Crosscutting Concepts: 1 of the 3 Dimensions of the AZ Science Standards
Who’s in the Room?

Complete the poll that will be on your screen.
Webinar Expectations

- Microphones are disabled
- Utilize the chat room for discussion/comments
- If you have a question type in “stack” so you can share your question when time is appropriate
Objectives

▶ Recognize how crosscutting concepts can deepen students conceptual understanding of science content.
▶ Describe how crosscutting concepts progress through the grade bands to support student learning.
▶ Explain how crosscutting concepts are an integral dimension to the Arizona Science Standards.

Norms

▶ Ask questions
▶ Embrace mistakes
▶ Integrate new information
▶ Open your mind to diverse views
▶ Utilize what you learn
I claim...

“An advantage of the AZSS over NGSS is that teachers and students can determine which crosscutting concept makes sense for learning the core ideas.”

As we go throughout this hour, determine evidence to support or negate this claim.
Record Your Observations

Inside a Monarch Swarm
Share Your Ideas…

► Did you notice a pattern? If so, what caused the pattern you observed?
► How did the different components of this system interact?
► What caused the butterflies to move?
► Is this system stable or unstable? What evidence do you have (or would need to have) to support your claim?
Brain Research…

Experts use a conceptual framework
What is a conceptual framework?
What is a conceptual framework?
What is a conceptual framework?
Experts and novices organize their ideas differently

» Experts use a conceptual framework
» Novices rely on surface features
Think about novice drivers....
Compared to expert drivers…
One goal of science education is to teach students think more like experts

» What if we gave students an expert-like conceptual framework to organize their ideas around?
How will the CCCs help students learn science?

1. A conceptual framework helps students make sense of new content and tackle novel problems

2. Allows students to be more flexible and creative with their science and engineering ideas

3. Helps students to develop their ideas over time
There are 7 Crosscutting Concepts (CCCs)

- Patterns
- Cause and effect
- Scale, proportion, and quantity
- System and system models
- Energy and matter
- Structure and function
- Stability and change
Patterns

Observed patterns in nature guide organization and classification and prompt questions and relationships and causes underlying them.
Cause and effect

The CCC of cause and effect investigates how things are connected by identifying the reasons behind an occurrence, and what that occurrence results in.
Different *measures* of size and time affect a system’s structure, performance, and our ability to observe phenomena.
A system is an organized group of related object or components; models can be used for understanding and predicting the behavior of systems.
Energy and matter

These things are neither created nor destroyed, but may flow into and out of a system and influence its functioning.
Structure and function

The way something is built and the parts that it has determine how it works.
Stability and change

Over time, a system might stay the same or become different, depending on a variety of factors.
What questions do you have?
There are 7 Crosscutting Concepts (CCCs)

- Patterns
- Cause and effect
- Scale, proportion, and quantity
- System and system models
- Energy and matter
- Structure and function
- Stability and change
Nitrogen fixation
Ammonification
Assimilation
Denitrification bacteria
Nitrifying bacteria
Nitrogen fixing Bacteria
NH₃
NH₄
NO₂
NO₃
N₂
Dentification

FrugalFun4Boys.com
Ready to Check Your Answers?
A

Scale, Proportion, and Quantity
B
Patterns
Energy & Matter
E

Cause & Effect
<table>
<thead>
<tr>
<th>Bone Structure &amp; Function</th>
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</thead>
<tbody>
<tr>
<td>Horse</td>
</tr>
<tr>
<td>Cat</td>
</tr>
<tr>
<td>Bat</td>
</tr>
<tr>
<td>Bird</td>
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<tr>
<td>Scissors</td>
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<tr>
<td>Hammer</td>
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<tr>
<td>File</td>
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<tr>
<td>Toothbrush</td>
</tr>
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<td>Baseball Bat</td>
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<td>Rake</td>
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Systems & System Models
Crosscutting concepts are valuable tools for making sense of phenomena.
Record Your Observations
Share Your Ideas…

- Did you notice a **pattern**? If so, what **caused** the pattern you observed?
- How did the different **components of this system** interact?
- What **caused** the butterflies to move?
- Is this system **stable or unstable**? What evidence do you have (or would need to have) to support your claim?
Crosscutting concepts are valuable tools for making sense of phenomena.
What questions do you have?
Where are the crosscutting concepts in the standards?

3.L2U1.8

*Construct an argument from evidence* that organisms are interdependent.
Where are the crosscutting concepts in the standards?

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<th>3.L2U1.8</th>
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<td><strong>Construct an argument from evidence</strong> that organisms are interdependent.</td>
<td><strong>Crosscutting Concepts:</strong> Patterns, Cause and Effect, Scale, Proportion and Quantity; <strong>Systems and System Models:</strong> Energy and Matter; <strong>Structure and Function:</strong> Stability and Change</td>
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Third Grade: Focus on Systems and System Models; Structure and Function

By the end of third grade, students will gain an understanding of how the Sun provides energy for life on Earth. Students apply their understanding of light and sound waves, how they travel, are detected, and transfer energy. Students learn that organisms have different structures and functions which increase their chances of survival. Student investigations focus on collecting and making sense of observational data and simple measurements using the science and engineering practices: ask questions and define problems, develop and use models, plan and carry out investigations, analyze and interpret data, use mathematics and computational thinking, construct explanations and design solutions, engage in argument from evidence, and obtain, evaluate, and communicate information. While individual lessons may include connections to any of the crosscutting concepts, the standards in third grade focus on helping students understand phenomena through systems and system models and structure and function.

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<td>P1: All matter in the Universe is made of very small particles.</td>
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<td><strong>Life Science</strong></td>
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<td>L1: Organisms are organized on a cellular basis and have a finite life span.</td>
<td>U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products.</td>
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<td>L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.</td>
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<td>L3: Genetic information is passed down from one generation of organisms to another.</td>
<td>U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.</td>
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<td>L4: The unity and diversity of organisms, living and extinct, is the result of evolution.</td>
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*Adapted from *Working with Big Ideas in Science Education*
Where are the crosscutting concepts in the standards?

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Arizona Science Standards

Kindergarten: Focus on Patterns; Structure and Function

First Grade: Focus on Cause and Effect; Stability and Change (cycles)

Second Grade: Focus on Systems and System Models; Energy and Matter

Third Grade: Focus on Systems and System Models; Structure and Function

Fourth Grade: Systems and System Models; Energy and Matter; Stability and Change

Fifth Grade: Patterns; Scale, Proportion, and Quantity

Sixth Grade: Focus on Patterns; Scale, Proportion, and Quantity, Systems and System Models; Energy and Matter

Seventh Grade: Focus on Patterns; Cause and Effect; Structure and Function

Eighth Grade: Focus on Cause and Effect; Energy and Matter; Stability and Change
High School Physical Sciences

Physical science encompasses physical and chemical sub-processes that occur within systems. At the high school level, students gain an understanding of these processes at both the micro and macro levels through the intensive study of matter, energy, and forces. Students are expected to apply these concepts to real-world phenomena to gain a deeper understanding of causes, effects, and solutions for physical processes in the real world. The essential standards are those that every high school student is expected to know and understand. Plus standards in chemistry and physics are designed to extend the concepts learned in the essential standards to prepare students for entry-level college courses. It is suggested to use the metric system within measurement.

Note:
- The standard number is designed for recording purposes and does not imply instructional sequence or importance.
- In all disciplines, educators should incorporate scientific measurement skills appropriate to that discipline.

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55
Where are the crosscutting concepts in the standards?

Chemistry – P1: All matter in the Universe is made of very small particles.

Structures and Properties of Matter
Essential standards are standards that will be assessed on the state exam and are intended for ALL students to have learned by the end of 3 credits of high school science courses.

Essential HS.P1U1.1

*Develop and use models* to explain the relationship of the structure of atoms to patterns and properties observed within the Periodic Table and describe how these models are revised with new evidence.

Physical Science Plus (+) Standards HS+C are supporting standards designed to be used with the essential standards for students taking a high school chemistry (C) course.

Plus HS+C.P1U1.1

*Develop and use models* to demonstrate how changes in the number of subatomic particles (protons, neutrons, and electrons) affect the properties of the atom.

Crosscutting Concepts & Background Information for Educators

**Crosscutting Concepts:**
- Patterns; Cause and Effect
- Scale, Proportion and Quantity
- Systems and System Models
- Energy and Matter
- Structure and Function
- Stability and Change

**Background Information:**
Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. Stable forms of...
What questions do you have?
Crosscutting Concept Progression
**Arizona Science Standards**

**COVID-19 HELPFUL GUIDANCE AND INFORMATION**

The Arizona Department of Education’s Virtual Learning Hub is a resource for teachers and families to assist them as they plan for non-traditional instruction and should be used with discretion and in the way that best fits with their school/district curricula. This is a living document that will be updated frequently.

Virtual Learning Resources

Important message to read for information regarding the implementation of the 2018 Arizona Science Standards and the new science assessment, please click [here](#)

**NEW STANDARDS (2018)**
(Adopted October 2018)

- Complete Standards document | PDF

**NEW STANDARDS SUPPORT MATERIALS**

- Planning Tools *NEW*
- Administrator Tool Kit *NEW*
- Vertical Progressions
- Distribution of Core Ideas

**PROFESSIONAL DEVELOPMENT VIDEOS**

- Recorded Webinars
- Science Standards Videos
- Timeline and Resources
Vertical Progression of Crosscutting Concepts

Vertical Progression of Science and Engineering Practices

Distribution of Core Ideas
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<td>Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.</td>
<td>Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products.</td>
<td>Macroscopic patterns are related to the nature of microscopic and atomic-level structure.</td>
<td>Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</td>
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<td>- Patterns of change can be used to make predictions.</td>
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<td><strong>2. Cause and Effect: Mechanism and Prediction</strong></td>
<td>Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.</td>
<td>Cause and effect relationships are routinely identified, tested, and used to explain change.</td>
<td>Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.</td>
<td>Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</td>
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<td>- Events have causes that generate observable patterns.</td>
<td>- Events that occur together with regularity might or might not be a cause and effect relationship.</td>
<td>- Cause and effect relationships may be used to predict phenomena in natural or designed systems.</td>
<td>- Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.</td>
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<td>- Simple tests can be designed to gather evidence to support or refute student ideas about causes.</td>
<td>- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.</td>
<td>- Systems can be designed to cause a desired effect.</td>
<td>- Changes in systems may have various causes that may not have equal effects.</td>
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1. **Patterns** – Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

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AZ 2018 Science Standards

Thinking about your own grade level standards …

How can you integrate the CCCs into your classroom?

Which CCC(s) would you use as a lens to teach the standard(s)?
I claim…

“An advantage of the AZSS over NGSS is that teachers and students can determine which crosscutting concept makes sense for learning the core ideas.”

What evidence did you collect to support or negate this claim?
Key Take-Aways
Crosscutting Concepts...

- Structure students’ reasoning.
- Focus students’ explanations.
- Deepen student understanding of the core ideas across disciplines.
- Provide a scaffold for science reasoning.
- Help students better understand core ideas in science and engineering.
- Grow in complexity and sophistication across the grades.
- Provide a common vocabulary for science and engineering.
What questions do you have?
Thank you

Sara Torres

sstorres71@gmail.com