SCIENCE STANDARDS FOR ALASKA (SSA’s) 6-8 Webinar

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Alaska Department of Education & Early Development
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Icebreaker Padlet - What is good science teaching to you?

1. Introduce yourself.

1. Where are you from?

1. What do you think makes effective science teaching?

1. Rate your level of awareness with the SSA’s (1-5)

1 - Completely Unfamiliar

2 - Somewhat familiar, more comfortable with NGSS

3 - Understand and implement DCI's

4 - Understand the key changes from NGSS and am attempting to unpack and apply the three dimensions

5 - Very aware and familiar with implementing the three dimensions
Objectives

➔ What are the Science Standards of Alaska (SSA)?
➔ GLE vs. NGSS vs SSA
  ◦ What is 3 dimensional Science teaching?
  ◦ Phenomena, storyline, performance expectations
➔ Transferring existing lessons to SSA friendly lessons
  ◦ Integration of all 3 dimensions
➔ Resources for teaching with the SSAs
Rigor, Relevance, and Equity

❖ Address complex situations and questions
❖ Assuring ALL students have access to “the real thing,” - challenging explorations and problem-solving that develops science thinking and doing
❖ Focus on phenomena familiar to students
GLE’s → Alaska’s grade level expectations for understanding adopted in the early 2000’s; identified as performance standards.

“Core content to be mastered”
NGSS → developed by a team of scientists and educators, adopted in some form by at least 20 states. Goal is to assure that science is for every student and growing scientific thinking, investigating, and communicating is essential to problem-solving in contemporary society.

**MS-ESS2-2 Earth's Systems**

Students who demonstrate understanding can:

**MS-ESS2-2.** Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]

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

**Science and Engineering Practices**

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future.

**Disciplinary Core Ideas**

**ESS2.A: Earth's Materials and Systems**

- The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.

**ESS2.C: The Roles of Water in Earth's Surface Processes**

- Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.

**Crosscutting Concepts**

**Scale Proportion and Quantity**

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
Science Standards for Alaska (SSAs)

SSA→ developed by a team of Alaska educators, sometimes working in grade band groups, guided by veteran facilitators; carefully reviewed and adapted elements of the Framework for K-12 Science Education to incorporate relevant Alaska examples in the content and performance expectations.

Intended as a **guide to developing curriculum** meaningful to each District.
The BIG Picture:

**Growing science minds**

Phenomena are in everyone’s lives! not just for professional pursuits but decision-making in our lives. 3-dimensions build a strong foundation for engaging in more complex ideas grade-to-grade.

**Storylines**

weave concepts together for progression and students making sense of ideas in their own way.

**Performance Expectations**

incorporate all three dimensions.

**3 Dimensions**

are: disciplinary core ideas (DCI), cross-cutting concepts (CCC), Science and Engineering Practices (SEP).
Disciplinary core ideas (DCI) ➔ (key principles for that topic)

Cross-cutting concepts (CCC) ➔ (broad principles that show up across the fields of science)

Science and Engineering Practices (SEP) ➔ (how science is pursued to reach conclusions)
Key Shifts

➔ "Three dimensions": ALL are essential throughout lessons and units
  ◆ 1. Practices: what do we do to investigate and understand science
  ◆ 2. Core Ideas: important principles applicable to investigation
  ◆ 3. Cross-Cutting Concepts: “big ideas” that are woven throughout science disciplines

➔ Performance Expectations use new verbs

➔ Fewer content topics per year (depth vs. breadth)

➔ Phenomena (real, authentic, observable in nature)

➔ Storyline

➔ Less emphasis on rote learning

➔ Vocabulary introduced as needed

➔ Engineering incorporated into science content
Common Language & Finding Phenomena

Phenomenon: Coastal Erosion and Thawing Permafrost

https://www.alaska.edu/k12reach/grade6-8lessons-theme2.php
Landscape Changes in Alaska-Mountain

Photo by Tom Ganner    Haines, AK 2020
Landscape Changes in Alaska-Ocean

Shishmaref, AK
Exploring Phenomena:

Unit Idea: What evidence is there that change in climate is influencing landscape changes in Alaska?

Mendenhall Glacier, Juneau AK  Photo courtesy: Alexandria Tannehill 2020
→ How the pieces fit together for the overall understanding of the standards for that grade (found in the standards document)

OR

→ Can be written as a way to tie together bundled standards (ex. climate and geoscience)
Disciplinary Core Ideas:

(key principles for that topic)

➔ System interactions have shaped Earth's history with varying scales and time frames and will determine its future over varying scales.

➔ Water's movements cause weathering and erosion which change the earth's surface features.

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MS-ESS2-2

Students who demonstrate understanding can: Construct and present an evidence-based explanation of how geoscience processes have changed Earth's surface at varying time and spatial scales.

Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.

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Cross-cutting Concepts:
(broad principles that show up across the fields of science)

➔ Choose one or two to emphasize.

➔ Often several can be applied.

That’s why they are considered the “big ideas” of science.

- Energy and Matter
- Patterns
- Cause and Effect
- Scale, Proportion and Quantity
- Systems and System Models
- Stability and Change
- Structure and Function

https://ngss.nsta.org/crosscuttingconceptsfull.aspx
Science and Engineering Practices: (how science is pursued to reach conclusions)

→ Choose one or two for a lesson.
→ Consider using all of them across a unit.

- Asking questions and defining problems.
- Developing and using models.
- Planning and carrying out investigations.
- Analyzing and interpreting data.
- Using mathematics and computational thinking.
- Constructing explanations and defining solutions.
- Engaging in argument from evidence.
- Obtaining, evaluating, and communicating information.
Integrating Engineering

Engineering is best integrated into lessons that incorporate **all three dimensions**

→ The focus of engineering is **solving problems**

- Example: How can a road safely be built across landslide area?
- How can the shoreline damage be slowed?
Prior knowledge

All three dimensions are progressive across the grades

DCI for Geoscience and climate

4th Grade:

4-ESS2-1 Make **observations and/or measurements** to provide **evidence** of the **effects** of weathering on the rate of erosion by water, ice, wind, or vegetation.

4-ESS2-2 Analyze and interpret data from maps to describe **patterns** of Earth’s features.

4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of **natural Earth process** on humans.

5th Grade:

5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and cryosphere, and/or atmosphere **interact**.
Breakout Session

Discuss ways you are already applying one of the three dimensions in your current teaching.

→ Disciplinary Core Ideas
→ Cross Cutting Concepts
→ Science and Engineering Practices
Lesson/Unit Examples

★ Modeling effect of rainfall rate on various soils.
  ➔ Using stream table or other flat container
  ➔ Plastic containers with different sizes or number of holes punched in them to apply the water

★ Analyzing weather data around various rapid erosion events in coastal Alaska

★ Reading topographic maps and evaluating risks

★ Tsunami effect of landslides displacing water in a narrow waterway
Performance Expectations

➔ Describes what students should be able to do by the end of a unit or multiple units or even the end of the year.

➔ “Construct and present an evidence-based explanation of how geoscience processes have changed Earth’s surface at varying time and spatial scales.”

➔ Since this unit includes reference to climate change as well, it could also include a PE related to that.

(The middle school climate change PE references human-related causes, which this unit doesn’t incorporate. It still does give a chance for an initial exploration of weather data.)
Phenomena Song!

Ted Willard @TedWillard2061 · Feb 4, 2016
I wrote some lyrics to the muppets “phenomena” song. #ngsschat

Muppets “Phenomena” Song

Phenomena are events in nature
Phenomena: Let’s investigate
Phenomena are events in nature
that scientists and students
investigate and then try to explain
Comonalties Among the Practices in Science, Mathematics and English Language Arts

Math
- M1: Make sense of problems and persevere in solving them
- M2: Reason abstractly and quantitatively
- M6: Attend to precision
- M7: Look for and make use of structure
- M8: Look for and make use of regularity in repeated reasoning
- M4: Models with mathematics
- S2: Develop and use models
- S5: Use mathematics and computational thinking

Science
- S1: Ask questions and define problems
- S3: Plan and carry out investigations
- S4: Analyze and interpret data
- S6: Construct explanations and design solutions

ELA
- E1: Demonstrate independence in reading complex texts, and writing and speaking about them
- E2: Build a strong base of knowledge through content rich texts
- E3: Obtain, synthesize, and report findings clearly and effectively in response to task and purpose
- E4: Construct viable arguments and critique reasoning of others
- E5: Read, write, and speak grounded in evidence
- E6: Use technology and digital media strategically and capably
- M5: Use appropriate tools strategically
- M3 & M4: Construct viable arguments and critique reasoning of others
- S7: Engage in evidenced argument from evidence

Commonalities Among the Practices in Science, Mathematics and English Language Arts

Based on work by Tina Cheuk ell.stanford.edu

www.nsta.org/ngss
Math and Literacy Links

- **News and magazine articles:**
  - read and write them

- **Radio stories:**
  - listening and creating mock broadcasts

- **Reading survival stories**

- **Weather data**
  - including graphs of change

- **Measurements and estimation**
  - of magnitude of landslides and coastal bluff setbacks

- **Analyzing force**

- **Calculating cost of damage**
Teacher Reflection: How does the activity students are doing incorporate the SSA’s?
Integration of Science Technology

Develop understanding of how technology advances science and science can be applied to design

→ Instruments used to gather data
→ Tools of communications to present data and model conclusions

→ etc. **MORE THAN JUST A PLATFORM OF DELIVERY!**
Integrating across fields of science

| Change of state → (thawing of permafrost changes soil horizons and shore bluffs, heavy rains on frozen soil in southeast) |
| Slow decay → creates thick layer of debris in southeast, reduces vegetation cover in tundra |
| Old trees have held soil in place for years |
| Gravitational force → on a steep slope and effect on heavy masses |
| Effects of energy → waves on bluffs, slide gaining speed |
| Landscape effect on microevolution → Salmon are getting smaller |
Assessing Students

Shift in approach in classroom assessments:

→ Equity
→ Incorporate all three dimensions
   Ex: model, evaluate an experiment, argue from evidence
→ Minimize “right vs wrong” rote answers
→ “Doing” is not all--- explaining & sharing ideas is key
→ Experience = demonstrating genuine learning
   → Discrepant events may be a resource
   → Students see themselves as scientists

SNAP = Stanford NGSS Assessment Project
TAPS = Task Annotation Project in Science
Achieve’s Science Cognitive Complexity Framework
Publications from Page Keely and associates
### Assessing Students Resource Links

<table>
<thead>
<tr>
<th>Resource</th>
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<td>Page Keely references</td>
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<td><a href="https://www.uncoveringstudentideas.org/books">https://www.uncoveringstudentideas.org/books</a></td>
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### 3D Tasks require a series of judgements at the item level

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<tr>
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<th>SEP</th>
<th>DCI [Conceptual - disciplinary]</th>
<th>CCC [Conceptual - crosscutting]</th>
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<td>High</td>
<td>Figuring out a phenomenon or problem using multiple SEPs in service of authentic sense-making.</td>
<td>Non-routine use of domain specific science ideas as part of sense-making.</td>
<td>Selection and use of conceptual understanding of crosscutting ideas is necessary and expands students' thinking.</td>
</tr>
<tr>
<td>Medium</td>
<td>Representation of ideas; use of skills that are relatively complex; some close application.</td>
<td>Supported application of science ideas in typical contexts.</td>
<td>Specific crosscutting concept understanding is needed and is used to focus students' thinking.</td>
</tr>
<tr>
<td>Low</td>
<td>Using the mechanics, skills, and specific knowledge associated with practices isolated from sense-making.</td>
<td>Producing previously-learned ideas and conceptual procedures in routine, well-practiced ways.</td>
<td>Crosscutting concepts are implicitly part of the task, but they are not required in service of sense-making.</td>
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### Earth Science (MS)

PE: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (MS-ESS3-2)

**Using the Natural Hazards assessment? Read this first!**

**Get the assessment**

**Get the scoring rubric with sample student responses**
Self-evaluation Components

Does the learning experience incorporate all three dimensions?

➔ Is the student tasked with explaining a phenomenon or designing a solution?
➔ Does the investigation deliberately build understanding of certain SEPs, DCIs, and CCC’s by developing and using them?
➔ Are the three dimensions integrated?

Are the tasks presented meaningfully and with equity?

➔ Is the phenomenon relevant and authentic?
➔ Is there opportunity for presentation and exchange of ideas?
➔ Are the lessons age-appropriate and scientifically accurate?
➔ Is instruction differentiated?

Is student progress monitored over the unit?

➔ Is observable evidence provided through student engagement?
➔ Is formative assessment embedded?
➔ Are tasks and assessments unbiased?
SMALL STEPS to Start

- Make adjustments to lessons and units you already use
- Talk to colleagues who are ready to make changes
- Use resources online, but be prepared to improve them yourself
- Encourage students to see themselves as scientists and engineers
- Tell students themselves about what the three dimensions are
- Celebrate your successes and theirs
Resources for Further Information

**Alaska Science Teachers Association:** join a network of teachers interested in engaging in science education; no specialty required; phenomena library coming soon

**NSTA Resource:** Charts, Tables, Background, Sample Lessons

**Dept. of Ed. and Early Dev. science ed listserv**

**Andrea’s Virtual Science Teaching Adventure**

**Sources for Phenomena:**

- Alaska Science Nuggets by Ned Rozell; [Frontier Scientists](https://frontiersciicients.org)
- [Village Science](http://villagescience.org) by Alan Dick
- [Alaska Public Media](https://www.alaskapublicmedia.org) daily or weekly bulletins

**Sea Grant publications**

**Agencies:** [USGS](https://www.usgs.gov), [NOAA](https://www.noaa.gov), USFS, NPS, [ADF&G](https://www.adfg.alaska.gov), Alaska Marine Highway

**Organizations:** [REAP](https://www.reap.org), [ANROE](https://www.anro.org), [GLOBE in Alaska](https://globe.gov), [SHI](https://www.shi.org), [Anchorage Museum](https://www.anchoragemuseum.org)
QUESTIONS?

Please type any questions / comments / ideas / feedback into the chat for open discussion.