The Next Generation Science Standards

What do they mean for afterschool?

Afterschool Alliance

National AfterSchool Association Conference
March 20, 2017

Melissa Ballard
Afterschool Alliance
mjballard@afterschoolalliance.org

Introductions

Session Overview

1. To “align”? (5 min)
2. NGSS 101 (5 min)
3. Digging into the standards (5 min)
4. Connections to afterschool (5 min)
5. Example (5 min)
6. Next steps (5 min)

Photo courtesy of Science Action Club, California Academy of Science

What does it mean to “align”?

What’s necessary for afterschool programs? Why?

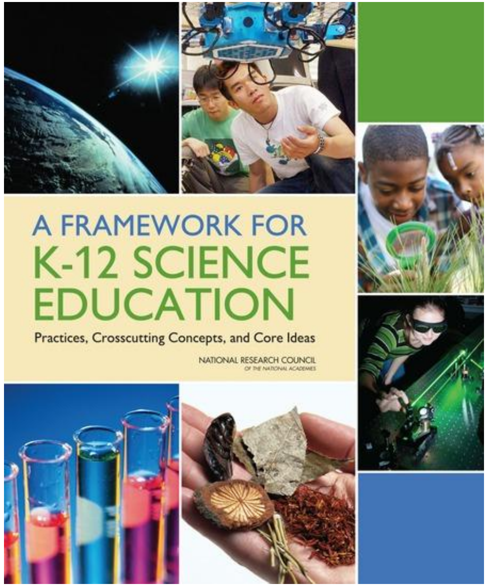
Bottom Line

What should you take away from this session?

- Easy ways to check the box of "alignment"
- A challenge to change practice (if you want it)
- Committed STEM educators should dig in!
- Opportunity to build relationships

NGSS 101

How to teach & learn STEM



A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (2012)

1. Science education should resemble the way scientists actually work and think
2. Instruction should reflect research on learning
3. Importance of building coherent understandings over time

Things to know

- Great need for new standards
- Multiple goals, which include science literacy
- Engineering design / technology integrated
- “Performance expectations” not memorizing facts
- Concern for diverse populations & underserved students

NEXT GENERATION SCIENCE STANDARDS
For States, By States

www.nextgenscience.org

Development process

- National Academy of Sciences, American Association for the Advancement of Science, & the National Science Teachers Association (managed by Achieve, Inc.)
- 41 writers, guided by 26 states, each with teams of 50-150
- Included teachers; higher education faculty; scientists & engineers; workforce experts
- Twice open for public feedback

Where is NGSS?

Officially Adopted*:

Arkansas
California
Connecticut
D.C.
Delaware
Hawaii
Illinois
Iowa
Kansas
Kentucky
Maryland
Michigan
Nevada
New Hampshire
New Jersey
New York
Oregon
Rhode Island
Vermont
Washington

Considering:

Florida
Maine
New Mexico
Ohio

Adapted:

Montana
Wyoming

* Many districts and schools have adopted NGSS, regardless of what their state is doing.

Digging into the standards

Three Dimensions of Science

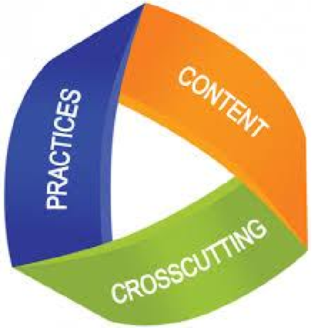
1. **Concepts:** Fewer to learn, allowing educators to deeper (called the "Disciplinary Core Ideas")
2. **Cross-Cutting Themes:** Big ideas within science that connect to the various fields (e.g. scale, patterns, systems…)
3. **STEM Practices:** Behaviors that scientists engage in as they investigate the natural world + what engineers do as they design and build models and systems

Disciplinary Core Ideas

1. **Physical Science** (Matter; Force & Motion; Energy; Waves)
2. **Life Science** (Organisms; Ecosystems; Heredity; Evolution)
3. **Earth & Space Science** (Earth's Systems; Human Impacts, including Climate Change; Earth & the Universe)
4. **NEW: Engineering, Tech, & their Applications** (Engineering Design; Links to Society)

Cross-Cutting Concepts

1. Patterns
2. Cause & effect
3. **Scale, proportion, & quantity**
4. Systems & system models
5. Energy & matter
6. Structure & function
7. Stability & change



Example: Scale, proportion, & quantity

- Cross-cutting concepts are relevant to **multiple science & engineering disciplines**:
    - Within **earth & space science**, students might need to understand the relative sizes of & distances between planets.
    - Within **physical science**, students might need to understand the relative size of electrons, atoms, and molecules.
- When the concept of scale is repeated across disciplines and in different contexts, students are better able to grasp these concepts, developing a **coherent and scientific view of the world**.
- Every year, students **expand & deepen their understanding** of each crosscutting concept.
    - Kindergarteners would use **relative scales** like hotter and colder, faster and slower.
    - In elementary school, students will take **measurements using standard units**.
    - In middle school, they might look at **proportional relationships** & use **equations**.

STEM Practices

1. **Asking questions, defining problems**
2. **Planning & carry out investigations**
3. Analyzing & interpreting data
4. Developing & using models
5. Constructing explanations, designing solutions
6. Engaging in argument from evidence
7. Using mathematical & computational thinking
8. Obtaining, evaluating & communicating information

Students who demonstrate understanding can:

3-5-ETS1-1. **Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.**

3-5-ETS1-2. **Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.**

3-5-ETS1-3. **Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)

ETS1.B: Developing Possible Solutions

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

ETS1.C: Optimizing the Design Solution

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World

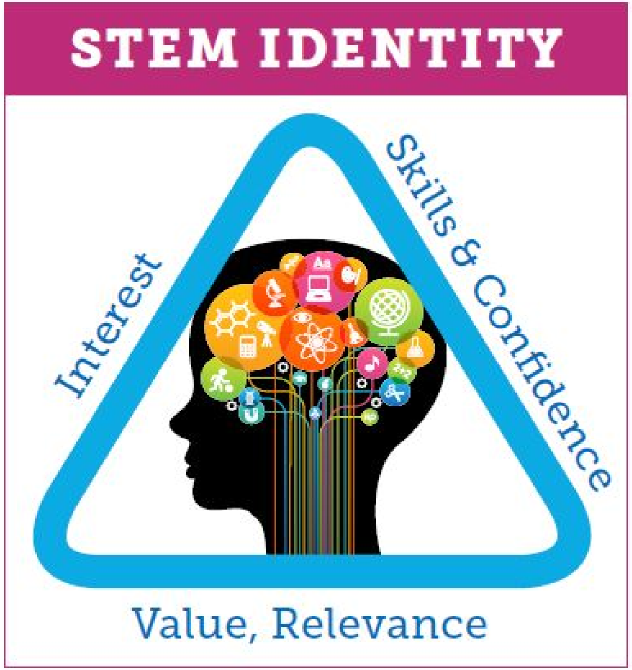
- People's needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1)
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

Preview: Engineering Design for Grades 3-5

Role of afterschool

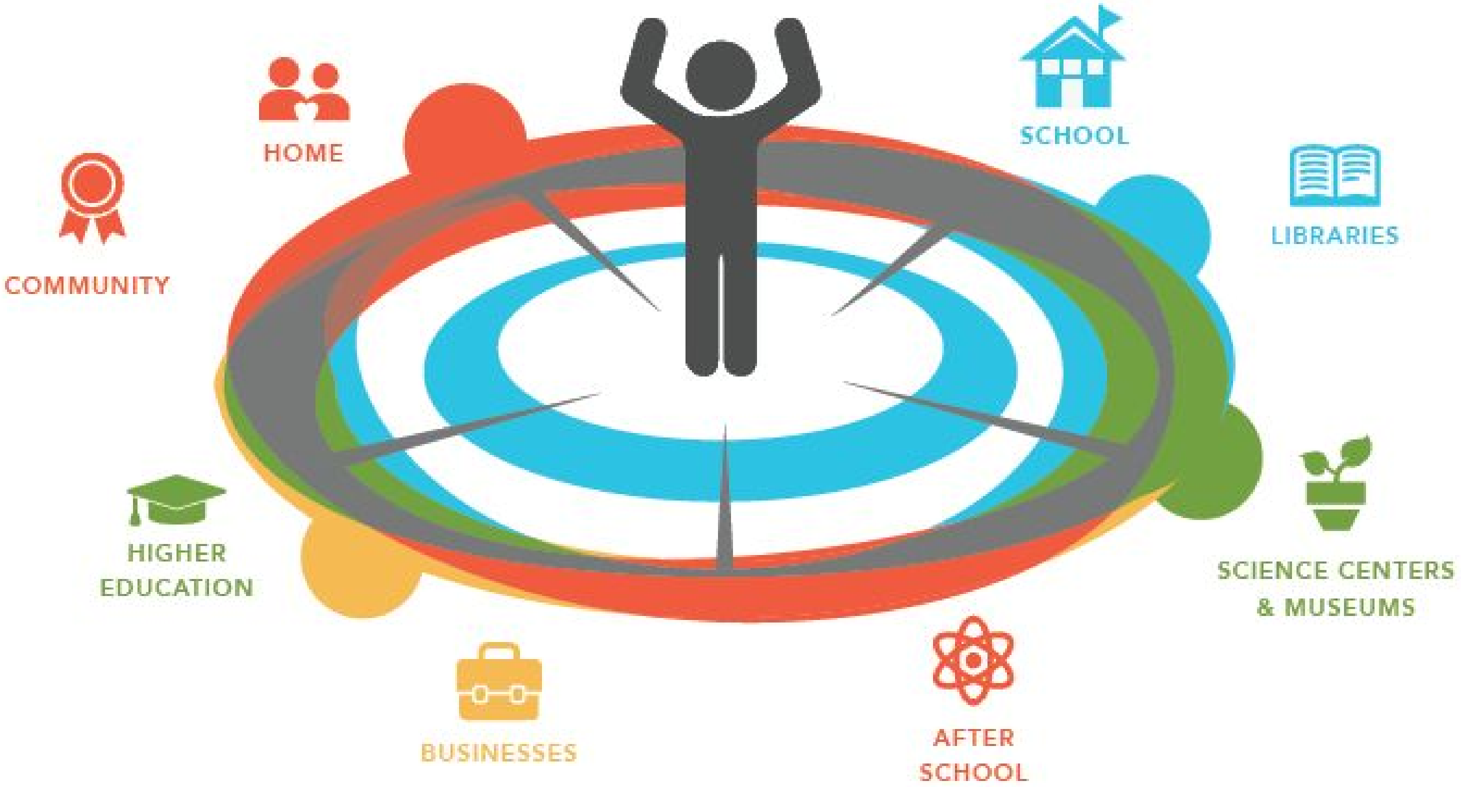
Defining the problem

Source:
http://afterschoolalliance.org/documents/STEMinAfterschool_Web.pdf



- Identity plays a huge role in kids' success in K-12 STEM, as well as their future college & career aspirations.
- Some kids have negative experiences in the classroom, or face challenging parent & community attitudes.
- Equity is not just about equal access.

I **like** to do this. | I **can** do this. | I **want** to do this!

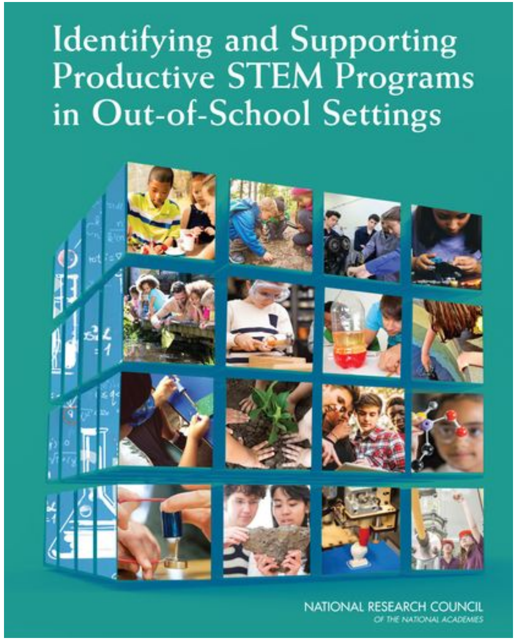


Kids learn in many settings

Source: stemecosystems.org/design-principles

What afterschool STEM does best

1. Provides **first-hand experiences** with phenomena, concepts, and practices that are both intellectually and socio-emotionally engaging.
2. **Recognizes & builds on** young people's interests, prior experiences, and cultural resources (which vary across communities).
3. Actively **makes connections** to STEM ideas and experiences in school, at home, and in future learning and work opportunities.



Identifying and Supporting Productive STEM Programs in Out-of-School Settings (2015)

An example

GET City: Boys & Girls Club of Lansing, MI and Michigan State University

Science Topics

Urban heat islands: Energy use & the environment

Energy crisis? City's energy production vs. demand, and it's carbon footprint.

Alternatives: Renewable energy & its connection to climate change.

Green Jobs: Green energy technologies & local opportunities.

Community Action

How can we save energy? Energy conservation & efficiency: audits, practices & policies.

Should Lansing build a new power plant? Arguments for/against a coal/biomass hybrid power plant

Can Green Design help? Green roofs in & around town.

Technology

Data gathering and analysis: Local & national databases; GIS; digital probes; MS Excel; online surveys; photography & and video capture

Communication: Blogging; podcasting; web design, i-Movie

http://invincibility.us/

Reactions?

Remember:

- **NGSS is a document for schools & districts!**
    - **We don't need to *implement* NGSS, rather we need to *strategically relate* to the vision (read the Framework).**
- Strategy won't look the same from across afterschool programs
    - Depends on your resources and strengths, as well as the youth you serve.
- Challenge to improve practice of afterschool educators--most adults are familiar with the "Scientific Process", i.e. Practices #1-2. Practices #3-8 are new for most non-STEM majors!

- Read the Framework and keep learning!
- Figure out what’s appropriate for your program
- Check in with your school or district
- Get in on the conversation (even citywide or regional)
- Cultivate partnerships with STEM education stakeholders

Next steps

NASA

techbridge
Inspire a girl to change the world.

DESIGN SQUAD

EiE Engineering is Elementary
Developed by the Museum of Science, Boston

NASA Wavelength
Afterschool Universe
Summer of Innovation

Multiverse
UC Berkeley Space
Sciences Laboratory

CALIFORNIA ACADEMY OF SCIENCES
SCIENCE ACTION CLUB

fhi360
THE SCIENCE OF IMPROVING LIVES

Afterschool Science Plus
Afterschool Math Plus

The Cornell Lab of Ornithology
BirdSleuth K–12

exploratorium

SciGirls

www.afterschoolalliance.org/STEM-curriculum.cfm

High-quality OST curriculum is "aligned"

Thank you!

Melissa Ballard, Afterschool Alliance
mjballard@afterschoolalliance.org

Afterschool Alliance

Guide & webinar series:

afterschoolalliance.org/STEM-NGSS.cfm

For all things STEM & afterschool:

afterschoolalliance.org/STEM