



Arizona Science Draft Standards

PUBLIC MEETING

APRIL 6, 2018

ADE Facilitators

K-12 Academic Standards Section

Carol Lippert

Associate Superintendent
High Academic Standards for Students

Jonathan Moore

Deputy Associate Superintendent
K-12 Academic Standards

Brea Rivera

K-12 Science Specialist
K-12 Academic Standards

Sarah Sleasman

K-12 STEM Specialist
K-12 Academic Standards

Purpose of Today's Public Meeting

- ❖ To review the current draft of the Arizona Science Standards
- ❖ To identify any questions or comments you may have related to the standards.

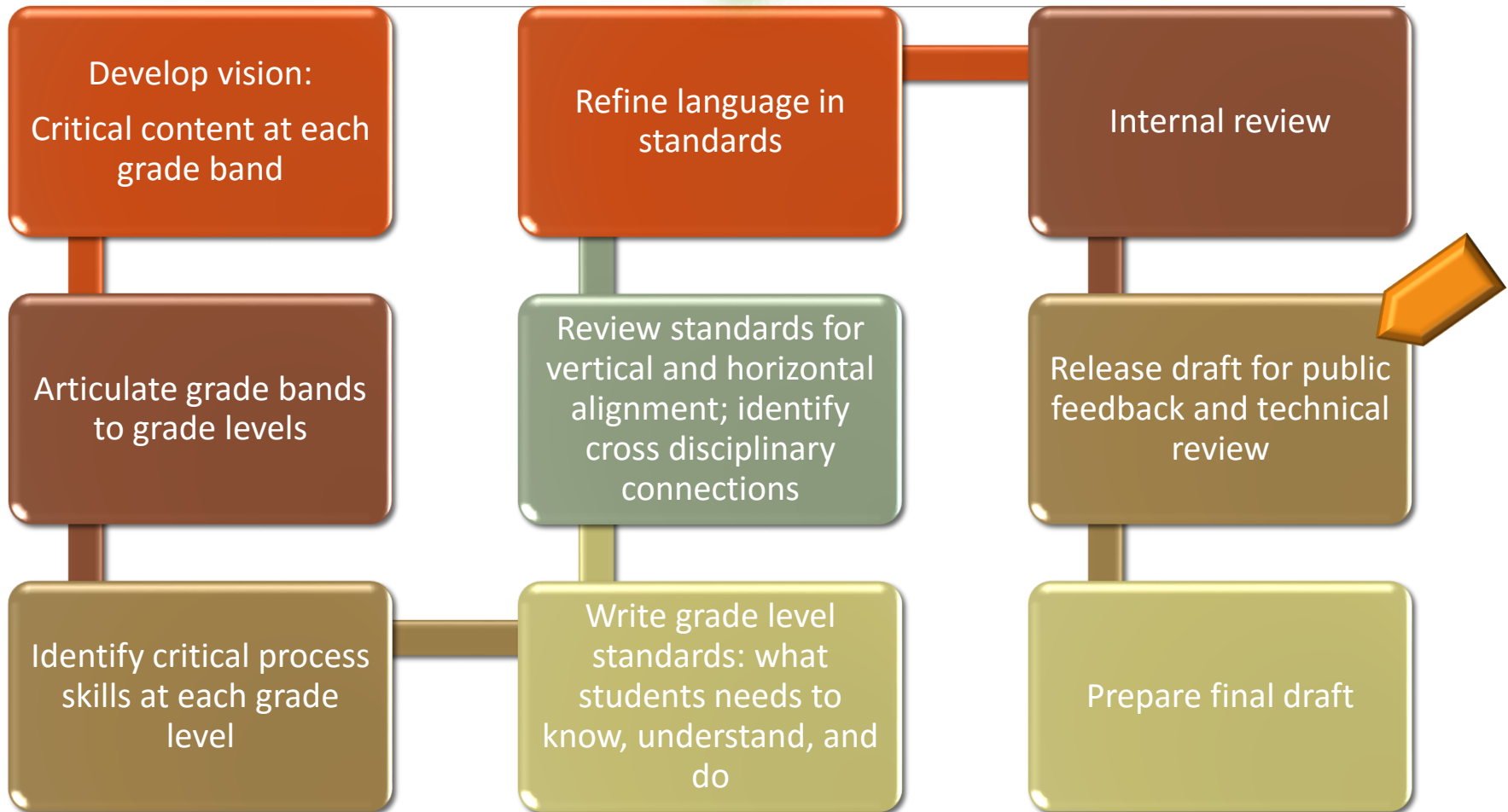
Agenda for Today's Public Meeting

<input type="checkbox"/> Presentation on Draft Standards	45 mins
<input type="checkbox"/> Brief Recess	10 mins
<input type="checkbox"/> Questions and Comments	35 mins

Norms for Today's Public Meeting

- ❖ Be kind, courteous, and respectful
- ❖ Be an engaged participant
- ❖ Be an active listener:
 - ❖ Open to new ideas
 - ❖ Speaking one at a time
- ❖ Use notes for side bar conversations
- ❖ Use electronics respectfully

It's a Process



Informed by research and public comment; Standards development is an on-going cycle of improvement

Standards, Curriculum, & Instruction

Standards – What a student needs to know, understand, and be able to do by the end of each grade. Standards build across grade levels in a progression of increasing understanding and through a range of cognitive demand levels. Standards are adopted at the state level by the State Board of Education.

This is the “WHAT”

Standards, Curriculum, & Instruction

Curriculum – The resources used for teaching and learning the standards. Curricula are adopted at a local level by districts and schools.

Instruction – The methods used by teachers to teach their students. Instructional techniques are employed by individual teachers in response to the needs of the students in their classes to help them progress through the curriculum in order to master the standards.

This is the “HOW”

Statutory References for Academic Standards

- ❖ **A.R.S. §15-701** directs **local education agencies (LEAs)** to **incorporate** the **academic standards adopted** by the **SBE** to be taught in the common schools. Additionally, the statute prescribes competency requirements for the promotion of pupils from the eighth grade and competency requirements for the promotion of pupils from the third grade incorporating the academic standards in at least the areas of reading, writing, mathematics, science, and social studies.
- ❖ **A.R.S. §15-701.01** prescribes competency requirements for the graduation of pupils from high school **incorporating the academic standards in at least the areas of reading, writing, mathematics, science, and social studies**.
- ❖ **A.R.S. §15-703** and **A.R.S. §15-249.09** also refer to the **implementation of academic standards** by local education agencies (LEAs).

This is the “WHAT”

Statutory References for Curriculum and Instruction

- ❖ **A.R.S. §15-721** directs **school district** and **charter school governing boards** to approve the course of study for schools within grades K-8 as well as **approve the textbooks, supplemental books, teaching aides, and computer software** for all courses of study.
- ❖ **A.R.S. §15-722** directs **school district** and **charter school governing boards** to approve the course of study for high schools as well as **approve the textbooks, supplemental books, teaching aides, and computer software** for all courses of study.

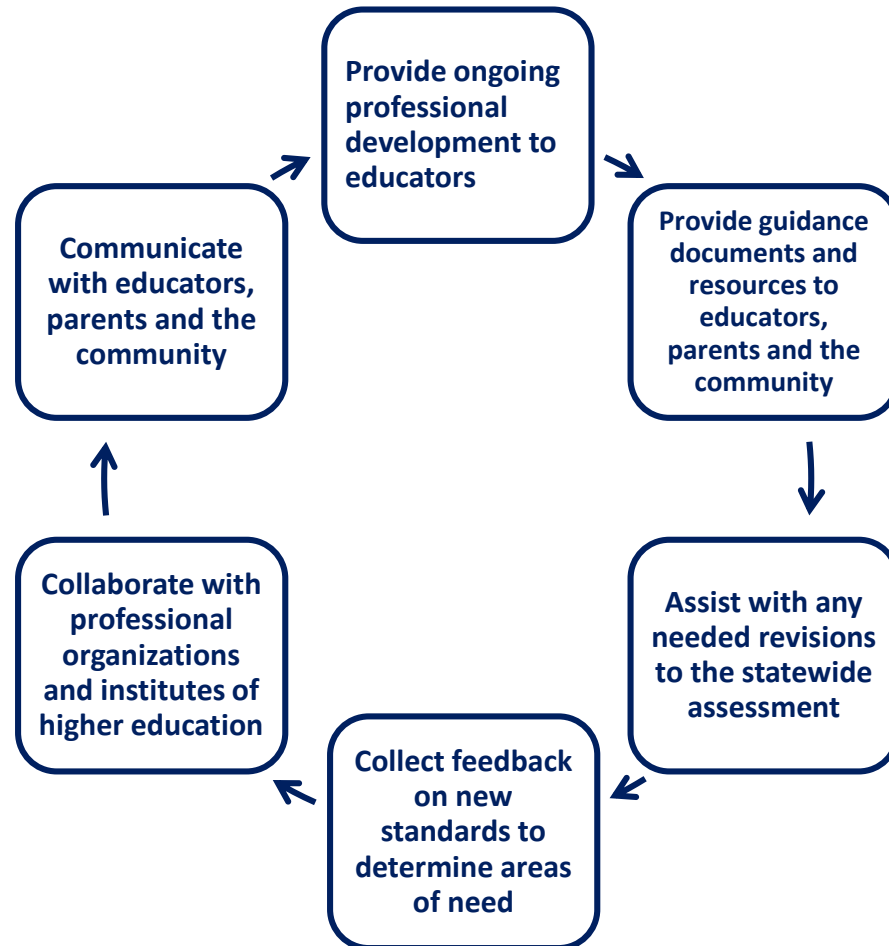
This is the “HOW”

Arizona Science Standards

DRAFT MARCH 2018

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K-12 Academic Standards Implementation Support

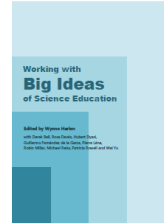


Research Base



Research Base

Knowing Science



Knowing Science

All matter in the Universe is made of very small particles.

Objects can affect other objects at a distance.

Changing the movement of an object requires a net force to be acting on it.

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.

The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth's surface and climate.

The Earth and our Solar System are a very small part of one of many galaxies within the Universe.

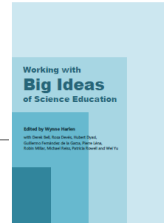
Organisms are organized on a cellular basis and have a finite life span.

Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.

Genetic information is passed down from one generation of organisms to another.

The theory of evolution seeks to make clear the unity and diversity of living and extinct organisms.

Research Base Using Science



Using Science

Science's purpose is to find the cause or causes of phenomena in the natural world

Scientific explanations, theories, and models are those that best fit the evidence available at a particular time.

The knowledge produced by science is used in engineering and technologies to create products.

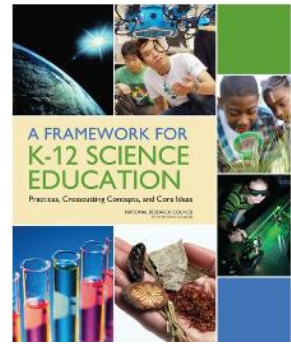
Applications of science often have both positive and negative ethical, social, economic, and political implications.

Structure of the Framework

Disciplinary Core
Ideas

Science and
Engineering Practices

Crosscutting
Concepts



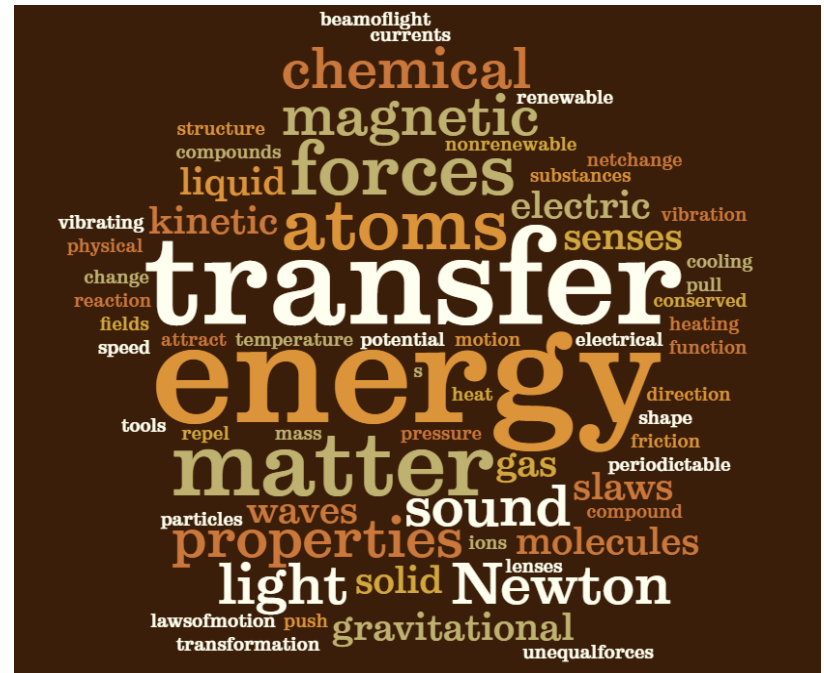
Core Ideas in Physical Science

All matter in the Universe is made of very small particles.

Objects can affect other objects at a distance.

Changing the movement of an object requires a net force to be acting on it.

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.



Physical Science Progression

Core Ideas for Knowing Science –Physical Sciences:

- **P3: Changing the movement of an object requires a net force to be acting on it.**

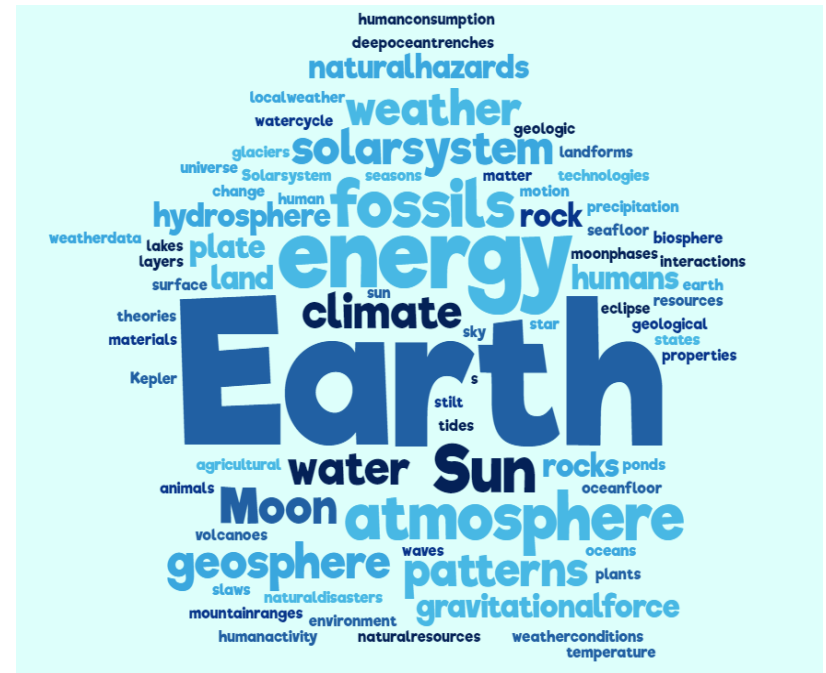
2018 DRAFT Arizona State Science Standard Progression

- **1.P3U1.3 Plan and carry out investigations** which demonstrate how equal forces can balance objects and how unequal forces can push, pull, or twist objects, making them change their speed, direction, or shape.
- **5.P3U1.4 Obtain, analyze, and communicate evidence** of the effects that balanced and unbalanced forces have on the motion of objects.
- **6.P3U2.4 Plan and carry out an investigation** that can support an evidence-based explanation of how objects on Earth are affected by gravitational forces.
- **7.P3U2.3** Use non-algebraic **mathematics and computational thinking** to explain Newton's laws of motion.
- **HS.P3U2.7 Develop a mathematical model**, using Newton's laws, to predict the change in motion of an object or system in one dimension.

Core Ideas in Earth and Space Science

The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth's surface and climate.

The Earth and our Solar System are a very small part of one of many galaxies within the Universe.



Earth/Space Science Progression

Core Ideas for Knowing Science -Earth and Space Sciences:

- **E2: The Earth and our Solar System are a very small part of one of many galaxies within the Universe.**

2018 DRAFT Arizona State Science Standard Progression

- **2.E2U1.8 Analyze and interpret data** to explain the Earth's position in relation to the Sun at different times during a twenty-four-hour period and changes in the apparent shape of the Moon from one night to another.
- **5.E2U1.7 Develop and use models** based on evidence to construct explanations about the movement of the Earth and Moon within our Solar System.
- **6.E2U2.11 Develop and use models** to construct an explanation of how eclipses, moon phases, and tides occur within the Sun-Earth-Moon system.
- **HS.E2U2.16** Apply **mathematical and/or computational representations** of Kepler's laws as they relate to the movement of planets and objects in the solar system.

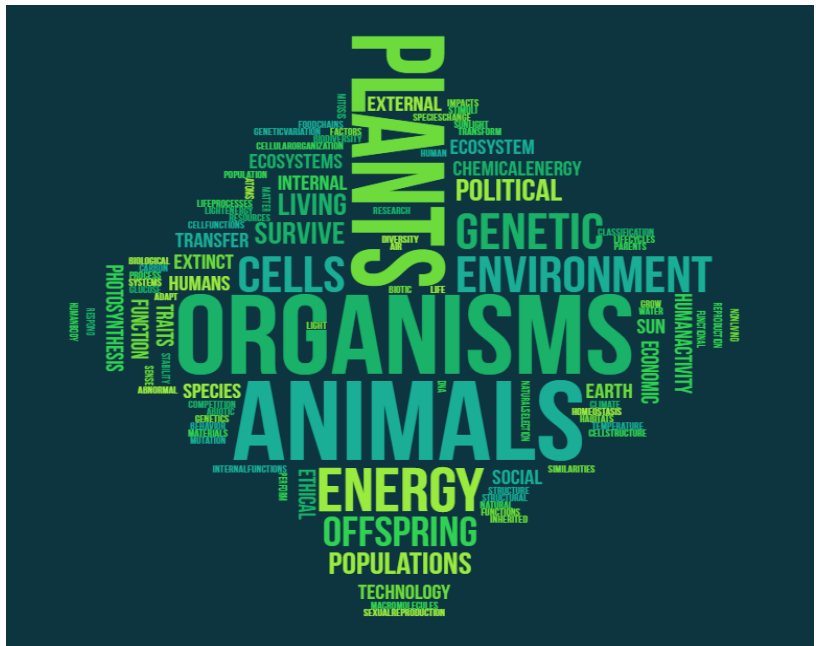
Core Ideas in Life Science

Organisms are organized on a cellular basis and have a finite life span.

Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.

Genetic information is passed down from one generation of organisms to another.

The theory of evolution seeks to make clear the unity and diversity of living and extinct organisms.



Life Science Progression

Core Ideas for Knowing Science – Life Sciences:

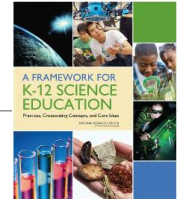
- **L1: Organisms are organized on a cellular basis and have a finite life span.**

2018 DRAFT Arizona State Science Standard Progression

- **K.L4U2.7 Ask questions about and explain** how specialized structures found on a variety of plants and animals (including humans) help them sense and respond to their environment.
- **3.L1U2.6 Develop and use models** to explain that plants and animals have internal and external structures that serve various functions that aid in growth, survival, behavior, and reproduction.
- **6.L1U1.14 Develop and use a model** to explain the organizational levels of structures in multicellular organisms consisting of organ systems, organs, tissues, and cells.
- **HS.L1U1.20 Generate questions** and/or predictions based on observations and evidence to explain cellular organization, structure, and function.

Research Base

Crosscutting Concepts



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

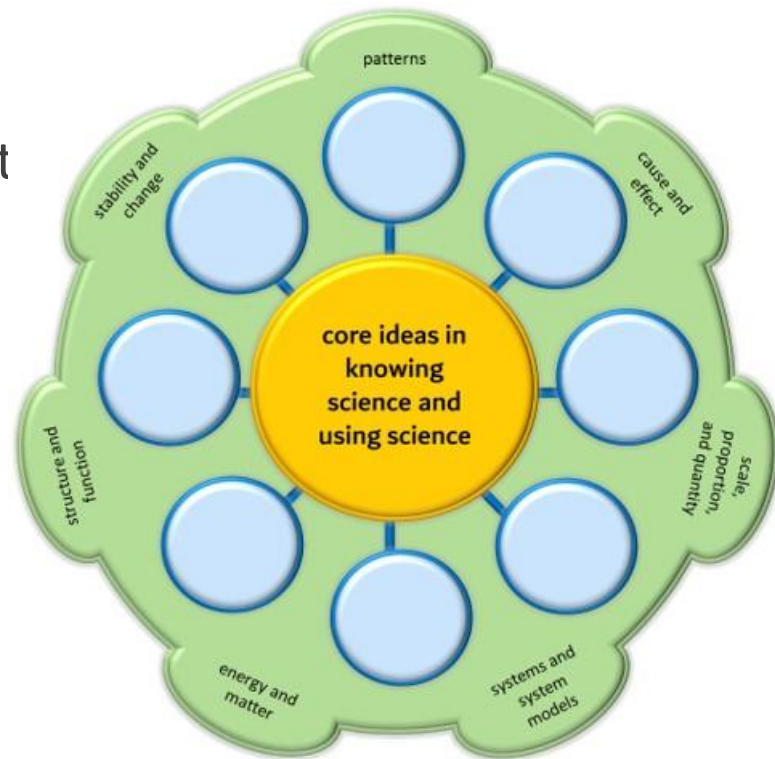
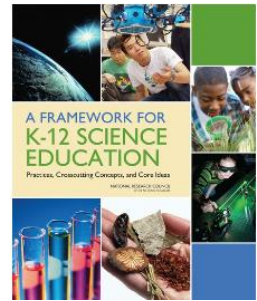


Figure 2: Crosscutting concepts provide a lens for understanding the core ideas

Research Base Science & 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
- Obtain, evaluate, and communicate information

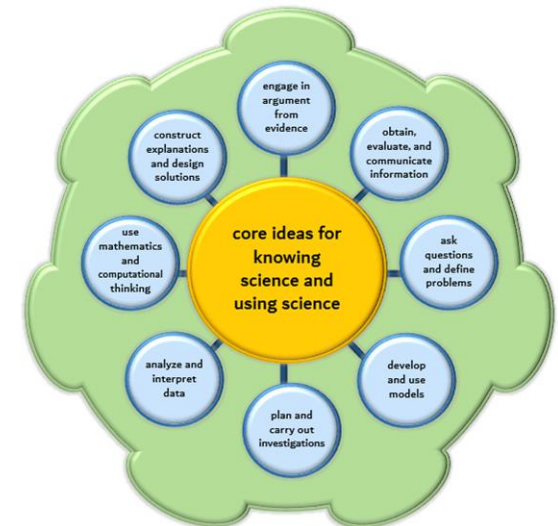
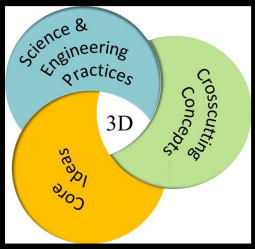


Figure 3: Science and engineering practices are used to investigate core ideas in science and develop scientific literacy



vs.

The Scientific Method

The Science and Engineering Practices

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 designing solutions



Engaging in argument from evidence



Obtaining, evaluating and communicating information



**Purpose/
Question**

Research

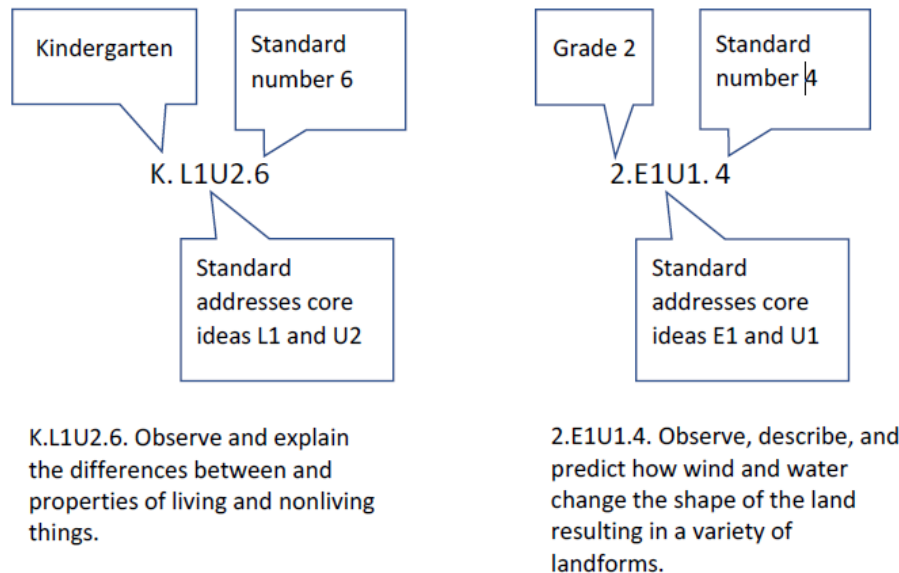
Hypothesis

Experiment

Analysis

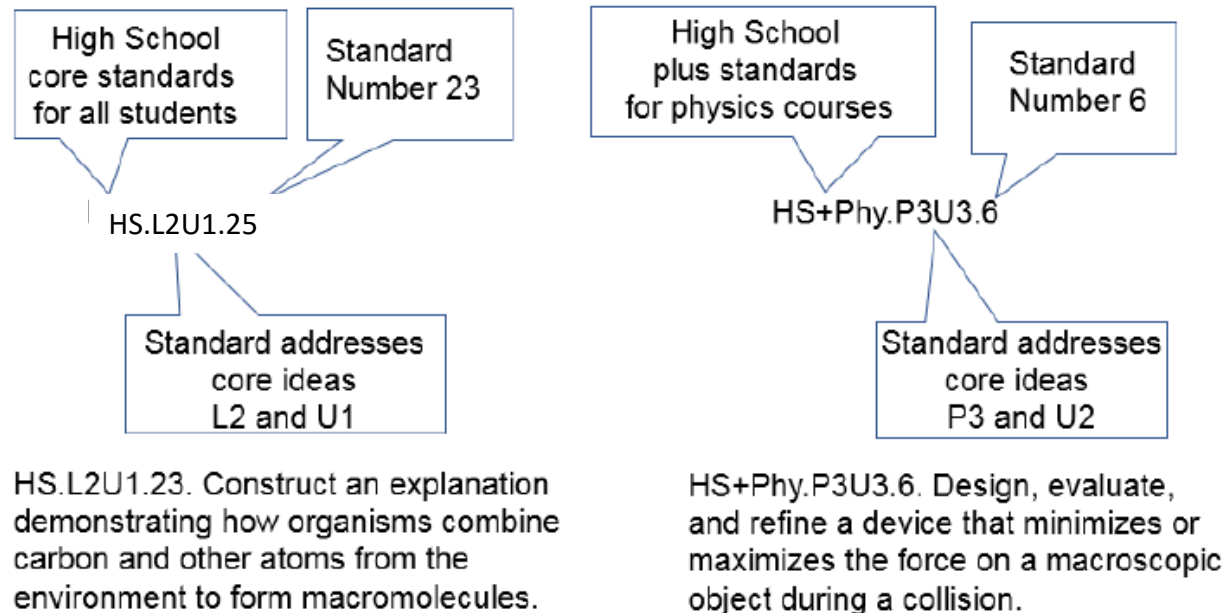
Conclusion

The Coding



K.L2U2.6 Ask questions about and explain the differences between properties of living and nonliving things.

The Coding



HS.L2U1.25 Construct an explanation demonstrating how organisms combine carbon and other atoms from the environment to form macromolecules.

Essential vs. Plus Standards for High School

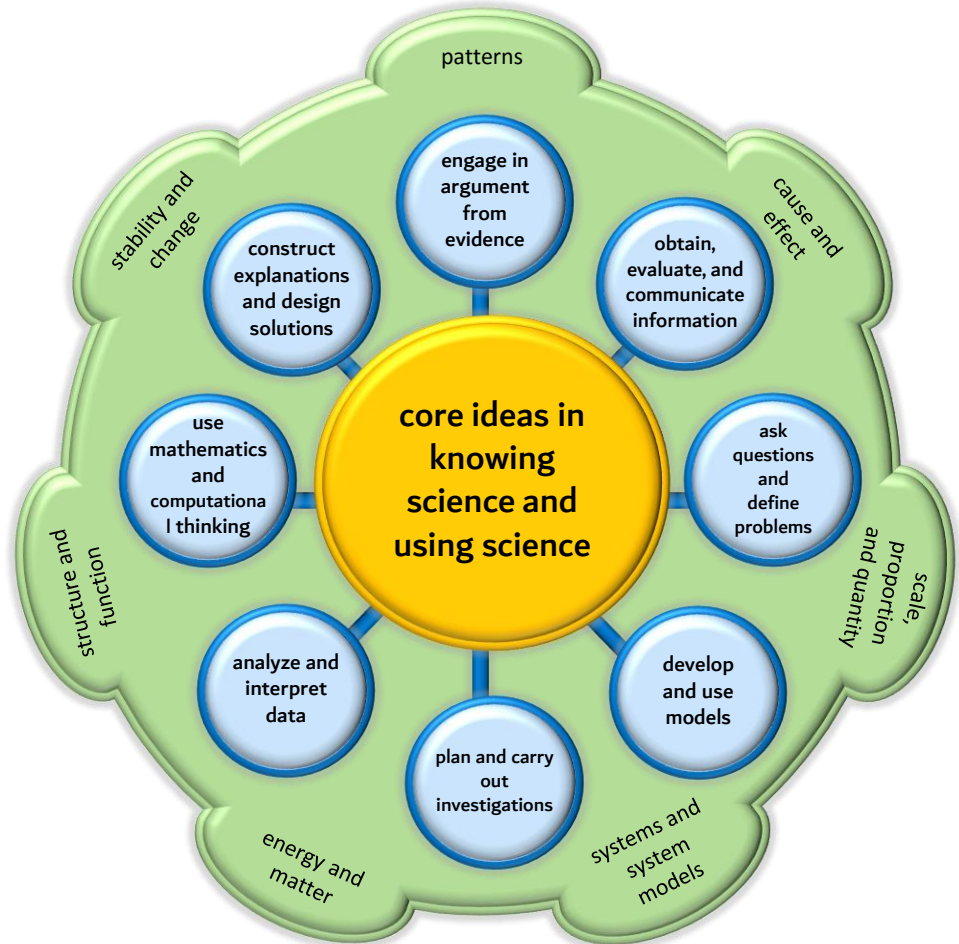
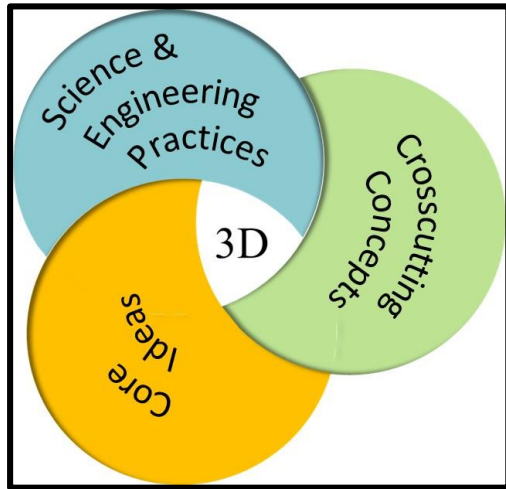
High School Essential Standards

- Learned by all students across three credits of high school science
- Includes all 14 big ideas to prepare students for adult science literacy
- May be assessed on the state science assessment

High School Plus Standards

- Designed to extend the learning of the core standards
- Specific to physics, chemistry, earth/space, and biology courses to prepare students for college-level courses
- May be assessed by districts but not by state

Three Dimensions



How does it work? 4th Grade Example

Physical Sciences: Students develop an understanding of how Earth's resources can be transformed into different forms of energy. Students develop a better understanding of electricity and magnetism and how they are forms of energy.

Physical Science Standards	Key concepts include but are not limited to:
4.P4U2.1	
Develop and use a model to demonstrate how a system transfers energy from one object to another even when the objects are not touching.	Radiation, heat, sun energy
4.P4U2.2	
Develop and use a model that demonstrates how energy is moved from place to place through electric and magnetic currents.	Concepts taught in <u>1.P3U1.3</u> and magnet composition, magnetic: forces, poles, fields, attraction, static electricity, electric current, circuits, conductors, insulators, electromagnets, electrical charge (protons, electrons), safety
4.P4U4.3	
Construct an explanation and engage in argument from evidence on the use of renewable and nonrenewable resources to provide energy.	Refer to standard

Knowing and Using Science

Physical Sciences: Students develop an understanding of how Earth's resources can be transformed into different forms of energy. Student develop a better understanding of electricity and magnetism and how they are forms of energy.

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

➤ Knowing Science:

- 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.

➤ Using Science:

- U2: Scientific explanations, theories, and models are those that best fit the evidence available at a particular time.

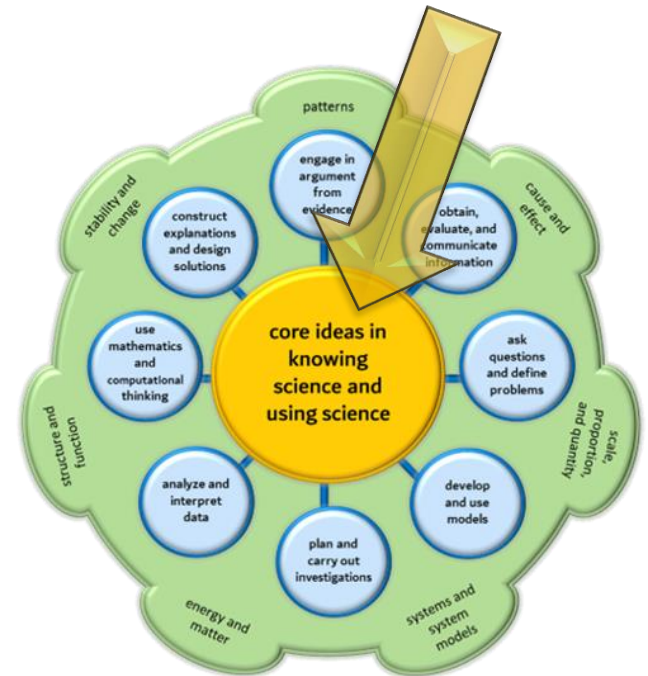


Figure 1: Three Dimensions of Science Instruction

Science and Engineering Practice

Develop a Model

- ❑ Diagrams
- ❑ Drawings
- ❑ Physical Replicas
- ❑ Mathematical Representations
- ❑ Analogies
- ❑ Computer Simulations

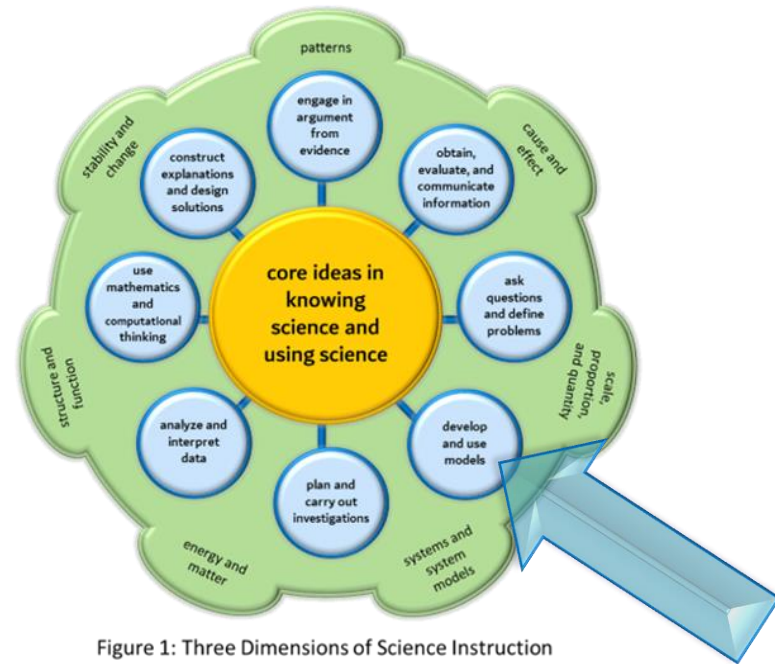
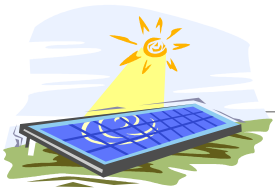


Figure 1: Three Dimensions of Science Instruction

Science and Engineering Practices

Use a Model



Students use their models to show how the energy is transferred from the sun to a solar panel to make the fountain function.

Once models have been designed and constructed, students **use** their models to test different angles and keep record of it on a diagram.

Identify key features and functions: Radiation is in the form of photon rays that excite electrons in the panel causing them to move. Once the electrons are moving and a path is provided, then the electrons can do work for us. In this case, energy from radiation is operating the pump allowing the fountain to operate.

Explain the phenomena:

What generated energy to make your model work?

What variables affect the production?

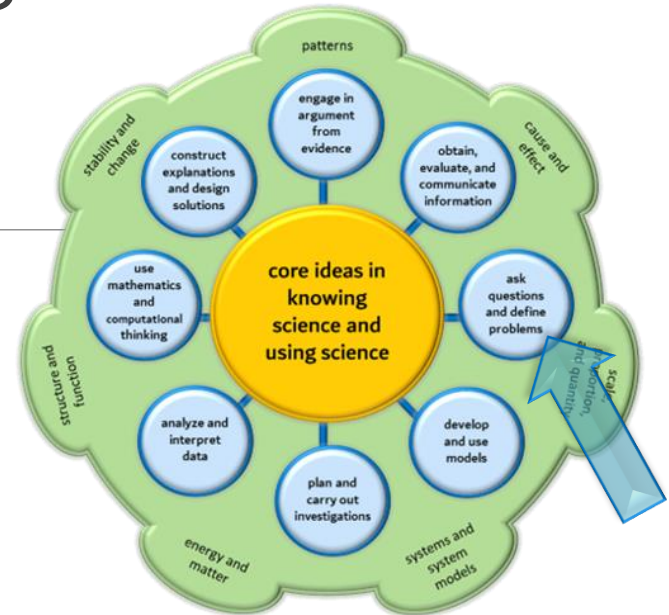


Figure 1: Three Dimensions of Science Instruction



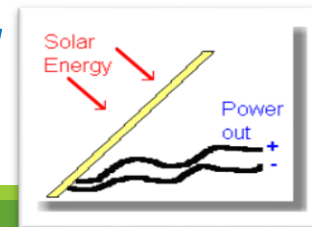
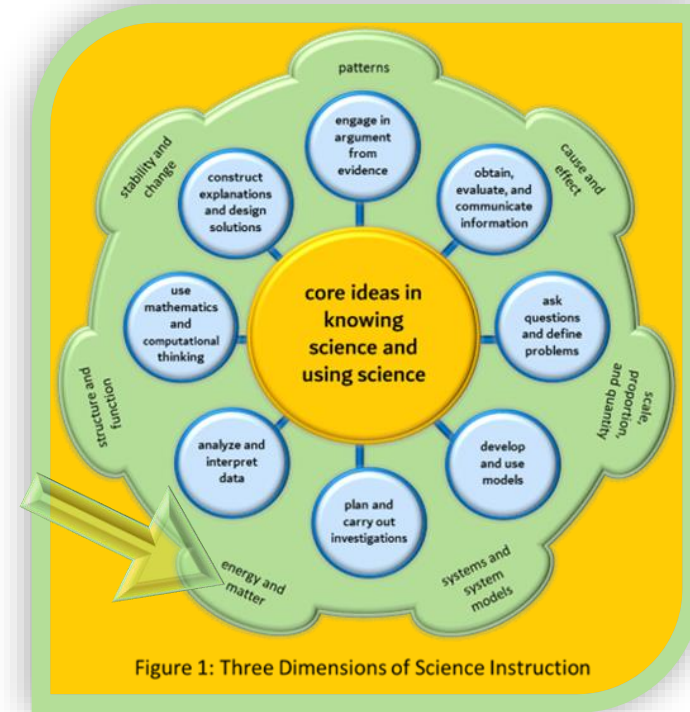
Crosscutting Concept Energy & Matter

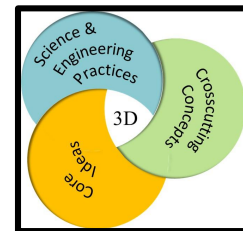


Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

Students can use their model, text, and diagrams to explain the phenomena of solar energy.

The small solar cell is like that of a larger one. It absorbs photons from the sun to excite electrons and generate electricity. The Sun is not physically touching it but the rays allow the fountain to work.





Putting it Together – 3 Dimensions

Knowing Science:

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.

Using Science:

Scientific explanations, theories, and models are those that best fit the evidence available at a particular time.

**Physical Science 4th Grade
Arizona Draft Science
Standard**

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

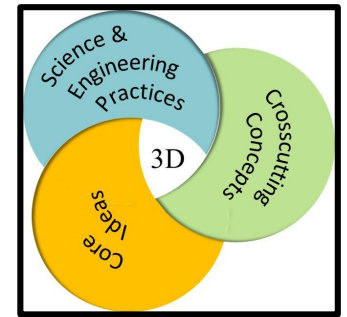
**Science &
Engineering
Practice:**

Developing and
Using Models

**Crosscutting
Concept:**

Energy & matter

2nd Grade Example



Knowing Science:

The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth's surface and climate.

Using Science:

The knowledge produced by science is used in engineering and technologies to create products.

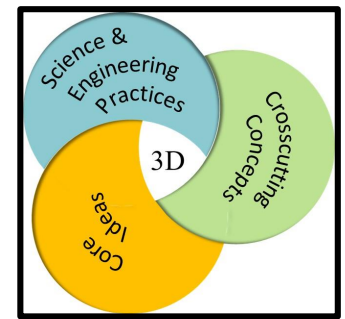
Earth & Space Sciences 2nd Grade: Analyze patterns in weather conditions of various regions of the world and **design, test, and refine solutions** to protect humans from severe weather conditions.

Science & Engineering Practice:

Constructing Explanations and Designing Solutions

Crosscutting Concept:

Structure & Function
Stability and Change
Cause and Effect



High School Example

Knowing Science:

Organisms are organized on a cellular basis and have a finite life span.

Using Science:

Science explanations, theories, and models are those that best fit the evidence available at a particular time.

Life Sciences High School

Obtain, evaluate, and communicate information to show that systems of specialized cells within organisms (plant and animal) help them perform the essential functions of life.

Science & Engineering Practice:

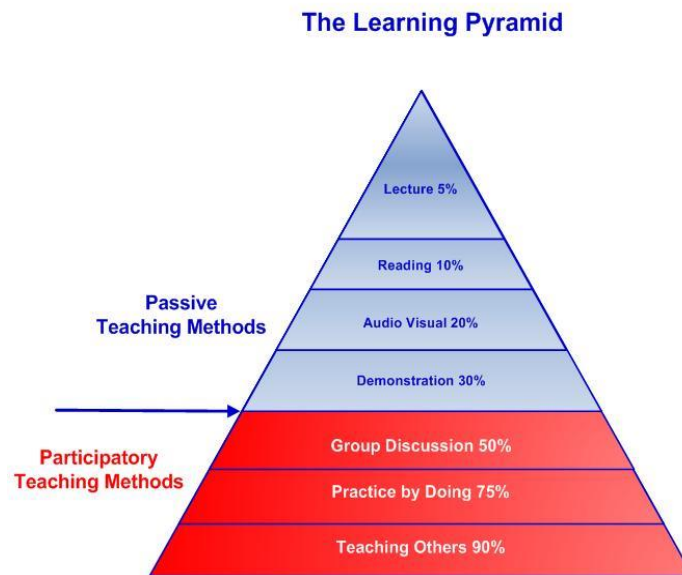
Obtaining, Evaluating, and Communicating Information

Crosscutting Concept:

Structure & Function
Systems and system models

Overview of Changes

1. Shift to broader standards
 - greater depth and more connections



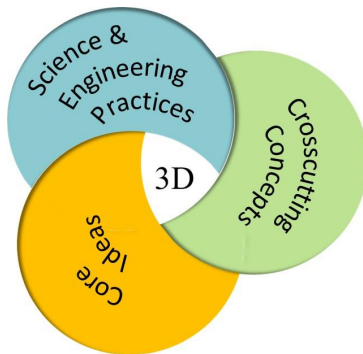
Overview of Changes

2. Organize standards around big ideas
 - clear progressions and increased coherence

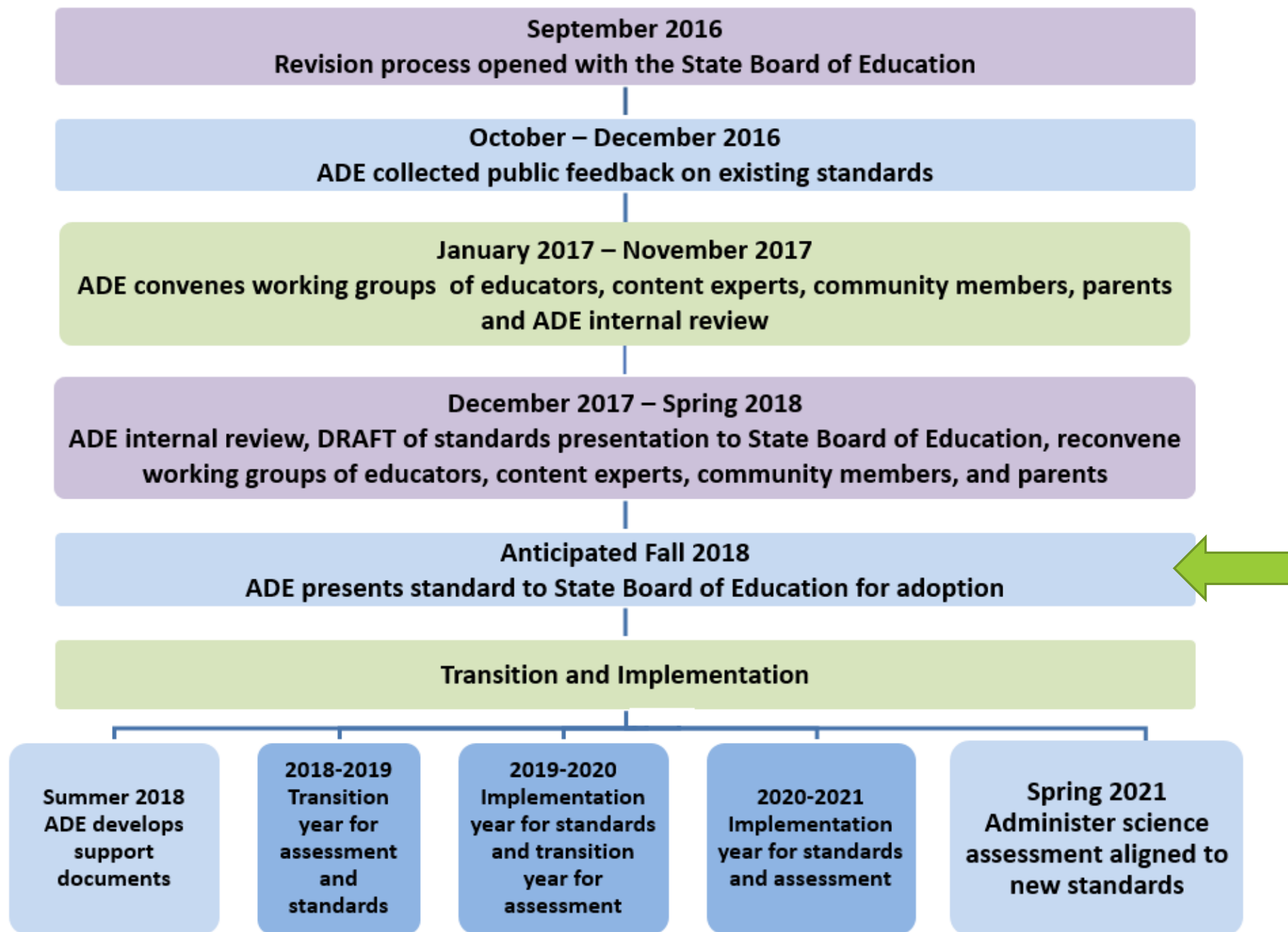


Overview of Changes

3. Connect science practices with content
 - better represents how science is practiced



Science Standards Revision and Tentative Implementation Timeline



Public Feedback

Must be:

**Actionable
Specific**

Examples:

- Space science should remain in 7th or 8th grade.
- The abstract concepts in 6th grade life science need a foundation which is not there

Must not be:

**Curriculum
Instruction
Too vague**

Examples:

- Providing resources, materials, and key vocabulary terms
- Structure and functions of living organisms

During the Break:

1. Please fill out your comment card and give it to an ADE staff member
2. Restrooms are located in the vestibule directly across from the elevators
3. Snacks and beverages can be purchased using a credit or debit card in the break room

Next Steps

- Collect your comments and questions from today's meeting for analysis
- Survey to collect public comments on draft is open through May 28, 2018
 - http://www.azed.gov/standards-practices/k-12standards/k12engagement/az_sci_ss_standards-review/
- Public Meeting
 - Recording of today's public meeting will be available at:
<https://www.youtube.com/channel/UCsNwAaD9tyciKskyp0R2e5A>
- Reconvene working groups – still accepting applications from educators
- Present revised standards to the State Board for adoption