The Next Generation Science Standards

What do they mean for afterschool?

Afterschool Alliance

National AfterSchool Association Conference
March 20, 2017
Introductions

Melissa Ballard
Afterschool Alliance
mjballard@afterschoolalliance.org
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
How to teach & learn STEM

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

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

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 go 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."

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asking Questions and Defining Problems</td>
<td>ETS1A: Defining and Delimiting Engineering Problems</td>
<td>Influence of Science, Engineering, and Technology on Society and the Natural World</td>
</tr>
<tr>
<td>Planning and Carrying Out Investigations</td>
<td>▪ 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)</td>
<td>▪ People’s needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1)</td>
</tr>
<tr>
<td>Constructing Explanations and Designing Solutions</td>
<td>ETS1B: Developing Possible Solutions</td>
<td>▪ Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)</td>
</tr>
<tr>
<td>▪ 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)</td>
<td>▪ 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)</td>
<td>▪ 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)</td>
</tr>
<tr>
<td>▪ 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)</td>
<td>▪ 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)</td>
<td>▪ 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)</td>
</tr>
<tr>
<td>▪ 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-ETS1-2)</td>
<td>▪ ▪</td>
<td></td>
</tr>
</tbody>
</table>

**Preview:** Engineering Design for Grades 3-5
Role of afterschool
Defining the problem

- **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.

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.

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


Technology

Data gathering and analysis: Local & national databases; GIS; digital probes; MS Excel; online surveys; photography & 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!
Next steps

- 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
High-quality OST curriculum is “aligned”
Thank you!

Melissa Ballard, Afterschool Alliance
mjballard@afterschoolalliance.org

Guide & webinar series:
afterschoolalliance.org/STEM-NGSS.cfm

For all things STEM & afterschool:
afterschoolalliance.org/STEM