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

Presented By:

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Alaska Department of Education & Early Development

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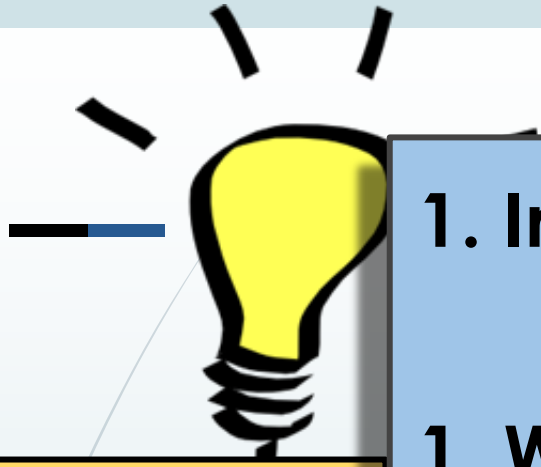
Icebreaker Padlet- What is good science teaching to you?



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

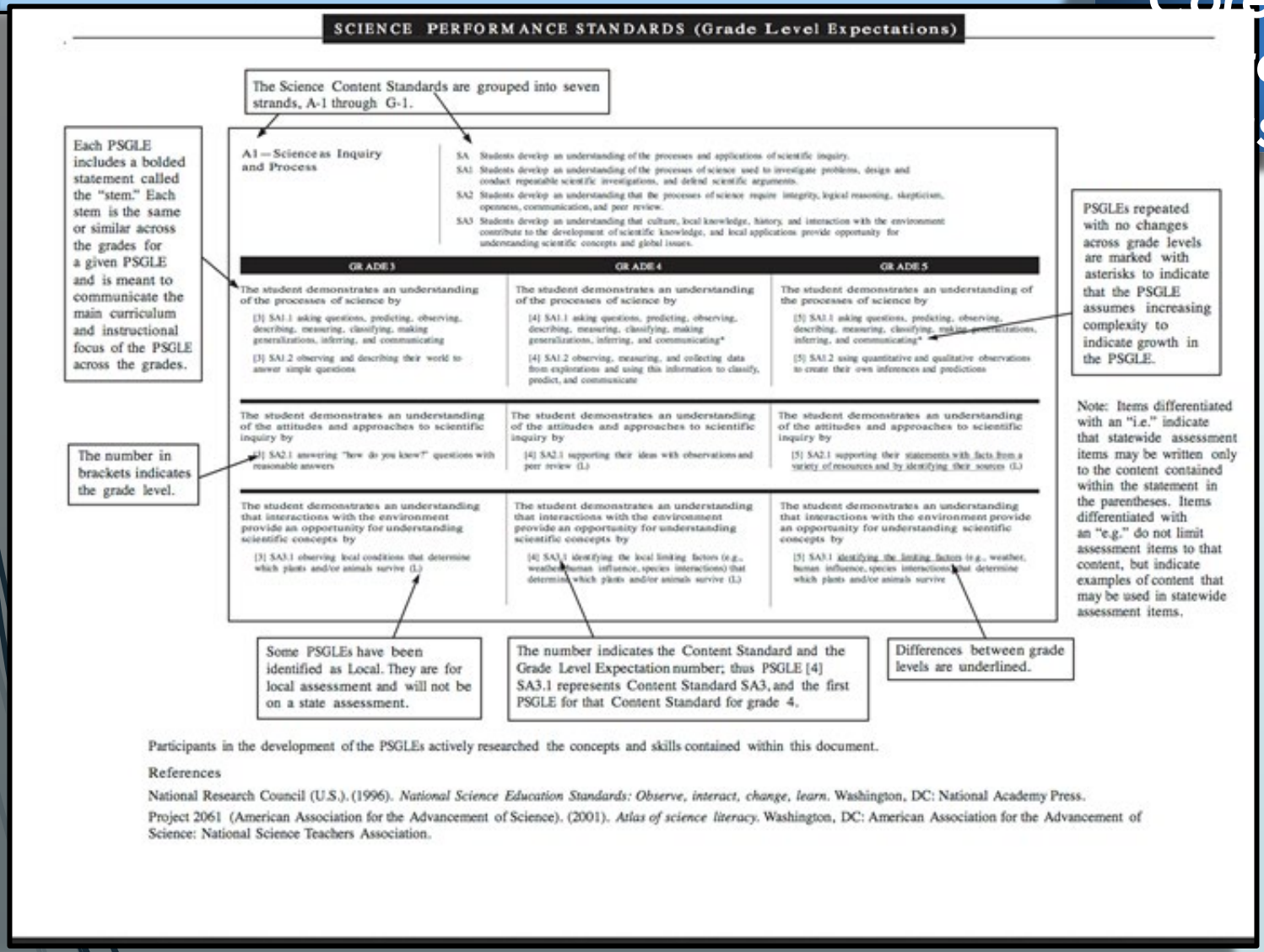
Rigor, Relevance, and Equity

- 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

Performance Standards/Grade Level Expectations

GLE's → Alaska's grade level expectations for understanding adopted in the early 2000's; identified as performance standards.

"Core content ... o be ...stered"



SCIENCE PERFORMANCE STANDARDS (Grade Level Expectations)

The Science Content Standards are grouped into seven strands, A-1 through G-1.

Each PSGLE includes a bolded statement called the "stem." Each stem is the same or similar across the grades for a given PSGLE and is meant to communicate the main curriculum and instructional focus of the PSGLE across the grades.

The number in brackets indicates the grade level.

PSGLEs repeated with no changes across grade levels are marked with asterisks to indicate that the PSGLE assumes increasing complexity to indicate growth in the PSGLE.

Note: Items differentiated with an "i.e." indicate that statewide assessment items may be written only to the content contained within the statement in the parentheses. Items differentiated with an "e.g." do not limit assessment items to that content, but indicate examples of content that may be used in statewide assessment items.

Some PSGLEs have been identified as Local. They are for local assessment and will not be on a state assessment.

The number indicates the Content Standard and the Grade Level Expectation number; thus PSGLE [4] SA3.1 represents Content Standard SA3, and the first PSGLE for that Content Standard for grade 4.

Differences between grade levels are underlined.

A1 — Science as Inquiry and Process

SA Students develop an understanding of the processes and applications of scientific inquiry.

SA1 Students develop an understanding of the processes of science used to investigate problems, design and conduct repeatable scientific investigations, and defend scientific arguments.

SA2 Students develop an understanding that the processes of science require integrity, logical reasoning, skepticism, openness, communication, and peer review.

SA3 Students develop an understanding that culture, local knowledge, history, and interaction with the environment contribute to the development of scientific knowledge, and local applications provide opportunity for understanding scientific concepts and global issues.

GRADE 3	GRADE 4	GRADE 5
The student demonstrates an understanding of the processes of science by	The student demonstrates an understanding of the processes of science by	The student demonstrates an understanding of the processes of science by
[3] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating	[4] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating*	[5] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating*
[3] SA1.2 observing and describing their world to answer simple questions	[4] SA1.2 observing, measuring, and collecting data from explorations and using this information to classify, predict, and communicate	[5] SA1.2 using quantitative and qualitative observations to create their own inferences and predictions
The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by	The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by	The student demonstrates an understanding of the attitudes and appreoaches to scientific inquiry by
[3] SA2.1 answering "how do you know?" questions with reasonable answers	[4] SA2.1 supporting their ideas with observations and peer review (L)	[5] SA2.1 supporting their statements with facts from a variety of resources and by identifying their sources (L)
The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by	The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by	The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by
[3] SA3.1 observing local conditions that determine which plants and/or animals survive (L)	[4] SA3.1 identifying the local limiting factors (e.g., weather, human influence, species interactions) that determine which plants and/or animals survive (L)	[5] SA3.1 identifying the limiting factors (e.g., weather, human influence, species interactions) that determine which plants and/or animals survive

Participants in the development of the PSGLEs actively researched the concepts and skills contained within this document.

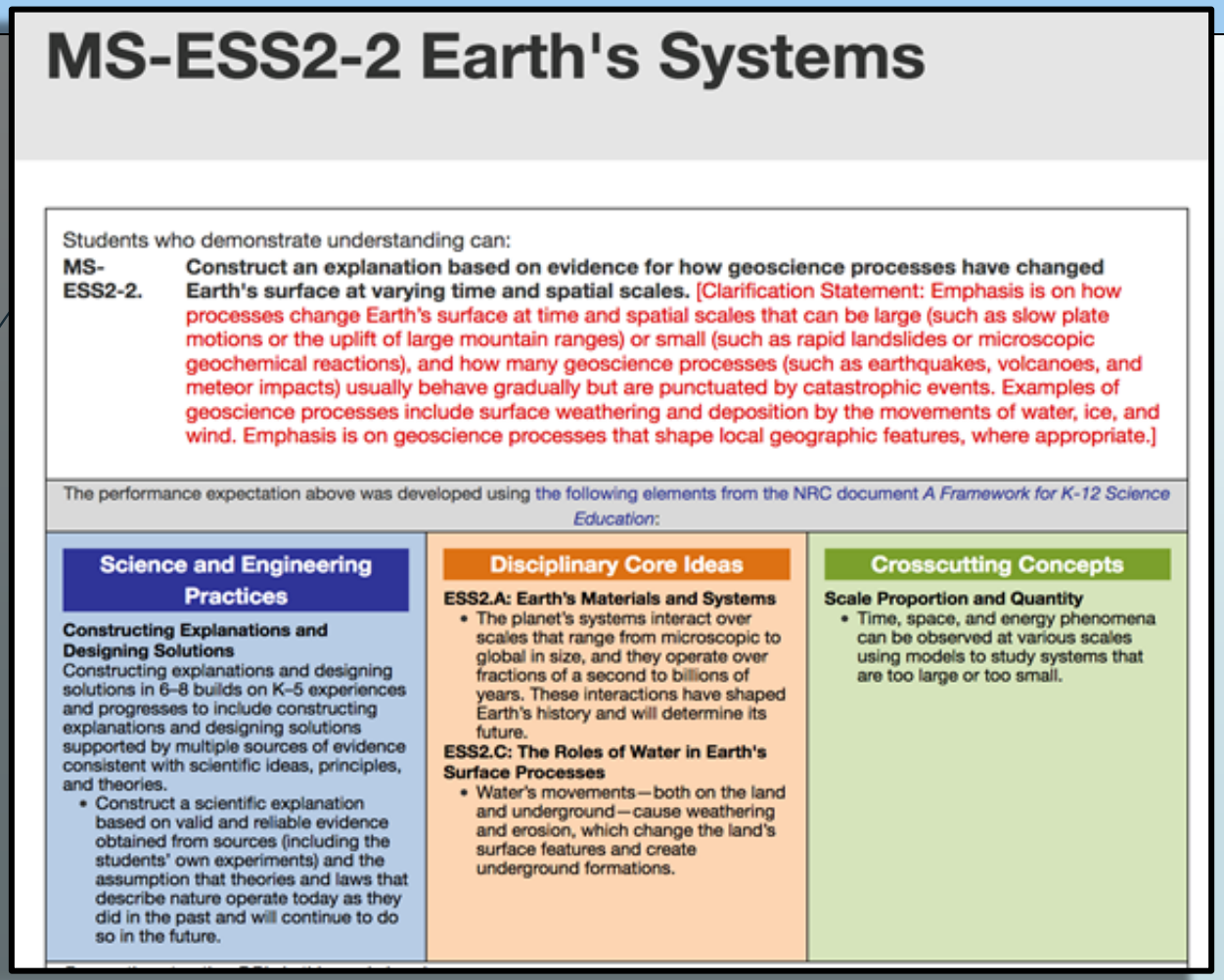
References

National Research Council (U.S.). (1996). *National Science Education Standards: Observe, interact, change, learn*. Washington, DC: National Academy Press.

Project 2061 (American Association for the Advancement of Science). (2001). *Atlas of science literacy*. Washington, DC: American Association for the Advancement of Science: National Science Teachers Association.

Next Generation Science Standards (NGSS)

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.

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. Alaskan examples should include locally significant landforms including coastal or ocean sea floor structures.

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

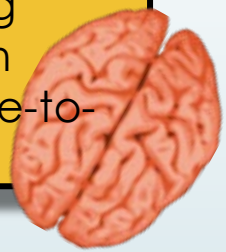
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**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.	**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.

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)

3D Acronyms

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)*

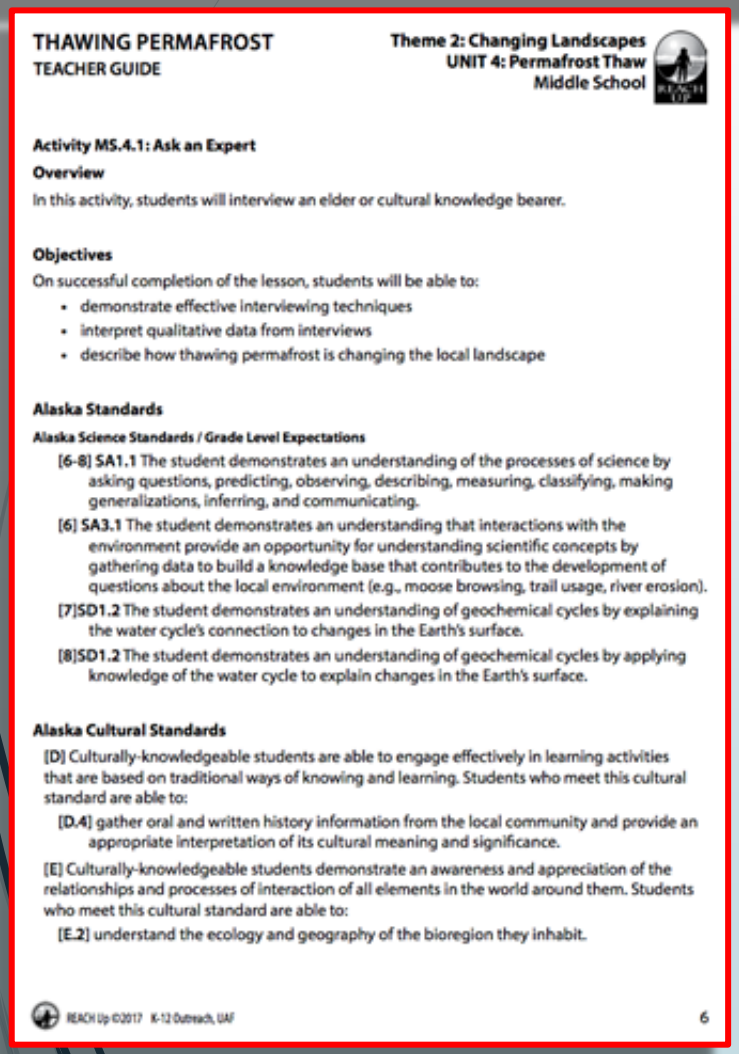
Key Shifts

- **"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



THAWING PERMAFROST
TEACHER GUIDE

Theme 2: Changing Landscapes
UNIT 4: Permafrost Thaw
Middle School

Activity MS.4.1: Ask an Expert

Overview

In this activity, students will interview an elder or cultural knowledge bearer.

Objectives

On successful completion of the lesson, students will be able to:

- demonstrate effective interviewing techniques
- interpret qualitative data from interviews
- describe how thawing permafrost is changing the local landscape

Alaska Standards

Alaska Science Standards / Grade Level Expectations

[6-8] **SA1.1** The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[6] **SA3.1** The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by gathering data to build a knowledge base that contributes to the development of questions about the local environment (e.g., moose browsing, trail usage, river erosion).

[7]**SD1.2** The student demonstrates an understanding of geochemical cycles by explaining the water cycle's connection to changes in the Earth's surface.

[8]**SD1.2** The student demonstrates an understanding of geochemical cycles by applying knowledge of the water cycle to explain changes in the Earth's surface.

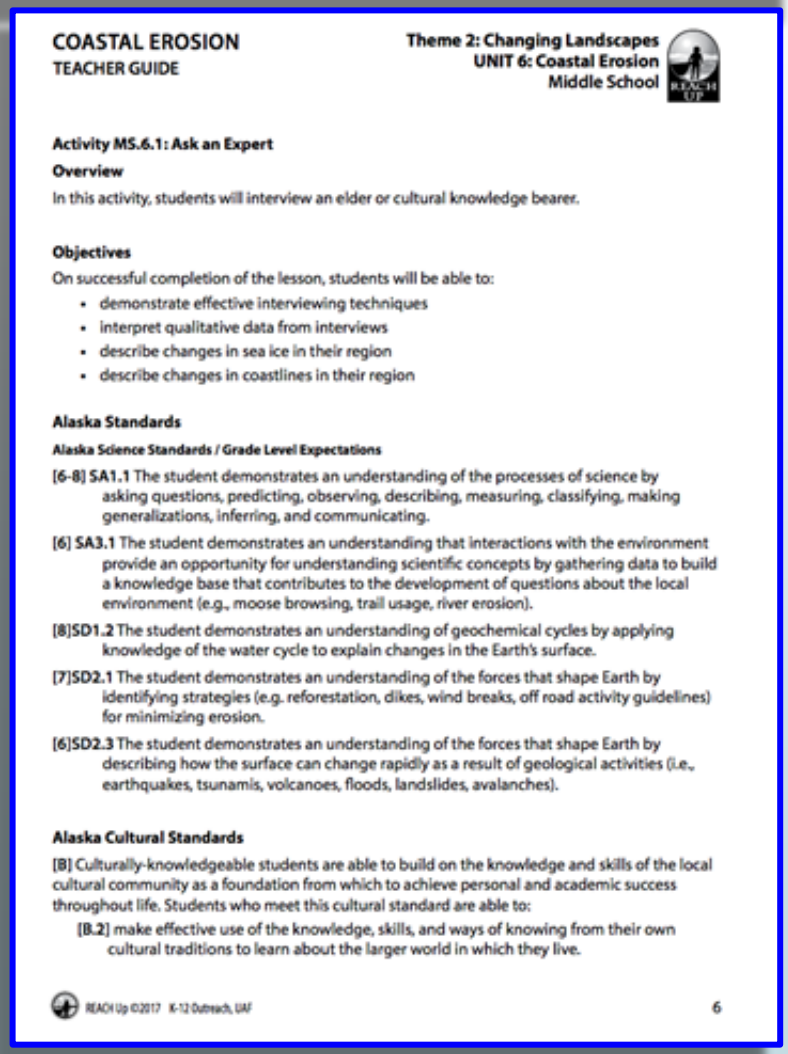
Alaska Cultural Standards

[D] Culturally-knowledgeable students are able to engage effectively in learning activities that are based on traditional ways of knowing and learning. Students who meet this cultural standard are able to:

[D.4] gather oral and written history information from the local community and provide an appropriate interpretation of its cultural meaning and significance.

[E] Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. Students who meet this cultural standard are able to:

[E.2] understand the ecology and geography of the bioregion they inhabit.



COASTAL EROSION
TEACHER GUIDE

Theme 2: Changing Landscapes
UNIT 6: Coastal Erosion
Middle School

Activity MS.6.1: Ask an Expert

Overview

In this activity, students will interview an elder or cultural knowledge bearer.

Objectives

On successful completion of the lesson, students will be able to:

- demonstrate effective interviewing techniques
- interpret qualitative data from interviews
- describe changes in sea ice in their region
- describe changes in coastlines in their region

Alaska Standards

Alaska Science Standards / Grade Level Expectations

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[8]**SD1.2** The student demonstrates an understanding of geochemical cycles by applying knowledge of the water cycle to explain changes in the Earth's surface.

[7]**SD2.1** The student demonstrates an understanding of the forces that shape Earth by identifying strategies (e.g. reforestation, dikes, wind breaks, off road activity guidelines) for minimizing erosion.

[6]**SD2.3** The student demonstrates an understanding of the forces that shape Earth by describing how the surface can change rapidly as a result of geological activities (i.e., earthquakes, tsunamis, volcanoes, floods, landslides, avalanches).

Alaska Cultural Standards

[B] Culturally-knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:

[B.2] make effective use of the knowledge, skills, and ways of knowing from their own cultural traditions to learn about the larger world in which they live.

Landscape Changes in Alaska-Mountain

Photo by Tom Ganner Haines, AK 2020

Landscape Changes in Alaska-Ocean

Shishmaref, AK

Exploring Phenomena:

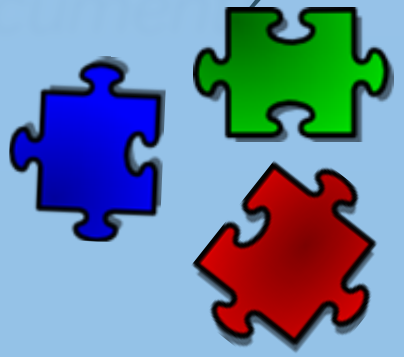
Unit Idea: *What evidence is there that change in climate is influencing landscape changes in Alaska?*

Mendenhall Glacier, Juneau AK Photo courtesy: Alexandria Tannehill 2020

Storyline:

→ 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.

MS-ESS2-2

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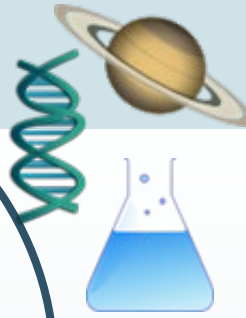
Cross-cutting Concepts:

(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

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 and Engineering Practices:

(how science is pursued to reach conclusions)

→ **Choose one or two for a lesson.**

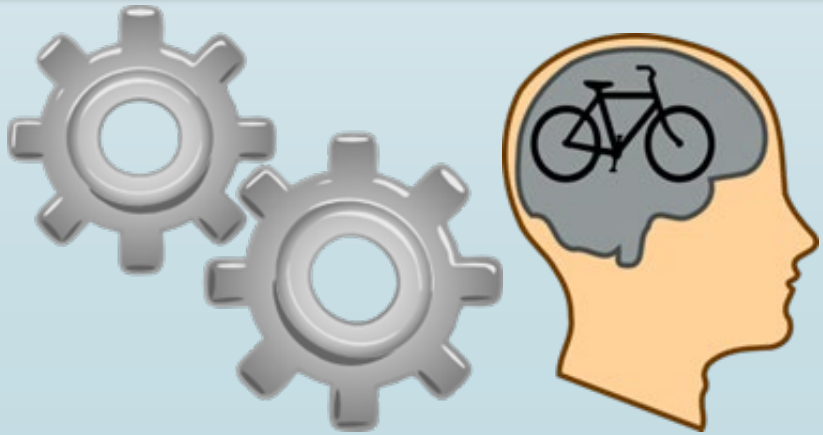
→ **Consider using all of them across a unit.**

- 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.

Science and Engineering Practices

Constructing Explanations and Designing Solutions

- 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 the natural world operate today as they did in the past and will continue to do so in the future.



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?

Figure 3-3. A revetment designed by the U.S. Army Corps of Engineers protects a street and buildings at Shishmaref in northwestern Alaska. Mikal Hendee photo.

esh gabions, gravel-filled fabric tubes, and sandbags
rray at Shishmaref, Alaska, 2006. Mikal Hendee photo.

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 vegetations.

4-ESS2-2 **Analyze and interpret data f**rom 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 geo**sphere**, biosphere, hydrosphere, and cryosphere, andor atmosphere **interact**.

Breakout Session

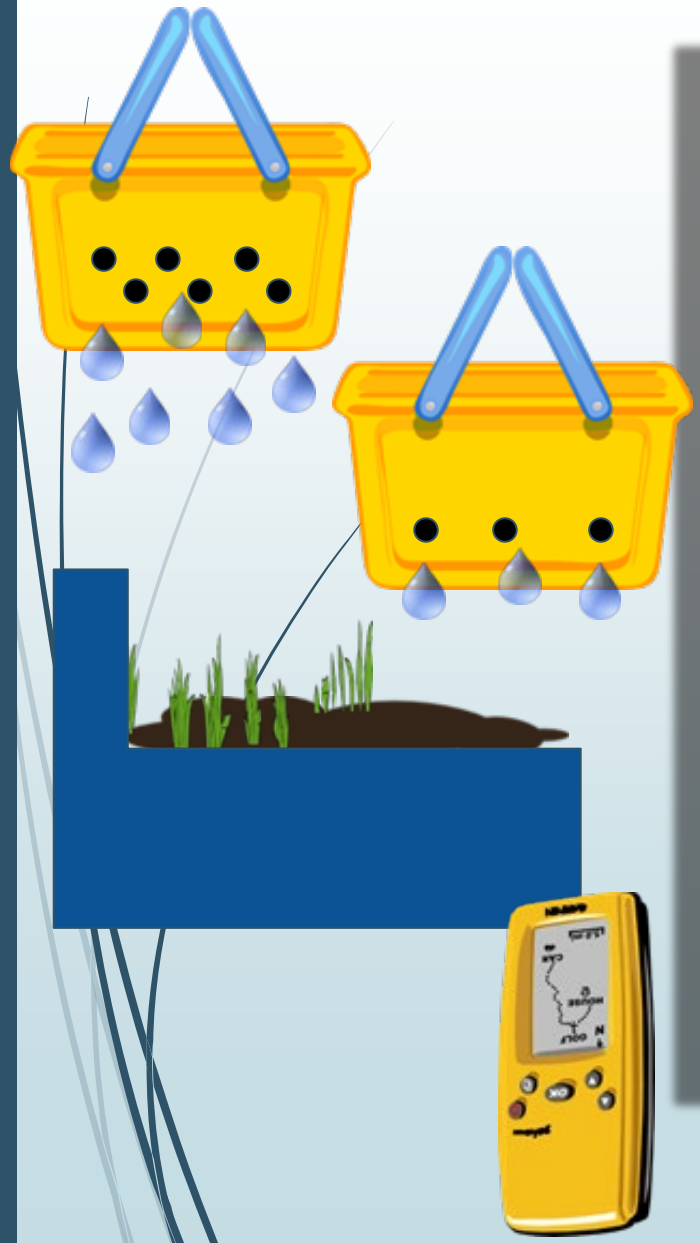
Discuss ways you are already applying one of the three dimensions in your current teaching.

→ **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

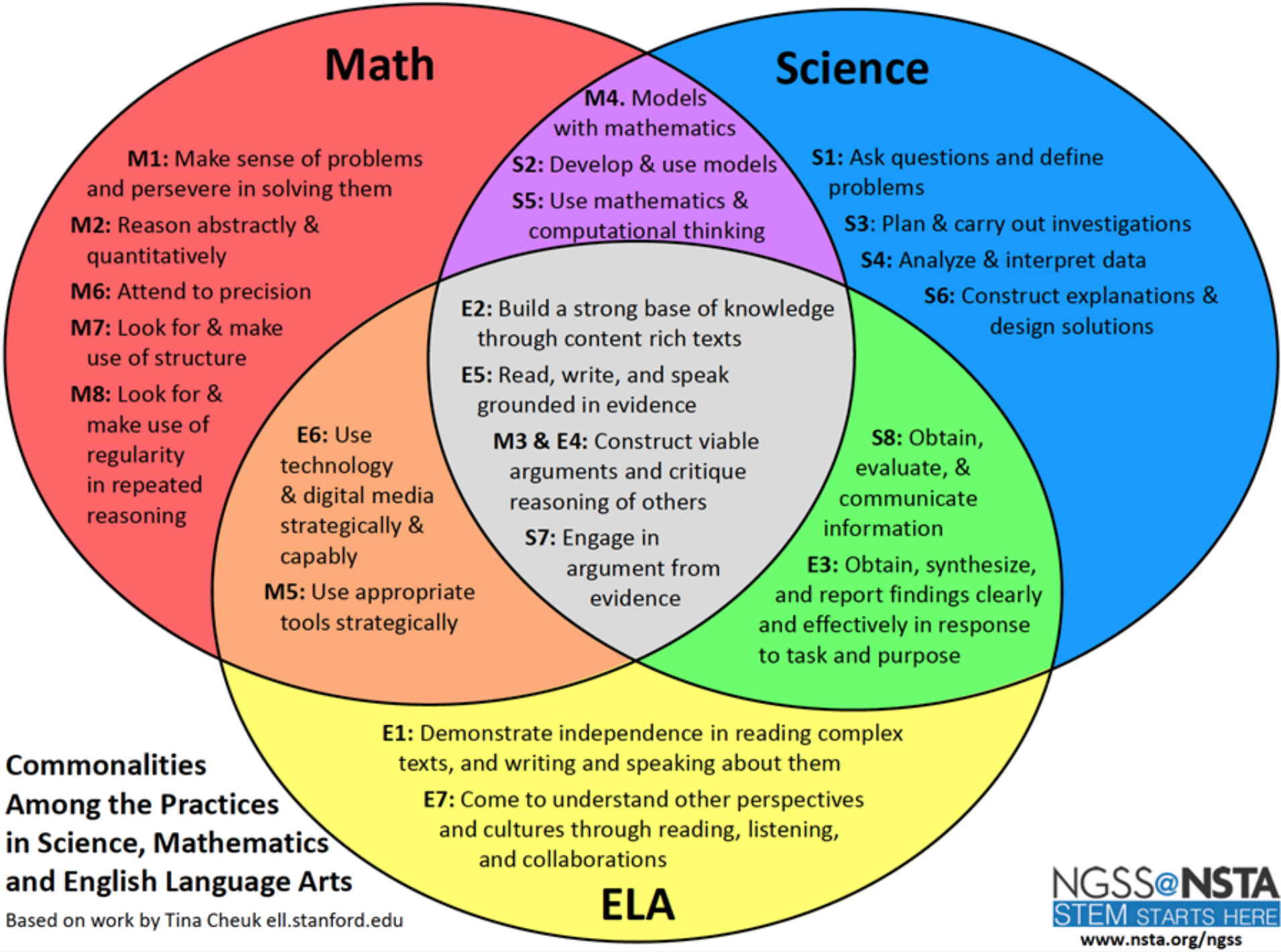
- Describes what students should be able to do by the end of a unit or multiple units or even the end of the year.

- "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!



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

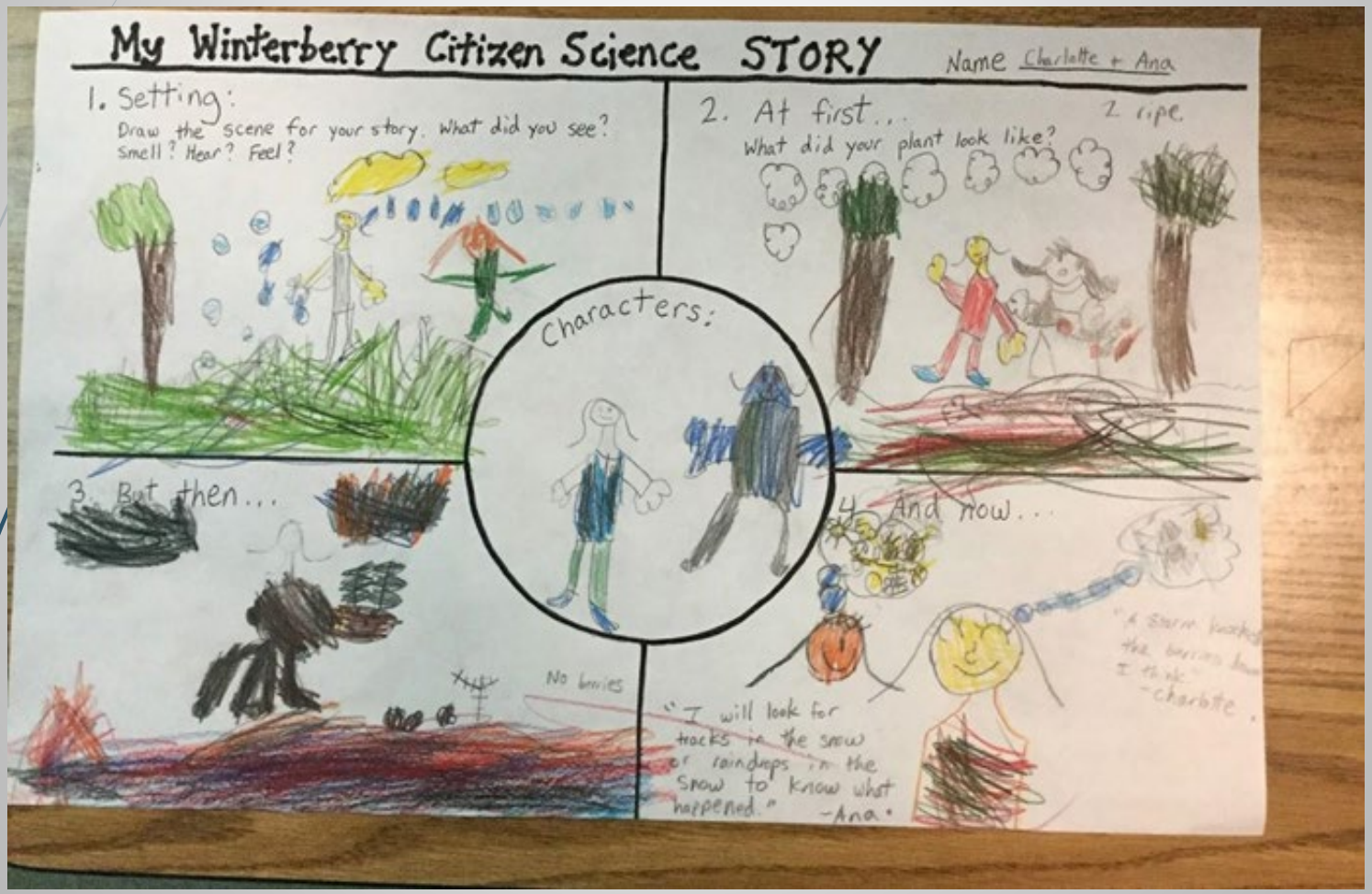
Based on work by Tina Cheuk ell.stanford.edu

NGSS@NSTA
STEM STARTS HERE
www.nsta.org/ngss

Math and Literacy Links

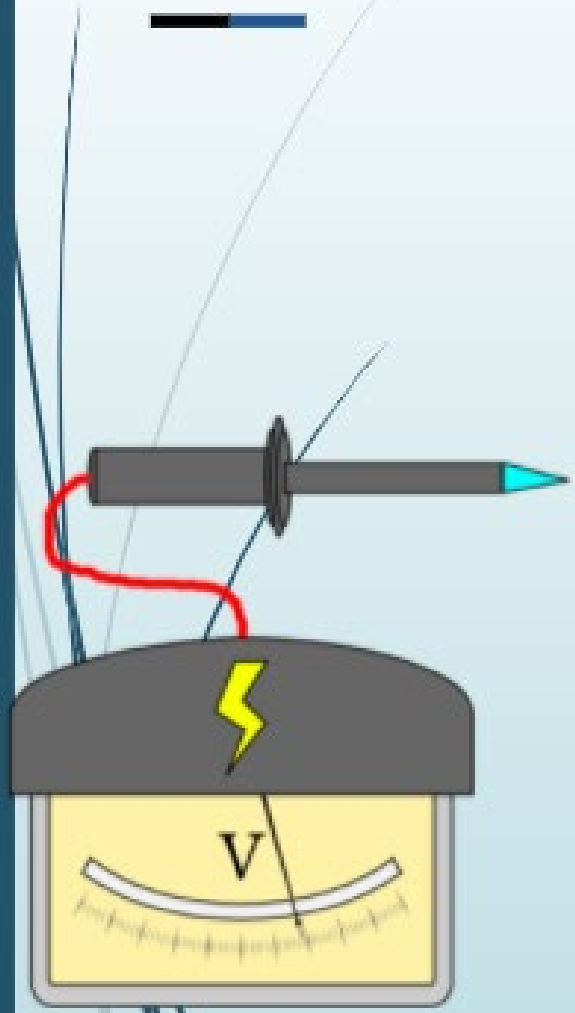
- **→ News and magazine articles:**
  - read and write them
- **→ Radio stories:**
  - listening and creating mock broadcasts
- **→ Reading survival stories**
- **→ Weather data**
  - including graphs of change
- **→ Measurements and estimation**
  - of magnitude of landslides and coastal bluff setbacks
- **→ Analyzing force**
- **→ Calculating cost of damage**

Teacher Reflection: How does the activity students are doing incorporate the SSA's?



tinyurl.com/1xeqxmwk

Integration of Science Technology

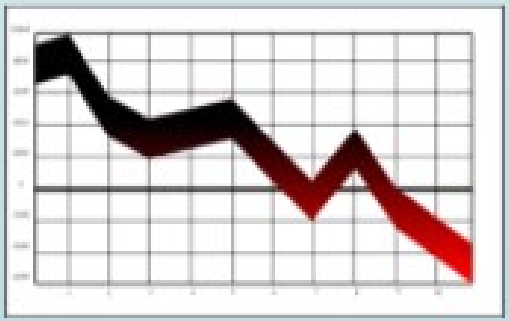


Develop understanding of how technology advances science and science can be applied to design

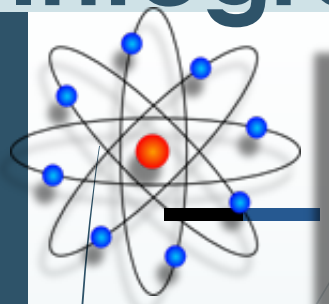
→ Instruments used to gather data

→ 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

SNAP: Stanford NGSS Assessment Project
https://snapgse.stanford.edu/snap-assessments-ngss

Task Annotation Project in Science
https://www.achieve.org/our-initiatives/equip/tools-subject/science/task-annotation-project-science

Science Cognitive Complexity Framework Text
https://www.achieve.org/cognitive-complexity-science
Webinar
https://www.youtube.com/watch?v=fuEmJqmYriY&t=25s

Page Keely references
https://www.uncoveringstudentideas.org/books
https://www.uncoveringstudentideas.org/resources/3dimensions

3D tasks require a series of judgements at the item level

	Scenario	SEP	DCI [Conceptual - disciplinary]	CCC [Conceptual - crosscutting]
High	Addressing a rich and puzzling phenomenon or problem presented with high-degree of uncertainty.	Figuring out a phenomenon or problem using multiple SEPs in service of authentic sense-making. ✓	Non-routine use of domain specific science ideas as part of sense-making.	Selection and use of conceptual understanding of crosscutting ideas is necessary and expands students' thinking.
Medium	Addressing a phenomenon or problem with some level of uncertainty. ✓	Representation of ideas; use of skills that are relatively complex; some close application.	Supported application of science ideas in typical contexts. ✓	Specific crosscutting concept understanding is needed and is used to focus students' thinking.
Low	Addressing routinely encountered or highly simplified scenarios.	Using the mechanics, skills, and specific knowledge associated with practices isolated from sense-making.	Producing previously-learned ideas and conceptual procedures in routine, well-practiced ways.	Crosscutting concepts are implicitly part of the task, but they are not required in service of sense-making.

3D Tasks

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

Village Science by Alan Dick

Alaska Public Media daily or weekly bulletins

Sea Grant publications

Agencies: USGS, NOAA, USFS, NPS, ADF&G, Alaska Marine Highway

Organizations: REAP, ANROE, GLOBE in Alaska, SHI, Anchorage Museum

QUESTIONS?

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