Science Standards March 2018 DRAFT – Expert Panel Review

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Introduction Section

As you conduct your review of the introduction, please consider the following questions.

A. Does the introduction provide sufficient information and guidance on how to read the standards?
B. Does the introduction provide sufficient information on how the standards are structured?
C. Is there anything missing that should be included in the introduction?

Please provide feedback on the Introduction section. Include strengths and well as suggestions for refinements.

The introduction is clear and crisp. The approach to the Arizona standards is well described. The core ideas provide a nice framework for the standards. It has led to no dead end topics (a topic covered in third grade for example and not addressed ever again) for science. Rather topics build on each other.

I have edits on the document I am submitting but would like to mention a few here.

In many places in the document, there is the phrase that the science and engineering practices were formerly known as the "the scientific method." This is not accurate and should be changed. First, the notion that there is one THE scientific method is a misconception that was very common. For example, astronomers, theoretical physicists and a drug company researchers have very different methods. Second the addition of engineering, makes this a very new approach.

Science and Engineering Practices

Moving past the linear "the scientific method," the science and engineering practices[4] describ
and build models and theories of the natural world or how engineers design and build system
conclusion, these practices reflect science and engineering as they are practiced and experien

Your normal editors won't capitalize Earth or Moon, but in science they should be when referring to their names, just like we capitalize Saturn. Sometimes the document does capitalize and others not, this should be made uniform.

Appendix Section

As you conduct your review of the appendices, please consider the following questions.

A. Do the appendices provide sufficient information and guidance on implement the standards?
B. Is there anything missing that should be included in the appendices?
C. Is there anything that should be removed from the appendices?

Please provide feedback on the Appendix section. Include strengths and well as suggestions for refinements.

The appendices were useful additions. I made suggestions/edits on the main document. Of these, I will point out a couple. Interdisciplinary connections: Mathematics, I made some suggested changes to the text.

Appendix 5 would benefit from getting more development. It feels like the appendix doesn't give enough for many of these. I put in some additional wording but in reality, a book could be written about each area.

On page 80, the technology integration works well. The computer science aspect, which is usually thought of as coding, isn't presented at all in the standards (and for good reason as it is not appropriate). Thus, this paragraph should be deleted.

I applaud the mention of citizen science in social integration. I wish, however, that at least one Citizen science project was mentioned in the standards.

Page 82: "While the language of science is distinct from the language used in mathematics or language arts…"

This is not an accurate statement. Language is mostly the same; in some cases there may be differences but it is more the same than different. This should be changed.

Please note these suggested changes on page 82:

- **Students with disabilities** include (1) multiple means of representation, (2) multiple means of action and expression, (3) multiple means of engagement, (4) concrete experiences with realia, and (5) scaffolds in problem-based and project-based learning.
- **English language learners** include (1) literacy strategies for all students, (2) language support strategies with English language learners, (3) discourse strategies with English language learners, (4) home language support, (5) home culture connections, (5) concrete experiences with realia, and (6) scaffolds in problem-based and project-based learning.

Standards Section by Grade Level

As you conduct your review of the grade band/level standards, please consider these questions.

A. Does the introductory information for the grade band and for each grade level provide enough context to understand how the standards connect within the grade and between grades within each band?
B. Does each standard clearly state what students should know and be able to do?
C. Can the standard be measured?
D. Are there any ambiguous or unclear words/phrases?
E. Do the standards in each section have appropriate **breadth**?
F. Do the standards in each section have appropriate **depth of content and rigor** for the grade level?
G. Is there meaningful alignment and development of skills/knowledge within each grade and from one grade band/grade level to the next?

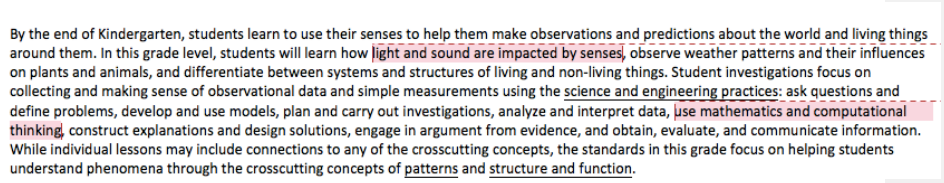
1. Please provide feedback on Kindergarten-Grade 2 Band:

A. Please provide feedback on Kindergarten:

B. Please provide feedback on Grade 1:

C. Please provide feedback on Grade 2:

I made suggestions/edits on the main document. Of these, I will point out a couple.


By the end of Kindergarten, students learn to use their senses to help them make observations and predictions about the world and living things around them. In this grade level, students will learn how light and sound are impacted by senses, observe weather patterns and their influences on plants and animals, and differentiate between systems and structures of living and non-living things. 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 this grade focus on helping students understand phenomena through the crosscutting concepts of patterns and structure and function.

In the above text, I corrected the light and sound statement. Also, the term computational thinking is vague, and thus one would wonder if kindergarten students can do this. I would prefer to call it problem solving.

I would prefer that the term “Refer to standard” be used far less or not at all. Put in concepts from the standards that should be addressed. These key concepts are likely to be more useful than the standard itself.

I think weather symbols should be saved for higher grades.

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.	Types of leaves, seeds, stem, root systems, farming, water, nutrients, shelter, air, soil, light, senses

The above key concepts are not matched well to the standard.

First grade is too early to introduce the abstract idea that light travels in waves.

may also include discussions surrounding

Commented [PR1]: It should include, not "may"

I don't like the use of may in the above. I think it should be stronger, and use a "should"

1.P4U3.4
Design and evaluate solutions to increase or reduce heat from friction between two objects.

This is going beyond what is normal in friction, especially at first grade. We increase friction to be safer when driving or walking. We decrease friction so we are more efficient at rolling. But it is not typically thought of as to increase or reduce heat.

1.L4U2.10	
Develop a model to describe how animals and plants are classified into groups and subgroups according to their similarities.	Classification of invertebrates, vertebrates

The key concepts above is odd. It should describe classification for both plants and animals. More detail needed.

2.E2U1.8
Analyze and interpret data to explain day and night regarding the Earth's movement and changes in the apparent shape of the Moon from one night to another.

2. **Please provide feedback on Grade 3-5 Band:**

   A. **Please provide feedback on Grade 3:**

   B. **Please provide feedback on Grade 4:**

   C. **Please provide feedback on Grade 5:**

I made suggestions/edits on the main document. Of these, I will point out a couple.

Physical Science Standards	Key concepts include but are not limited to:
3.P2U1.1	
Ask questions and investigate the relationship between light, lenses, and parts of the human eye.	Concepts taught in 1.P2U1.1 and characteristics such as speed and shadows
3.P2U2.2	

Key concepts needs work. I would add what you want students to know about lenses. I would delete mention of speed or clarify what you want students to know.

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.	Classification systems, herbivore, carnivore, omnivore
3.L2U2.7	

Not a good match between key concepts and standard.

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 1.P3U1.3 and magnet composition, magnetic: forces, poles, fields, attraction, static electricity, electric current, circuits, conductors, insulators, electromagnets, electrical charge (protons, electrons), safety
4.P4U4.3	

I would separate into two standards, one on electric currents and the other on magnetism.

5.P2U1.3	
Construct an explanation using evidence to demonstrate that objects can affect other objects even when they are not touching.	Concepts taught in 4.P4U2.2 and chemical bonds, forces (such as gravity)
5.P3U1.4	

This standard is okay with magnetism or static electricity. But it will be very confusing when talking about chemical bonds.

5.E2U2.8
Obtain, analyze, and communicate evidence to support an explanation that the gravitational force of Earth on objects is directed down (towards the center of the spherical Earth).

This makes it seem like gravity is only one way, and thus reinforces an alternate conception.

5.L3U1.9	
Obtain, evaluate, and communicate information about patterns between the offspring of plants and animals (including humans) and construct an explanation on how genetic information is passed from one generation to the next.	Concepts taught in 1.L1U1.6 and life cycles, reproduction, traits, characteristics

More clarity in Key Concepts about what are new concepts.

3. Please provide feedback on Grade 6-8 Band:

A. Please provide feedback on Grade 6:

B. Please provide feedback on Grade 7:

C. Please provide feedback on Grade 8:

I made suggestions/edits on the main document. Of these, I will point out a couple.

6.E2U3.10	
Construct an explanation from evidence that correlates patterns in the night sky to human navigation and agricultural practices.	Refer to standard

This seems antiquated. Either delete or give key concepts. I would delete.

6.L1U2.15	
Construct an explanation to demonstrate the relationship between major cell structures and cell functions (plant and animal).	Application of key concepts outlined in grade level connection to 6.L1U1.14

Teachers would appreciate guidance on key organelles that are appropriate for this grade. Hopefully it isn't all of them.

7.E1U3.6
Construct an explanation for how the technology used to predict weather and to explore Earth has evolved over time.

I deleted scientists. We want to differentiate the work of scientists versus engineers and people who predict the weather.

7.L2U2.9	
Develop and use models to demonstrate the interdependence of organisms and their environment including biotic and abiotic factors.	Concepts taught in 2.L2U1.10 and biotic, abiotic, symbiotic relationships (mutualism, commensalism, and parasitism), types of environments (freshwater, oceanic, forest, desert, grassland, tundra, mountain, etc.), succession, population growth

Important change made in key concepts.

8.P4U1.3	
Construct an explanation on how energy can be transferred from one energy store to another.	Energy (motion, heat, light, sound), types of energy transfer (conduction, convection, radiation), types of energy stores (chemical, nuclear, gravitational, mechanical), renewable (biomass, electrical, wind, water, geothermal, solar) and nonrenewable (fossil fuel) energy sources

Important change made in key concepts.

8.E1U3.7	
Obtain, evaluate, and communicate information about technologies that use data and historical patterns to predict natural hazards.	Seismology, climatology, mathematical modeling (including fractals)

Suggested change above.

4. **Please provide feedback on the High School Standards:**

   A. **Please provide feedback on high school core standards:**

   B. **Please provide feedback on high school plus standards:**

I made suggestions/edits on the main document. Of these, I will point out a couple.

Standards Section organized by Core Idea/learning progression

You have also been provided with each standard organized by core idea to review and provide feedback on the development of the learning progression for each core idea. As you conduct your review of the progression, please consider the following questions.

A. Does the standard address meaningful content within both core ideas?
B. Do the standards within each progression have appropriate **depth of content and rigor**?
C. Is there meaningful alignment and development of skills/knowledge within each grade and from one grade band/grade level to the next for each progression?

5. **Please provide feedback on Core Ideas for Physical Science:**

   A. **Please provide feedback on the progression for P1:**

   B. **Please provide feedback on the progression for P2:**

   C. **Please provide feedback on the progression for P3:**

   D. **Please provide feedback on the progression for P4:**

6. **Please provide feedback on Core Ideas for Earth/Space Science:**

   A. **Please provide feedback on the progression for E1:**

   B. **Please provide feedback on the progression for E2:**

7. **Please provide feedback on Core Ideas for Life Science:**

   A. **Please provide feedback on the progression for L1:**

   B. **Please provide feedback on the progression for L2:**

   C. **Please provide feedback on the progression for L3:**

   D. **Please provide feedback on the progression for L4:**

8. **Please provide feedback on Core Ideas for Using Science:**

   A. **Please provide feedback on the progression for U1:**

   B. **Please provide feedback on the progression for U2:**

   C. **Please provide feedback on the progression for U3:**

   D. **Please provide feedback on the progression for U4:**

9. Please provide any additional comments about this draft that you want the revision committee to consider.

These proposed new standards are a big improvement over the current Arizona standards. Good that different grade focus on different crosscutting concepts. Good that no dead ends in early grades, concepts continue building. There are some topics that are important for building further topics that are not included such as sinking and floating, layering because of differences in density, and the metric system.

Some topics are too advanced for early grades (weather symbols and the terms "deciduous" and "precipitation" in kindergarten; terms light waves, opaque, translucent; Classification of invertebrates, vertebrates; in first grade; and normal force, magnitude, and momentum in fifth grade.

Commented [PR2]: Needs more explanation

Commented [PR3]: Again, I like the enhanced explanations but **normal force** goes too far beyond the standard.
Are you sure you want to introduce the following terms in this grade: potential energy, kinetic energy, magnitude, direction of force, momentum

In the tables the Key concepts (right column) that explain content of the standard are a very useful idea but often are often poorly constructed or are absent (just a statement "refer to standard"). An effort should be made in almost all of these cases to add guiding content.

Metric units, as a part of science instruction, needs to be introduced before high school.

Delete mentions of "the scientific method." This notion of "THE scientific method" was more of an ideal rather than an actual practice; science has always had many different methods, depending upon the type of science done. Referring to scientific and engineering practices as formerly the scientific method is not accurate.

The high school essential standards (HS) versus plus standards is a good idea. The weakness, however, is that the HS model seems to assume that students will take biology, chemistry, physics, Earth science, and space science in high school. This is typically not done. For example, many students will avoid physics, especially students who are not college bound. And many college bound students do not take Earth science. (And while this is a bit off topic, if the current 9th grade science assessment is the only high school science assessment, it is not clear what the topics for that exam will be.)

High school topics are generally described in good detail.

Too little focus on electricity in HS and Plus standards. This is an important topic for everybody to understand. It should cover voltage, current, resistance, parallel circuits, series circuits, short circuits (including fuses). There is the standard "Construct an explanation for a field's strength and influence on an object (electric, gravitational, magnetic)" but that has a different focus than directly understanding current electricity.