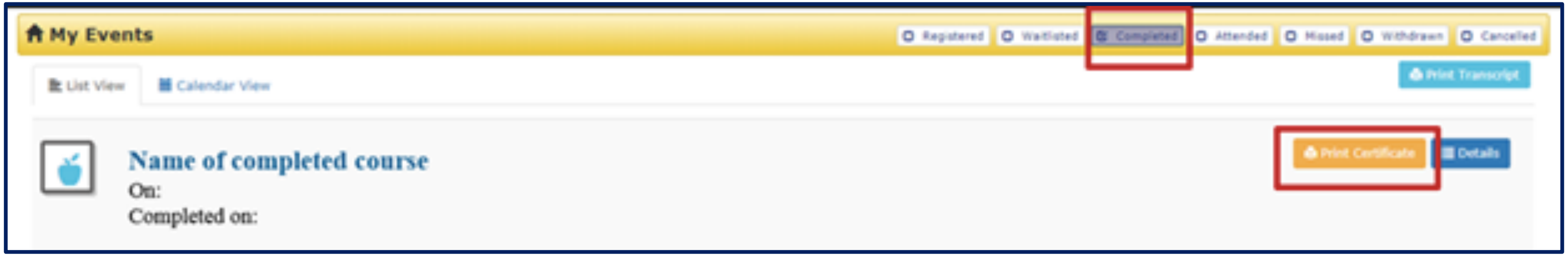
WELCOME!

Please review this information while we wait for all to join!

Attendance, Resources & PD Clock Hours

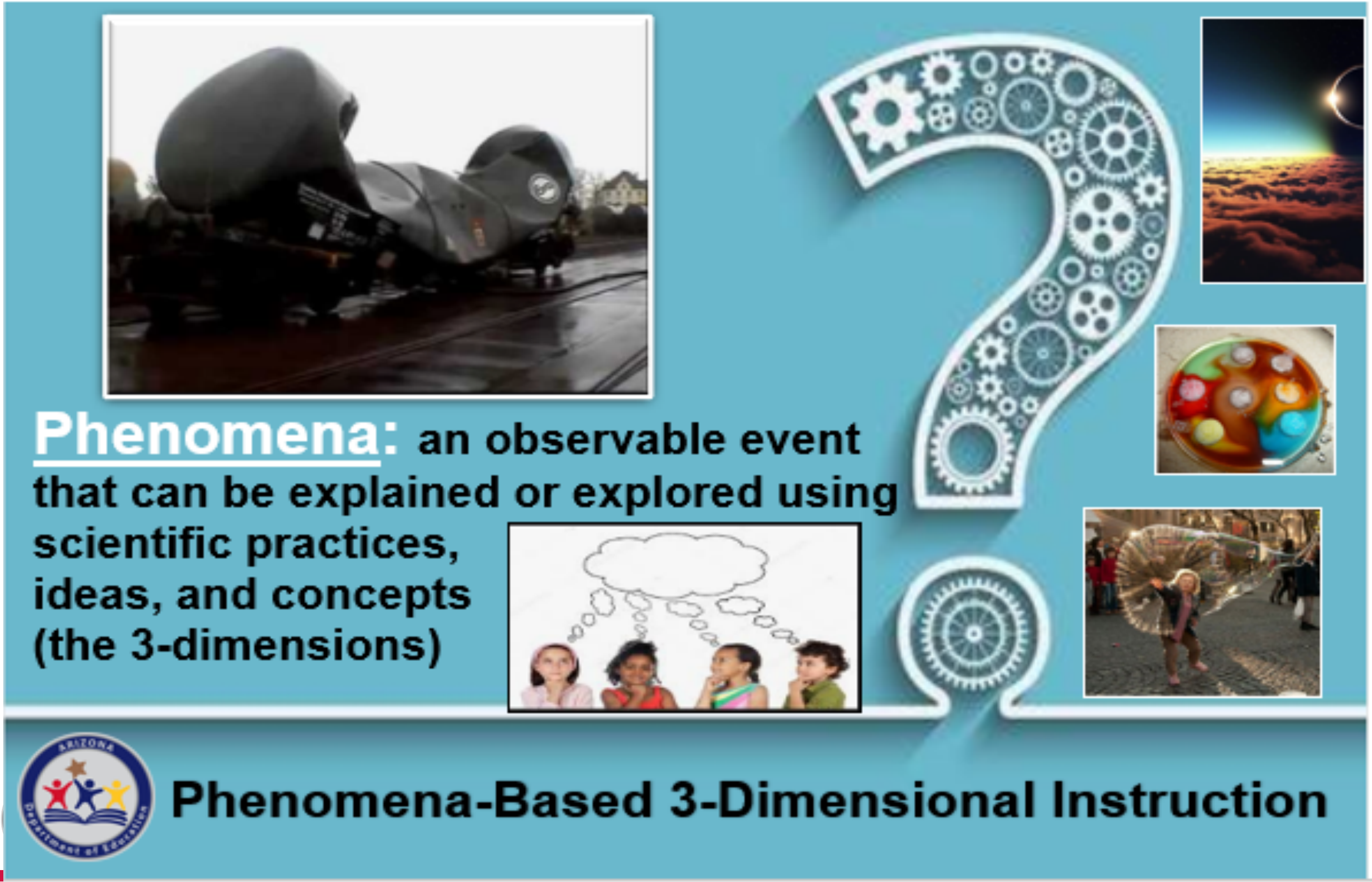
- **You must stay on the whole time- 1 hour- to receive credit**

- **YOU print your certificate through ADE Connect- please wait 24-48 hours of webinar before printing certificates**



- AFTER WEBINAR- you will receive PDF of presentation and resource page

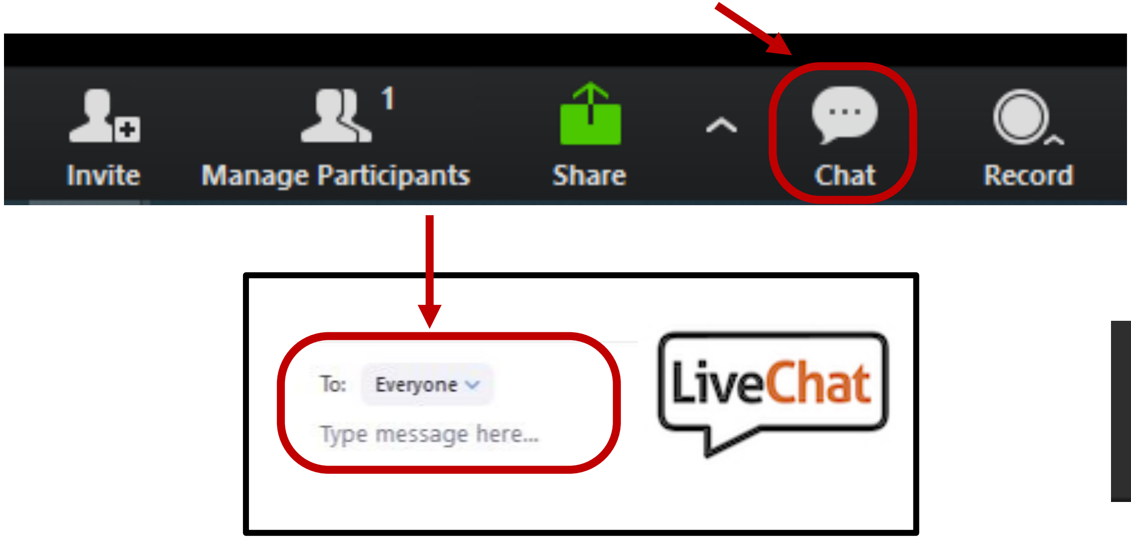
Instructional Shift: from LEARNING ABOUT to FIGURING OUT

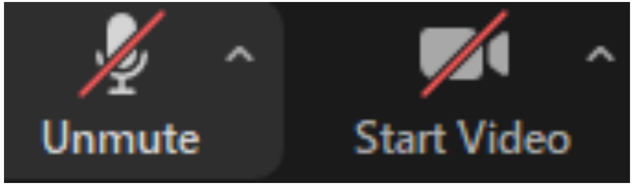


Hi!

I'm Rebecca Garelli

ADE K-12 Science & STEM Specialist





1. Please click on the **chat box button** (top) use the chat box for questions or comments. All participants **will be muted** to avoid feedback during the session.
2. Please use this drop-down box to select **"everyone"** so we can collaborate during this session.

1. What is your current position or job title?
2. Have you had a chance to look at the new Arizona State Science Standards?

Goals:

- Gain a better understanding of the **instructional shifts** needed for three-dimensional science instruction and how this relates to the AzSS

- Explore how scientific phenomena can be used to drive standards-based instruction

- Learn how to read the new AZ Science Standards and unearth the 3-dimensions of learning within the standard

Overview of Shifts

What would you see less of?

What would you see more of?

LiveChat

What are 3-5 items that resonate with you?

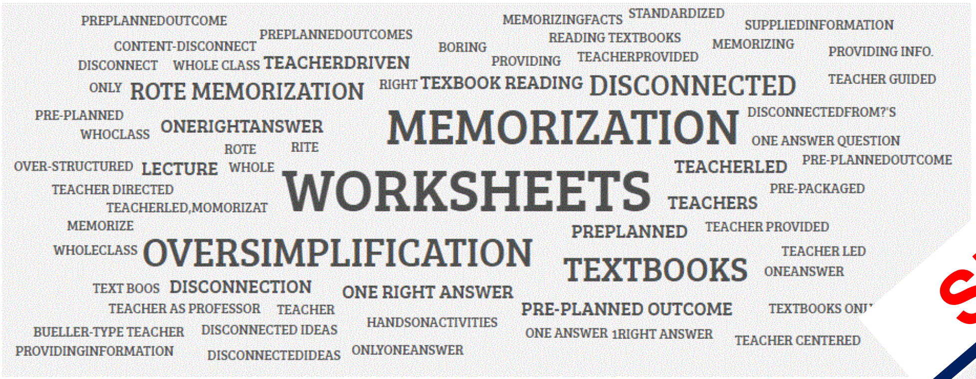
A New Vision for Science Education

Implications of the Vision of the Framework for K-12 Science Education and the Next Generation Science Standards

SCIENCE EDUCATION WILL INVOLVE LESS:	SCIENCE EDUCATION WILL INVOLVE MORE:
Rote memorization of facts and terminology	Facts and terminology learned as needed while developing explanations and designing solutions supported by evidence-based arguments and reasoning.
Learning of ideas disconnected from questions about phenomena	Systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned
Teachers providing information to the whole class	Students conducting investigations, solving problems, and engaging in discussions with teachers' guidance
Teachers posing questions with only one right answer	Students discussing open-ended questions that focus on the strength of the evidence used to generate claims
Students reading textbooks and answering questions at the end of the chapter	Students reading multiple sources, including science-related magazine and journal articles and web-based resources; students developing summaries of information.
Pre-planned outcome for "cookbook" laboratories or hands-on activities	Multiple investigations driven by students' questions with a range of possible outcomes that collectively lead to a deep understanding of established core scientific ideas
Worksheets	Student writing of journals, reports, posters, and media presentations that explain and argue
Oversimplification of activities for students who are perceived to be less able to do science and engineering	Provision of supports so that all students can engage in sophisticated science and engineering practices

Less of this….. More of this…..

In a science classroom you would see **less** of…..



FIGURING OUT

SHIFT

In a science classroom you would see **more** of…..

LEARNING ABOUT

ARIZONA Department of Education

Goals:

- Gain a better understanding of the **instructional shifts** needed for three-dimensional science instruction and how this relates to the AzSS
- Learn how to read the new AZ Science Standards and unearth the 3-dimensions of learning within the standard
- Explore how scientific phenomena can be used to drive standards-based instruction

NEW AZ Science Standards Comfort Level

LiveChat

1- What?! We have new standards?!?

2- I've glanced at them….

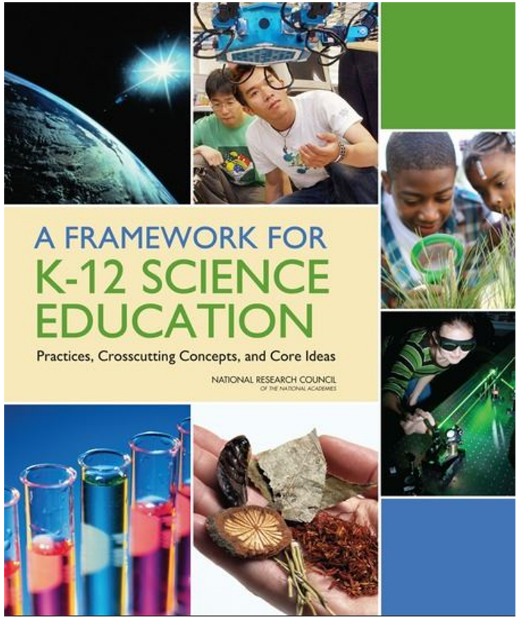
3- In the process of transitioning…

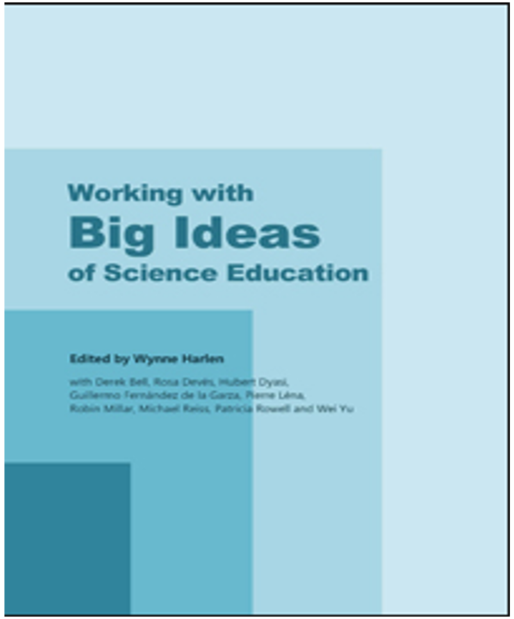
4- I am fully implementing them!

Background Information

NGSS

AzSS





AzSS

"Framework-Based" State, not an NGSS state

What Is 3- Dimensional Science Instruction?

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

3

Dimension 1

SCIENTIFIC AND ENGINEERING PRA

Copyright © National Academy of Sciences. All rights reserved.

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

4

Dimension 2

CROSSCUTTING CONCEPTS

83

Copyright © National Academy of Sciences. All rights reserved.

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

7

Dimension 3

DISCIPLINARY CORE IDEAS—EARTH AND SPACE SCIENCES

Earth and space sciences (ESS) investigate processes that operate on Earth and also address its place in the solar system and the galaxy. Thus ESS involve phenomena that range in scale from the unimaginably large to the invisibly small.

Earth and space sciences have much in common with the other branches of science, but they also include a unique set of scientific pursuits. Inquiries into the physical sciences (e.g., forces, energy, gravity, magnetism) were pursued in part as a means of understanding the size, age, structure, composition, and behavior of Earth, the sun, and the moon; physics and chemistry later developed as separate disciplines. The life sciences likewise are partially rooted in earth science, as Earth remains the only example of a biologically active planet, and the fossils found in the geological record of rocks are of interest to both life scientists and earth scientists. As a result, the majority of research in ESS is interdisciplinary in nature and falls under the categories of astrophysics, geophysics, geochemistry, and geobiology. However, the underlying traditional discipline of geology, involving the identification, analysis, and mapping of rocks, remains a cornerstone of ESS.

Earth consists of a set of systems—atmosphere, hydrosphere, geosphere, and biosphere—that are intricately interconnected. These systems have differing sources of energy, and matter cycles within and among them in multiple ways and on various time scales. Small changes in one part of one system can have large and sudden consequences in parts of other systems, or they can have no effect at all. Understanding the different processes that cause Earth to change over time (in a sense, how it "works") therefore requires knowledge of the

169

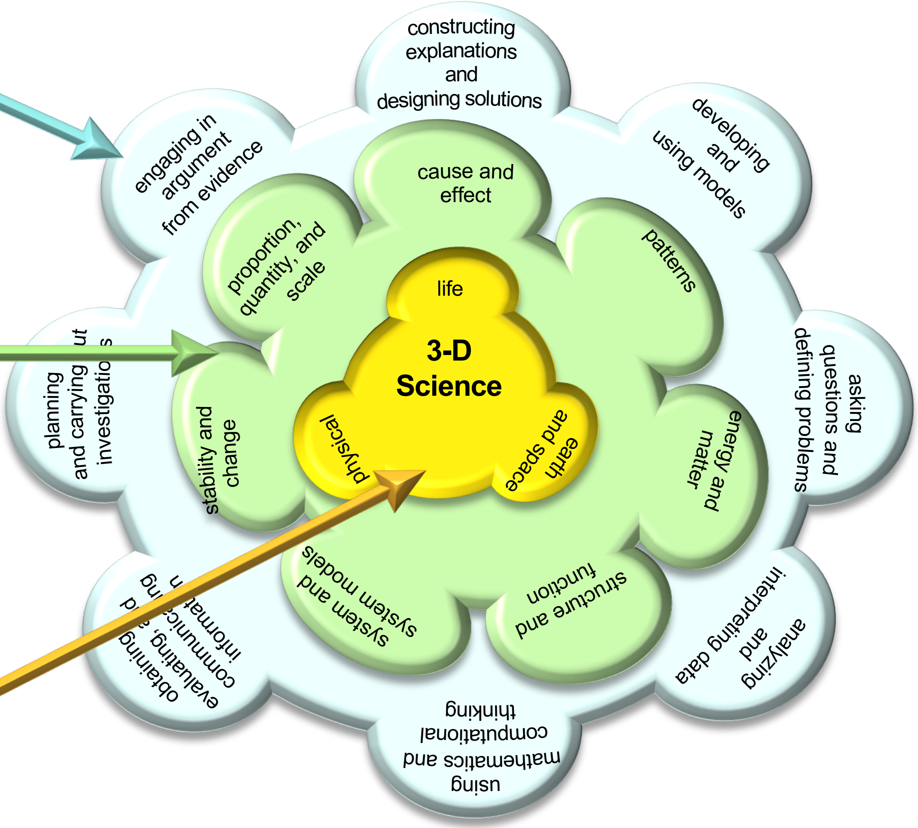
Copyright National Academy of Sciences. All rights reserved.

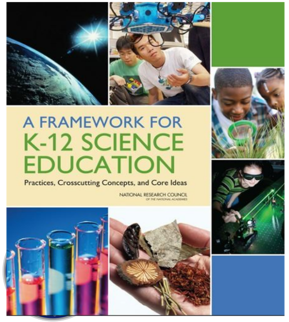
What is 3-Dimensional Science Instruction?

Science & Engineering Practices

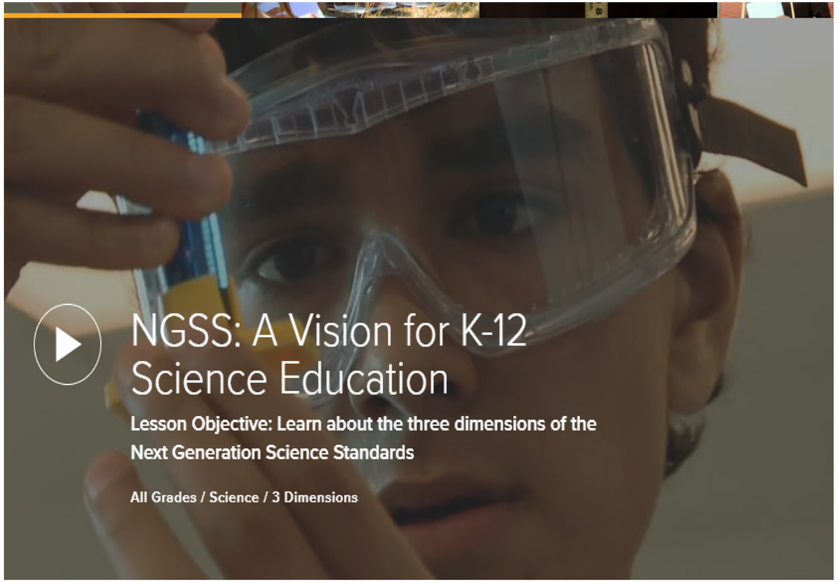
Crosscutting Concepts

Core Ideas





What Is 3-Dimensional Science Instruction?



LiveChat

1. How do the Arizona Science Standards represent a shift in science education?
2. What examples of phenomena do you see in the video?

AzSS Snapshot: What You Should See Students "Doing," "Thinking," "Knowing," and "Using" in Science

A Framework/Big Ideas for K-12 Science Instruction's 3-Dimensions and AzSS Using Science

SEPs

CCCs

1

Dimension 1: The Science and Engineering Practices

DO

1. Asking questions and defining pr s (p. 54)*
2. Developing and using mode
3. Planning and carrying out investig s (p. 59)*
4. Analyzing and interpreting data (p *
5. Using mathematics and computat thinking (p. 64)*
6. Constructing explanations and des ng solutions (p. 67)*
7. Engaging in argument from evidence (p. 71)*
8. Obtaining, evaluating, and communicating information (p. 74)*

2

Dimension 2: The Crosscutting Concepts

THINK

1. Patterns (p. 85)*
2. Cause and effect (p. 87)*
3. Scale, proportion, and quantity (*
4. Systems and system model)*
5. Energy and matter (p. 9
6. Structure and function (p. 96)*
7. Stability and change (p. 98)*

3

Dimension 3: The Core Ideas of Knowing S ence and The Core Ideas of Using Science

The core ideas of Knowing science (CIs)

The Core Ideas of Knowing Science

KNOW

P: Physical Science (p. 105)*

P1: All matter in the Universe is made of very small particles. (p. 20)**
P2: Objects can affect other objects at a distance. (p. 21)**
P3: Changing the movement of an object requires a net force to be ac n it. (p. 22)**
P4: The total amount of energy in a closed system is always the same but can be transferred from one energy store to another during an event. (p. 23)**

E: Earth and Space Science (p. 171)*

E1: The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth's surface an climate. (p. 24)**
E2: The Earth and our solar system are a very small part of one of many galaxies within the Universe. (p. 25)**

L: Life Science (p. 142)*

L1: Organisms are organized on a cellular basis and have a finite life span. (p. 26)**
L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms. (p. 27)**
L3: Genetic information is passed down from one generation of organisms to another. (p. 28)**
L4: The unity and diversity of organisms, living and extinct, is the result of

Arizona Science Standards unique Using Science (CIs)

The Core Ideas of Using Science

USE

U1: Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised. (p. 30 & 31)**

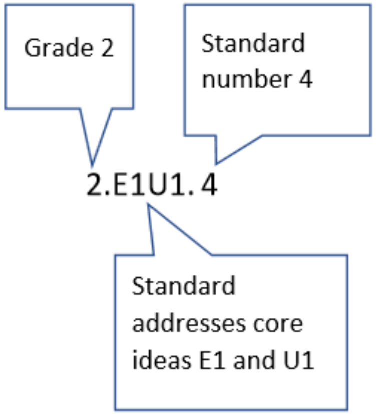
U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products. (p. 32)**

U3: Applications of science often have ethical, social, economic, and/or political implications. (p. 23)**

*A Framework for K-12 Science Education **Working with Big Ideas of Science Education Updated: 3/4/20

The Coding – How To Read It And How It's Useful

Earth and Space Standards
K.E1U1.3
Observe, record, and ask questions about temperature, precipitation, and other weather data to identify patterns or changes in local weather.



Earth and Space Standards
2.E1U1.4
Observe, describe, and predict how wind and water change the shape of the land resulting in a variety of landforms.

2.E1U1.4. Observe, describe, and predict how wind and water change the shape of the land resulting in a variety of landforms.

Putting it Together – 3 Dimensions

Phenomena

Physical Science 4th Grade 4.P4U1.1

Develop and use a model to demonstrate how a system transfers energy from one object to anther even when the objects are not touching.

Core Idea:
P4: The total amount of energy in a closed system is always the same but can be transferred from one energy store to another during an event.

Science & Engineering Practice:
Developing and Using Models

Crosscutting Concept:
Energy & matter
Systems and system models

Doing

Know/Learn

Thinking

Goals:

- Gain a better understanding of the **instructional shifts** needed for three-dimensional science instruction and how this relates to the AzSS
- Learn how to read the new AZ Science Standards and unearth the 3-dimensions of learning within the standard
- Explore how scientific phenomena can be used to drive standards-based instruction

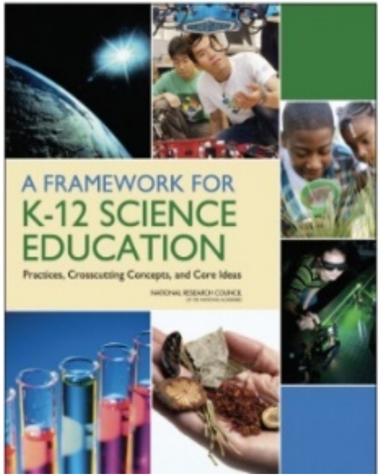
LiveChat

What are some possible things we could try and figure out or explore in this picture?

List as many as you can.

Phenomena = effect

Science seeks to explain the cause of the phenomena.



The word PHENOMENA (or phenomenon) appears **114 times** in the Framework

Arizona Science Standards
2018

Arizona Department of Education
High Academic Standards for Students

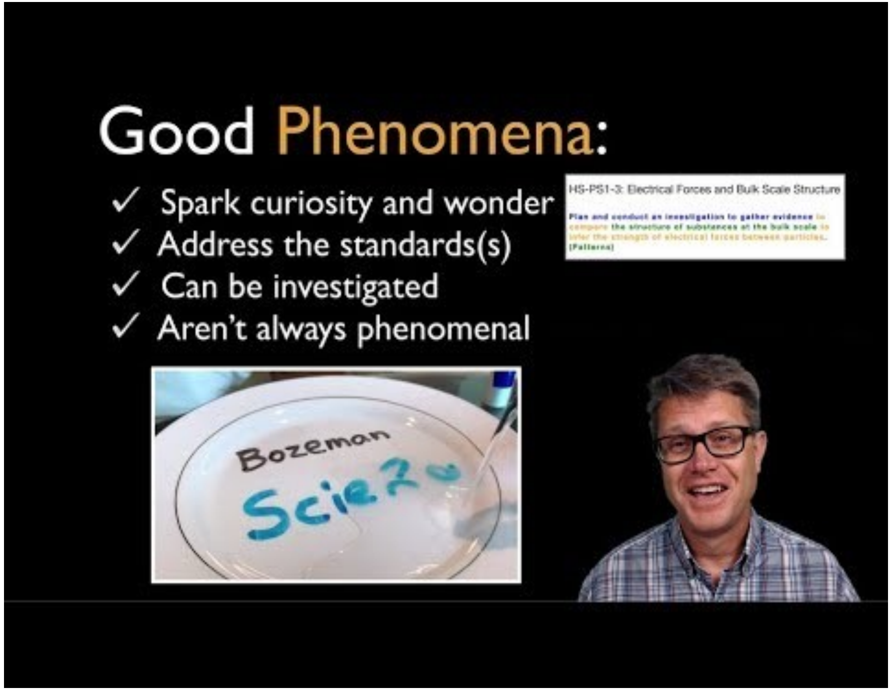
The word PHENOMENA (or phenomenon) appears **97 times** in our NEW AzSS

Phenomenon & Sense-Making

What exactly is a phenomenon?

An **observable event** that can be explained or explored using scientific practices, ideas, and concepts (the three dimensions).

Helps students with sense-making in science



Shifts in

LiveChat

1. Read
2. Share one of the following:
   - A-ha! Moment
   - Quote
   - Connection

Prior Thinking About Phenomena	Thinking About Phenomena Through the AzSS
If it's something fun, flashy, or involves hands-on activities, it must be engaging.	Authentic engagement does not have to be fun or flashy; instead, engagement is determined more by how the students generate compelling lines of inquiry that create real opportunities for learning.
Anything students are interested in would make a good "engaging phenomenon"	Students need to be able to engage deeply with the material in order to generate an explanation of the phenomenon using target DCIs, CCCs, and SEPs.
Explanations (e.g., "electromagnetic radiation can damage cells") are examples of phenomena	Phenomena (e.g., a sunburn, vision loss) are specific examples of something in the world that is happening—an event or a specific example of a general process. *Phenomena are NOT the explanations or scientific terminology behind what is happening. They are what can be experienced or documented.*
Phenomena are just for the initial hook	Phenomena can drive the lesson, learning, and reflection/monitoring throughout. Using phenomena in these ways leads to deeper learning.
Phenomena are good to bring in after students develop the science ideas so they can apply what they learned	Teaching science ideas in general (e.g., teaching about the process of photosynthesis) may work for some students, but often leads to decontextualized knowledge that students are unable to apply when relevant. Anchoring the development of general science ideas in investigations of phenomena helps students build more usable and generative knowledge.
Engaging phenomena need to be questions	Phenomena are observable occurrences. Students need to *use the occurrence to help generate the science questions or design problems* that drive learning.
Student engagement is a nice optional feature of instruction, but is not required	Engagement is a crucial access and equity issue. Students who do not have access to the material in a way that makes sense and is relevant to them are disadvantaged. Selecting phenomena that students find interesting, relevant, and consequential helps support their engagement. A good phenomenon builds on everyday or family experiences: who students are, what they do, where they came from.

Introducing a Phenomenon

1. Find a short video or piece of data to present or lead a demonstration / exploration with students.

2. Show the video / present the data / explore the object or process, and get their ideas about <u>questions</u> they have about the phenomenon.

Let's Try it Out!

Teacher Lens

1) Watch the video clip.

2) Think about what science **content** the students need to know to explain this video.

3) Share your thoughts in the chat box.

Plus HS+C.P1U1.3
Analyze and interpret data to develop and support an explanation for the relationships between kinetic molecular theory and gas laws.

Let's Try it Out!

Student Lens

1) Watch the video clip.

2) What do you notice?
What do you wonder?

THINK: What are some related things we know about or have experienced, that could help us understand what's going on here?

(elicit initial ideas & connect to prior experiences)

I notice…	I wonder…

3) Share one "I notice" observation in the chat box.

Generating/Asking Questions

Student Lens

Question starters to consider:

As Noun/pronoun

- How – Mechanism by which phenomenon occurs, What is the mechanism, the way of doing something, or way phenomenon occurs
- Why – Causes of phenomenon, reason for, what causes the phenomenon
- What – Identity, specify, nature of
- That – This happens, exists, is, a fact, point out, used to indicate

I notice…	I wonder…
	?

3) Share one "I wonder" question in the chat box.

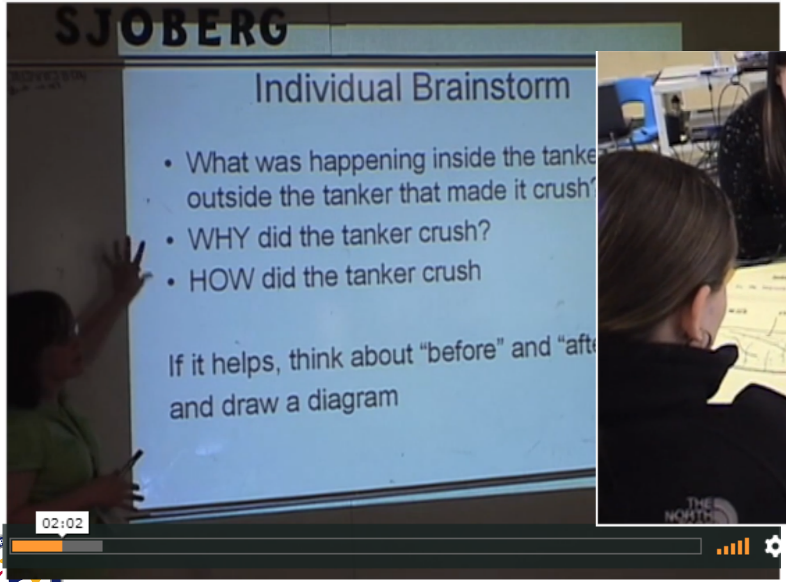
If we were to continue this activity..

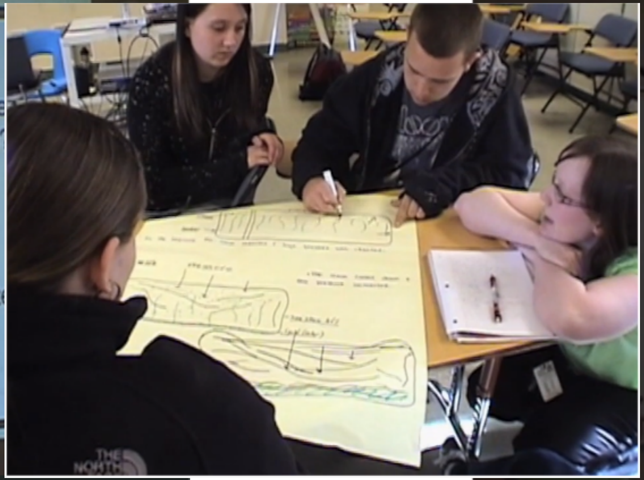
Students might…

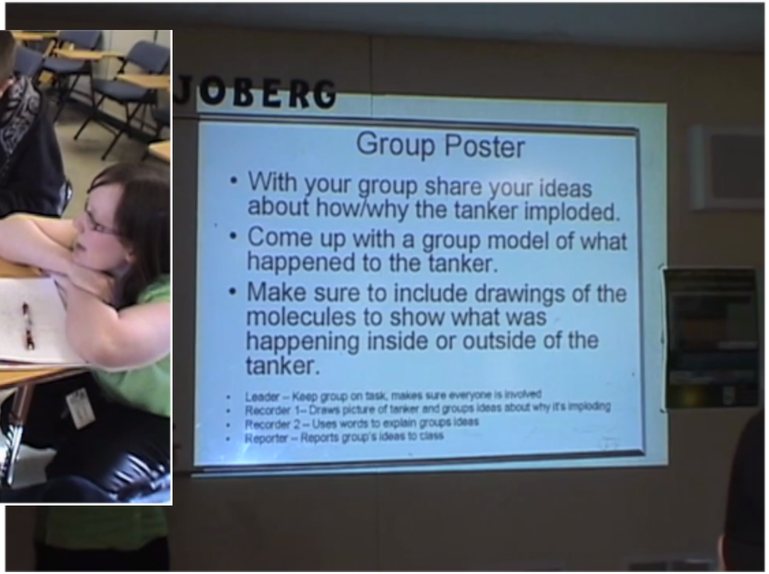
Draw an initial model of what they think is happening (individually)

And then…

Combine their ideas with other members of their group to make a Group or Consensus Model







Source: https://ambitiousscienceteaching.org/video-series/

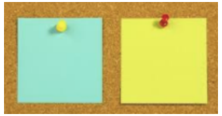
If we were to continue this activity…

Students might…

Ask any remaining questions and put in "I wonder" chart

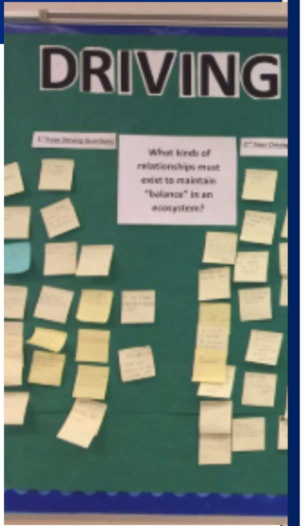
I notice…	I wonder…

Choose top 2 questions and write on post-its



Build a public record of questions using a Driving Question Board (DQB)

Decide collectively on a first investigation to conduct



Possible Future Investigations

Ideas to Research:

Debriefing the Launch

The launch presents the phenomena, setting up the expectation that they will **observe** some things that need investigating.

The launch involves **asking questions**, and therefore puts students in the driver's seat for a series of lessons.

The launch engages learners' **prior knowledge and related experiences** as resources for understanding.

The launch requires them to **prioritize** when to take up what questions, providing a possible learning pathway for them to pursue.

LiveChat

How is it different from what typically happens in science classrooms in your grade band? How is it different from how you learned?

A Sequence to Promote Sense Making

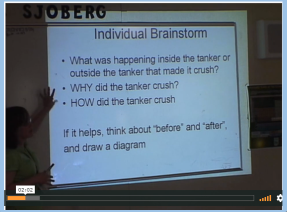
Phenomena

What was the event(s) in the world that happened that we need to explain?

Question

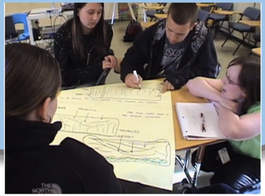
What about the phenomena do we need to explain?

I notice…	I wonder…



Science & Engineering Practices

How are we modeling, explaining, etc. the phenomena, or designing a solution to solve the problem?

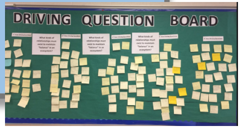


New Ideas

What did we **figure out** using these practices?

What pieces of the **CIs** or **CCCs** did we figure out?

What new ideas do we have? What questions do I have?



Guidance for Selecting Phenomena

- ✓ Identify phenomena students could encounter in the real-world (classroom, lab, outdoors, home).
- ✓ Having data, or support information, is a plus, but not a requirement
- ✓ All three dimensions should be necessary to explain the phenomena
- ✓ Phenomena can be, but do not have to be, phenomenal.

Good Candidate Phenomena:

- ✓ Sparks curiosity and wonder- doesn't have to be "wow!," but more likely is a "huh?" experience
- ✓ Can be investigated
- ✓ Address the standard(s)

Do not select a phenomenon if it:

- Is peripheral to the subject content of the curriculum
- Does not surprise or generates little curiosity and the teacher has to do all the work
- Involves science concepts that are too difficult for students to grasp
- Is too complex for the students to solve, leading them to simply think of it as 'magic'

How Using Mysteries Supports Science Learning– TEMI – Sept 2015

Designing Phenomena-Based Instruction

AZ Science Standard

Core Ideas of Knowing & Using

What phenomenon can be explained using the core ideas?

Phenomenon

How will students interact with the phenomenon?

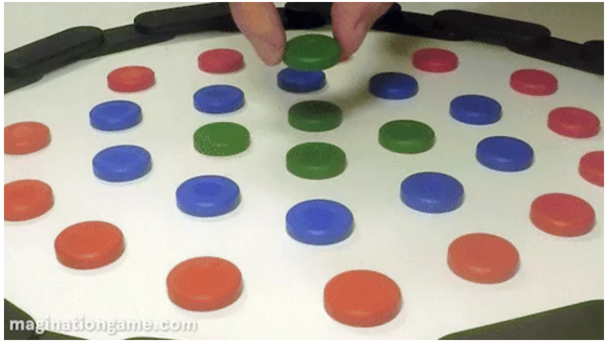
Science & Engineering Practice

What "lens" will students use to think about the phenomenon?

Crosscutting Concept

4.P4U1.1	U1: Phenomena/Sense-making

Develop and use a model to demonstrate how a system transfers energy from one object to another even when the objects are not touching.



Energy and Matter

Systems & System Models

Crosscutting Concepts:
Patterns, Cause and Effect, Scale, Proportion and Quantity; **Systems and System Models**; **Energy and Matter**; Structure and Function; **Stability and Change**[4]

Designing Phenomena-Based Instruction

AZ Science Standard

Core Ideas of Knowing & Using

What phenomenon can be explained using the core ideas?

Phenomenon

How will students interact with the phenomenon?

Science & Engineering Practice

What "lens" will students use to think about the phenomenon?

Crosscutting Concept

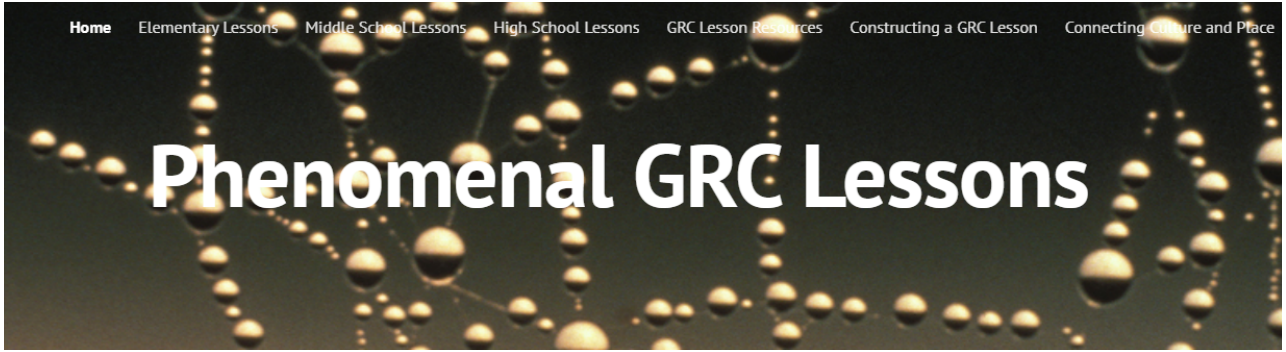
3.L2U1.8	U1: Phenomena/Sense-making
Construct an argument from evidence that organisms are interdependent.	

Systems & System Models

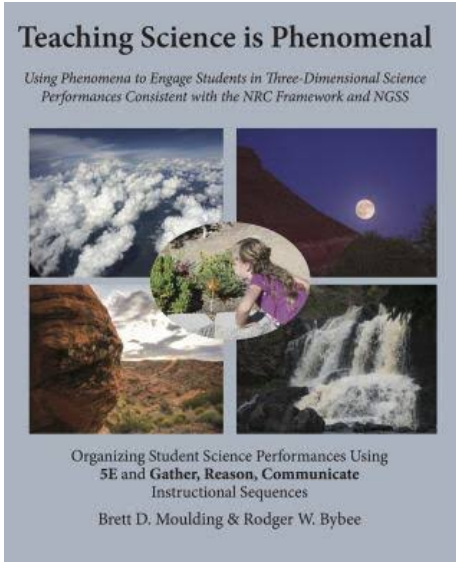
Structure & Function

Crosscutting Concepts:
Patterns, Cause and Effect, Scale, Proportion and Quantity; **Systems and System Models**; Energy and Matter; **Structure and Function**; Stability and Change[4]

#Going3Dw/GRC- Lessons that Use Phenomena



Recommend reading this book- accompanies the website!



Link to #Going3Dw/GRC Website

Phenomena Resources

- ❑ Phenomena for NGSS
https://www.ngssphenomena.com/
- ❑ Project Phenomena
https://sites.google.com/site/sciencephenomena/
- ❑ The Wonder of Science
https://thewonderofscience.com/phenomenal
- ❑ Project SING Phenomena
http://questlc.org/phenomena/#phenomena

Almost done!

Two Emails

1. **From EMS with a survey- MUST be filled out to receive PD Clock hours**

2. **From ME☺ with resources and this presentation & upcoming PD opportunities**

Scan me

Title	Date	Time	Cost	Type
Crosscutting Concepts: 1 of the 3 Dimensions of the AZ Science Standards	6/4/2020	9:00am – 10:00am	FREE	W
STEM Series: Meet Computer Science Standards with Code.org	6/4/2020	4:00pm – 5:00pm	FREE	W
Science & Engineering Practices: 1 of the 3 Dimensions of the AZ Science Standards	6/5/2020	9:00am – 10:00am	FREE	W
5-E Instructional Model & Science Notebooks	6/9/2020	4:00pm – 5:00pm	FREE	W
#SciencingAndEngineering with @TheSTEMAZingPro and @RobotGeneral5- Session 2	6/10/2020	4:00pm – 5:00pm	FREE	W
STEM Series: Meet Computer Science Standards with Code.org	6/11/2020	4:00pm – 5:00pm	FREE	W
Phenomena-Based 3-D Instruction	6/16/2020	4:00pm – 5:00pm	FREE	W
#SciencingAndEngineering with @TheSTEMAZingPro and @RobotGeneral5- Session 3	7/1/2020	4:00pm – 5:00pm	FREE	W
#SciencingAndEngineering with @TheSTEMAZingPro and @RobotGeneral5- Session 4	7/22/2020	4:00pm – 5:00pm	FREE	W
#SciencingAndEngineering with @TheSTEMAZingPro and @RobotGeneral5- Session 5- Early Childhood	8/12/2020	4:00pm – 5:00pm	FREE	W

Thanks!

Any questions?

Please contact: Rebecca Garelli

Rebecca.Garelli@azed.gov