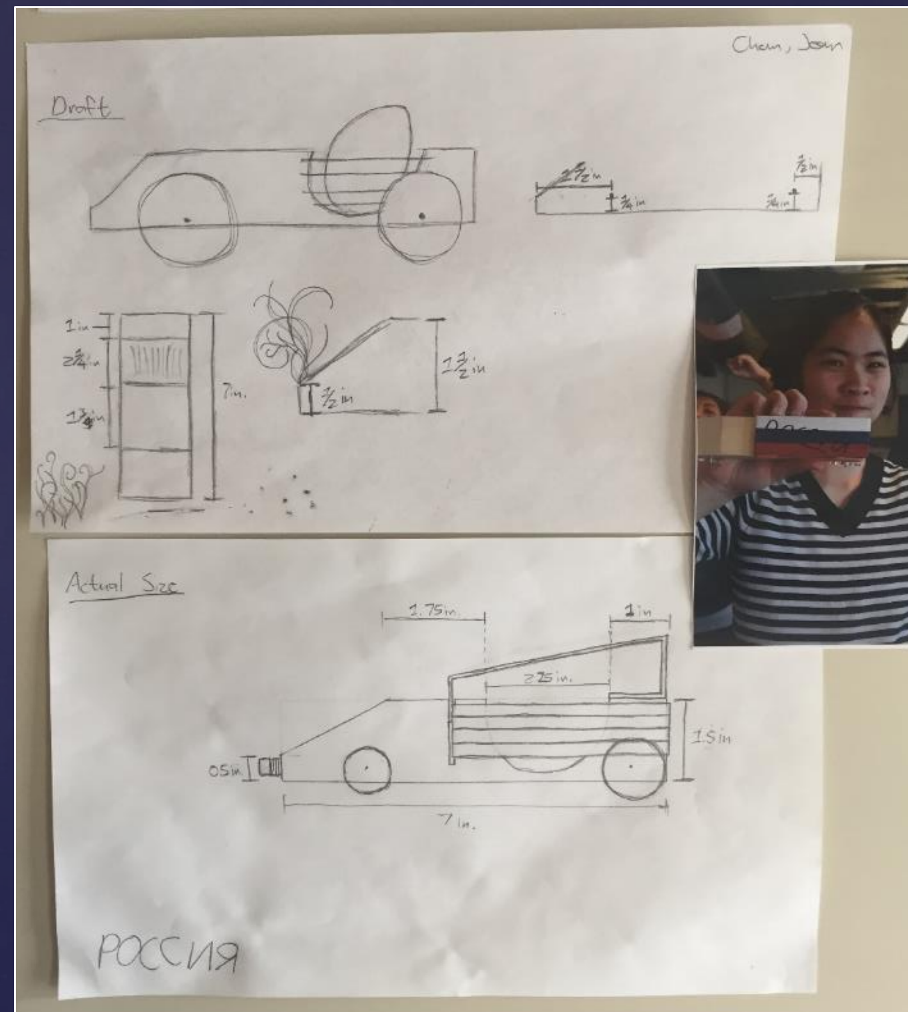
tools to use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РОССИЯ

Scaffolded Curriculum:

Multiple entry points & increased complexity for similar concepts

Kindergarten – 6th Grade:

Circuit Boards → Paper Circuits → Wearable Wire Circuits

Middle School & High School:

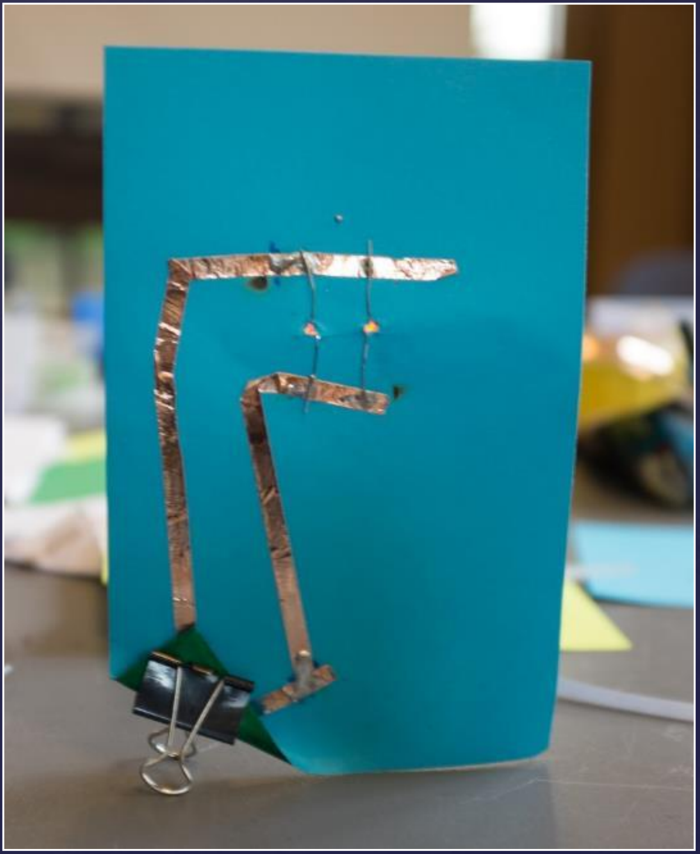
Marble Machines → Pin Mazes → Tabletop Pinball Machines

Age-appropriate Variations

allow for deepening understanding over time

Kindergarten-6th grade

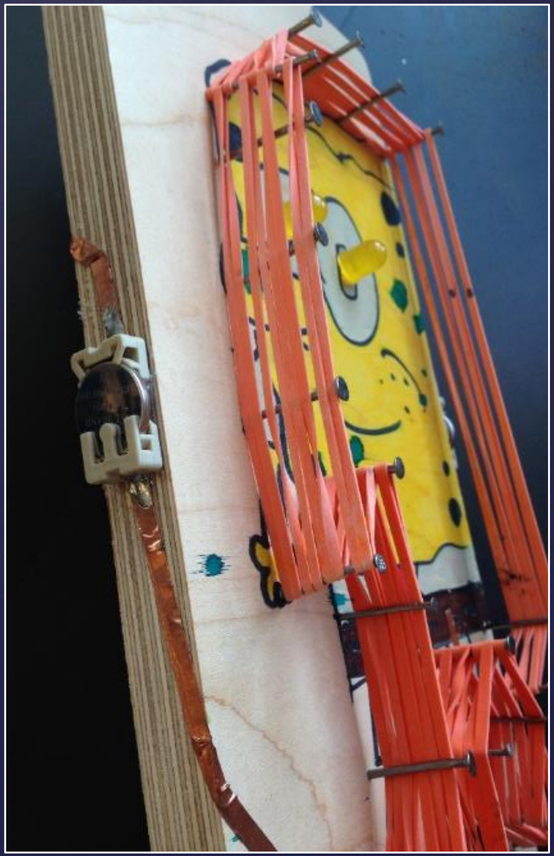
Paper Circuits: copper tape and LED lights merge circuitry with drawing



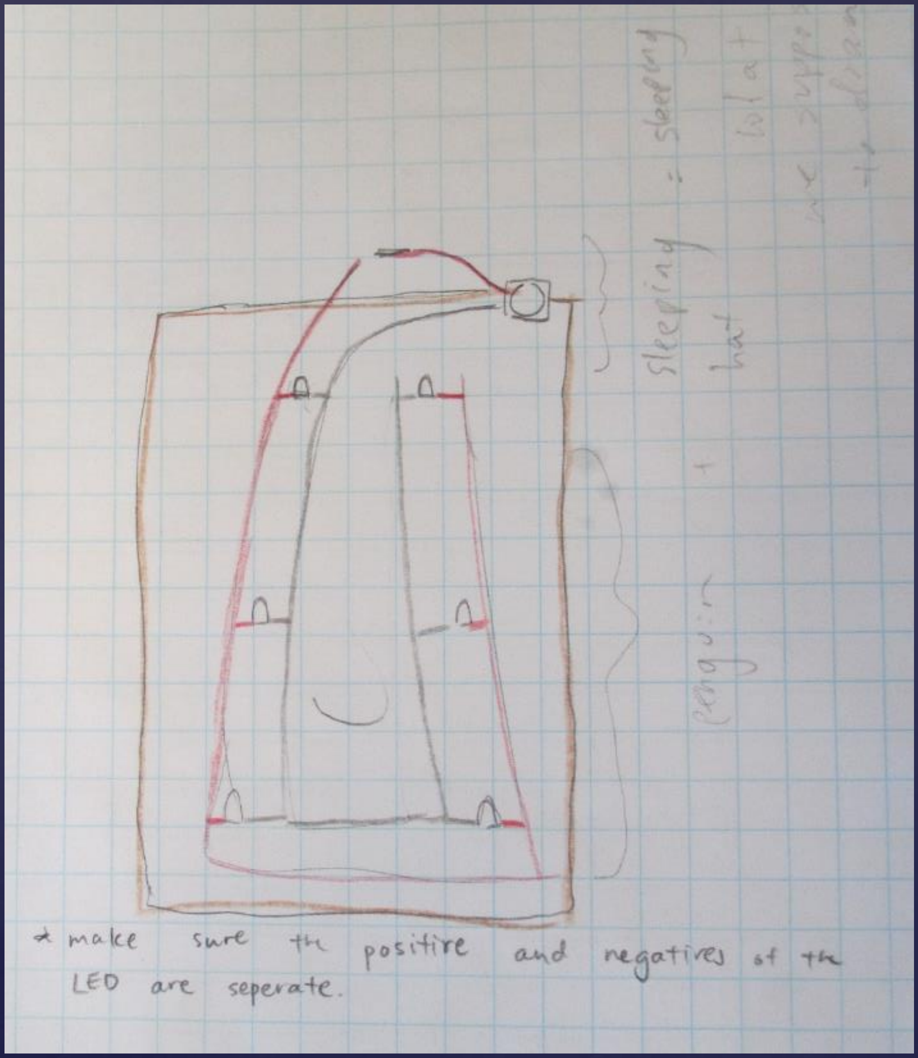
Age-appropriate Variations
allow for deepening understanding over time

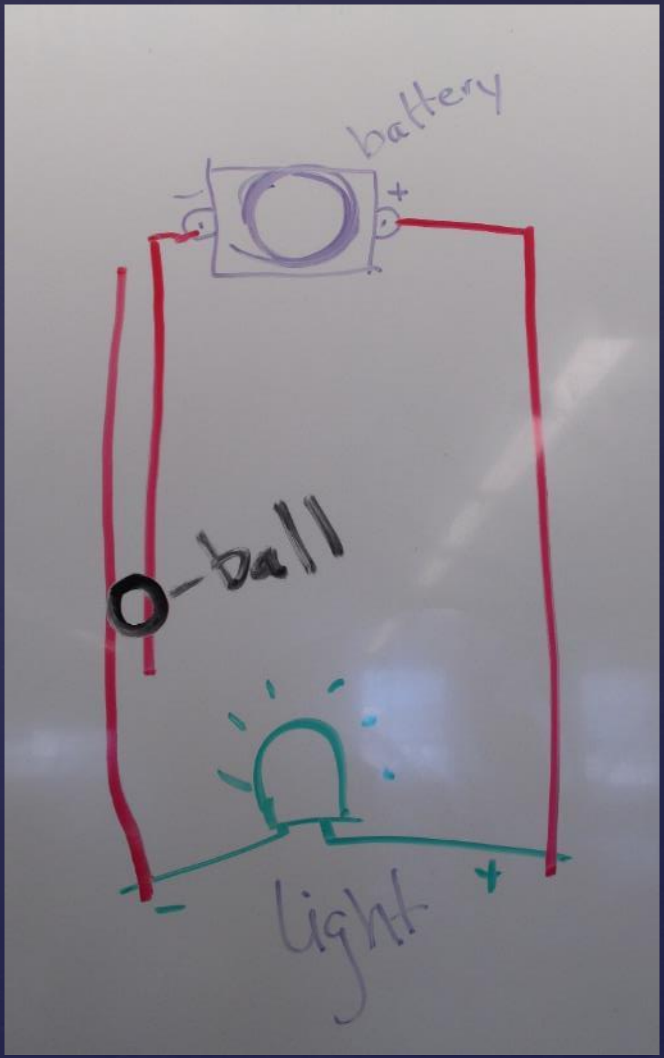
Middle School

Pin Mazes- Handheld games using a steel ball as switch to complete circuits as it passes through the game.



Circuit diagrams by HS facilitators made for teaching MS students

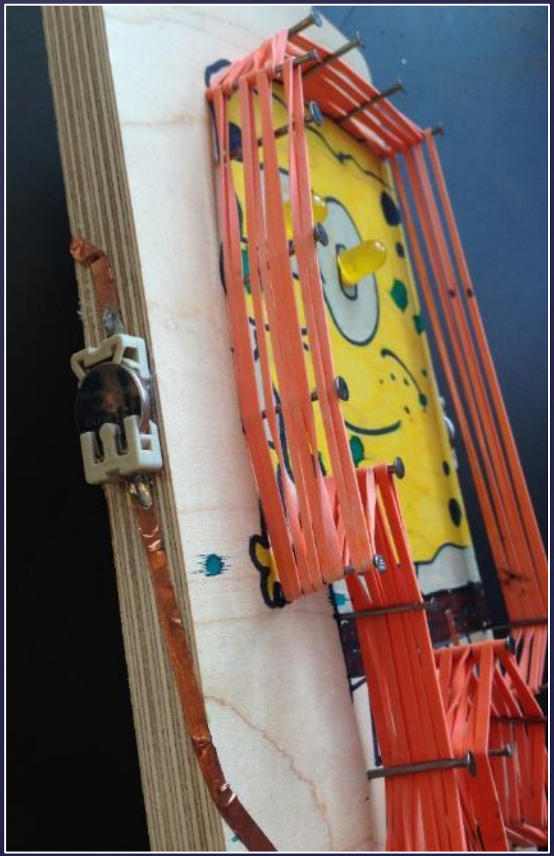




Scaffolded Curriculum:

Multiple entry points & increased complexity for similar concepts

Middle School: Circuit Boards → Pin Mazes → Pinball Machines



Training Afterschool Educators

Beth Unverzagt
Executive Director, OregonASK

Challenge Across the State:
Access to High-Quality STEM Programs

Types of afterschool STEM in Oregon:	
STEM-focused	**Comprehensive afterschool programs**
• National programs like MESA, Girls, Inc., or university-based • Low capacity • Urban focus, no rural • High cost	• 21st Century Community Learning Center (21CCLC) funded • Spotty access to high-quality curriculum • Difficultly in developing own curriculum

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Solutions

OregonASK Expanded Learning Partnership

State STEM Strategic Plan

- Development of STEM Hubs (11)
- Policy that acknowledges time and importance of afterschool & summer
- Increased partnerships with industry & schools

Our Network Work

- Training & Coaching
- SciGirls, Science Action Club (California Academy of Sciences), Afterschool Science Plus, Afterschool Math Plus, NASA's Afterschool Universe, BirdSleuth (Cornell Lab of Orinthology), and more!
- Curriculum development – elementary and middle

Learning Progressions in Our Work

Goals for Programs

1. Develop a deeper understanding of STEM curricula and structure while we focus on training educators in the thought process and facilitation techniques.
2. Build systems of training and TA for youth programs to implement high quality STEM

Examples

- SIN.Q Science Inquiry & Engineering Design for elementary and middle school
- Alignment with NGSS

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Expanded Learning Partnership

Thank you for attending!

Bronwyn Bevan
bronwynb@uw.edu

Meg Escude
mescude@exploratorium.edu

Melissa Ballard
mjballard@afterschoolalliance.org

Andy Shouse
andy@washingtonstem.org

Beth Unverzagt
beth.unverzagt@oregonask.org

Afterschool Snack Blog

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