Science Standards March 2018 DRAFT – Expert Panel Review

Reviewer Name ___Ron Madler_____

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?
    a. Yes – the section is well written in general.
B. Does the introduction provide sufficient information on how the standards are structured?
    a. Yes
    b. From a more broad point of view – an appendix discussing the relationship between the various standards groups would be nice. The graphic logo is nice as well as the section at the end of each grade level on "Connections to Other Academic Disciplines".
    c. I thought that the Science Standards focused on a reasonable number of topic areas. My understanding is that there may have been too many standards in the past.
    d. Future iterations of all four sets of standards in the academic disciplines could focus on "harmonizing" the standards to make it easier for the districts to have a coherent plan on addressing the standards.
    e. My personal observation is that the Science Standards might be expanded to be the STEM Standards.
C. Is there anything missing that should be included in the introduction? –
    a. RESPONSE: I would suggest an executive summary for people who are not familiar with the science standards. Except for the second paragraph on page 2, it took to page 5 for me to get the broad idea of the AZ Science Standards. I expect everyone to understand the rationale for science, but not everyone to understand the broad context of science standards. I would probably even go so far as to suggest putting the science standards discussion first and the rationale/context for the science standards, before the more philosophical "why science". This is probably just a personal preference for an executive summary to give me a sense of the overall idea of what I am about to read. As they say – "tell them what you are going to tell them, tell it to them, and then tell them what you just told them."
    b. Computer Science is an important topic in STEM but does not fit well within a discussion of the natural world. It fits somewhere in between all the STEM disciplines, but is a fundamental aspect of our designed world. I hope that this can be addressed in a future iteration or possibly by the Mathematics Standards.

c. I like that the Science and Engineering Practices in Appendix 2 have an increased emphasis on the "designed" or "built" world in addition to the standard natural world focus of classical science education. If possible – I would like to see the words built and designed a couple more times in the introduction. This comes from my strong interest in project-based learning and desire to see more emphasis on how science and engineering are all around us and we experience it every day. (I am writing this after the bullets below – so it appears very redundant)

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

- For U3 – I would suggest adding "and solve problems" – an updated Core Idea would be : U3: The knowledge produced by science is used in engineering and technologies to create products and solve problems.
- Good overview of science and science education. I think the introduction is well written for science education, but misses the opportunity to bring an emphasis to the "designed" or "built" world. Engineering and a recognition of the technologies in the "built" world should be an important aspect of STEM education.
- Is the intent to have these standards cover all the apsects of STE (M already in a Math standards) standards or only Science Standards with mention of the importance of the fields? My personal opinion is that the future versions of this should be fully STEM oriented with a focus on the innovation, creativity and business aspects of the built world and how it affects the lives of the students. The focus on science is a great foundation, but often does not connect with the lives of students. Science Education is great for people like myself (who are scientists) because we could see applications beyond the natural world to understand how it can affect our lives. A shift in focus to balance the emphasis between the built and natural worlds will by definition make AZ STEM Education stronger.
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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?
   a. In my note in the next paragraph – I believe the appendices are written at a very high level which do not constrain implementation. However – I believe that a supplemental curricular framework created from statewide best practices would help with effectively and efficiently implementing the standards. Otherwise –

everyone will simply create a mapping with what they are already doing. Please create a change pathway.

B. Is there anything missing that should be included in the appendices?
    a. While I understand that the state "standards" provide the framework for the local school districts to define their "curriculum" so as not to dictate a curricular standard, I also recognize that this leaves a lot of local interpretation. I would suggest that a state convention of master teachers and K-12 curricular experts at least create a "draft curriculum". I have a colleague from Germany who is amazed that we attempt to have each state and district "re-invent the wheel". While the state may choose to not dictate a solution – a base framework from which to deviate helps to ensure that these broad standards can be applied with reason and there may be some economy of scale efficiencies realized.
    b. As noted above – some discussion on the other academic discipline standards and how they are intended to be linked together so that the districts can address all the standards in a cohesive manner.
C. Is there anything that should be removed from the appendices?
    a. No. The appendices seemed short and broad – not much to remove.

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

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?
    a. Unfortunately I do not really remember the intellectual capacity of my children as they were progressing through the K-8 system here in Arizona. I do have one in HS and one at the university here in AZ. I would suggest creating a workshop of the most effective teachers from each grade band from around the state to iterate on the standards by grade level (and also provide curricular input).
    b. Clearly this suggestion is not in the scope of this review, but the age appropriate feedback would be very appropriate.
    c. I like that each grade has a focus on some crosscutting concepts.
    d. The various "Connections to Other Academic Disciplines" are a good idea and the logo is useful to paint the picture that the various AZ Standards are interlinked. However, I thought you might review the connections. Please make sure there is a connection with the Science Standards for that grade. A link to the various other AZ Standards would be reasonable – I didn't see that in the appendices or references.

i. The ELA standards were quite succinct and made sense. The "standards for mathematical practice were not as succinct and didn't always make sense.
ii. Do K students really "Use appropriate tools strategically?" – I don't think so since I know Kindergarten teachers.
iii. The Health Standards also should be reviewed for age appropriateness and linkage to the Science Standards

B. Does each standard clearly state what students should know and be able to do?
   a. There is a lot of conceptual knowing.
   b. Adding key concepts of solving problems of application and real-world problems would more directly support the Science and Engineering Practices. This application to the designed world may be identified at the curricular level, but specifying at the standards level would encourage it.
   c. The HS standards indicate a strong understanding of the concepts. It appears that a couple standards have applications to problems in the designed world. HS.P3U3.8 is one standard that has a relationship to a "product" and HW.P2U3.6 has students investigate how basic concepts are applied in current technology. I am a strong proponent of specifying that the application of the sciences. My wife taught "Chemistry in the Community" when she taught as a student teacher – it was an excellent opportunity to expose students to the science around us every day.
C. Can the standard be measured?
   a. At what level in this process do you intend to create rubrics for attainment of the standards? I assume that is at the curricular or instructional level.
   b. I suggest you all consider your goals in measuring at each grade level. In the K-2 and 3-5 levels I would expect goals to be at the introduction level while 6-8 can develop intermediate knowledge and some application of the knowledge.
D. Are there any ambiguous or unclear words/phrases?
   a. I did not note any that I could not find or figure out.
E. Do the standards in each section have appropriate **breadth**?
   a. I understand that you are trying to balance between breadth and depth – which is why I believe the concept of the "T-shaped student" is a good one and is briefly introduced next.
   b. This focus on enough breadth while having some areas of depth is what we call "creating the T-shaped student". This is a useful concept to provide students with a broad understanding of the concepts yet provide opportunities to follow some topic to great depth so that the student understands the increasing level of complexity to solve a specific problem. The T-shaped student concept may be appropriate at the curricular level – but could be a concept introduced at the state standards level.
   c. The Core Ideas for knowing science are somewhat specific examples of more broad concepts. Are they too specific?

i. For example – P1 says "All matter in the universe is made of very small particles". P1 could be more broadly stated as "the fundamental nature of matter"
ii. Also – P3 states "Changing the movement of an object requires a net force to be acting on it." While this is indeed a core idea – it is part of a more broadly stated outcome of "Understanding the nature of motion."
iii. Each of the P1-4 and other core ideas could be broadened into the overarching science concepts, however, stating the core idea in more specific terms as you have done is probably more appropriate for this document.

F. Do the standards in each section have appropriate **depth of content and rigor** for the grade level?
   a. I would leave this to the grade level experts.
   b. Specific projects focusing on examples from the natural or designed world would require depth in content and would be appropriate.

G. Is there meaningful alignment and development of skills/knowledge within each grade and from one grade band/grade level to the next?
   a. Some of the standards specifically referred to previous standards by number reference – which does show a development (for example 8.E1U1.6 refers to 7.E1U2.5).
   b. The overall standards do appear to have increasing levels of depth culminating in the high school key concepts.
   c. I could envision a "flow" document/chart/figure showing how each standard is supported over the K-12 time. This visual flow could be useful for the districts as they create their curricular maps.

1. **Please provide feedback on Kindergarten-Grade 2 Band: I am sorry that I do not feel connected enough to this youngest age group to understand to what level they can be introduced to science.**

   A. Please provide feedback on Kindergarten:

   B. Please provide feedback on Grade 1:

   C. Please provide feedback on Grade 2:

2. **Please provide feedback on Grade 3-5 Band: I did not feel I could adequately assess the advanced elementary students concept level in the standards. They are my favorite group to interact with, however, because of their interest and enthusiasm. I would suggest a special emphasis be placed on this age group and the standards for this group.**

My understanding is that this is the key age group for sparking an interest in STEM and conversely having students believe it is not for them. I would strongly encourage that the emphasis be placed on how science (technology, engineering and mathematics) affects their everyday lives in this age group.

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

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

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

3. **Please provide feedback on Grade 6-8 Band: I did not feel I could adequately assess a middle-school students ability to grasp – I have only given guest presentations to this age.**

   A. **Please provide feedback on Grade 6:**

   B. **Please provide feedback on Grade 7:**

   C. **Please provide feedback on Grade 8:**

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

   A. **Please provide feedback on high school core standards: I did not think that Physics was required for HS students. It seems that having fundamental physics concepts in the HS Standards may require all students to take HS Physics? My children's HS typically required Earth/Geo at 9th grade, Biology in 10th grade and Chemistry in 11th grade. Will students now be required to take Physics in 12th grade to complete the standards. (or more likely I missed something)**

   B. **Please provide feedback on high school plus standards: I have been surprised how much more is taught and expected at the High School level than when I was a HS student.**

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?
    a. Yes.
    b. From a philosophical point of view I found myself questioning whether the Core Ideas should be broad concepts or more tangible concepts such as are in the standards. At first I thought they should be broad concepts, but after further consideration – I think it may be easier for the districts to have tangible examples of the Core Ideas. Nevertheless, I put the "broad science concept" in the below area for the 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?
    a. I think a standards map that shows this progression might be helpful for districts as they create their curriculum map. This is done in one sence with the "Distribution of the Grades x-7 Standards" chart. I expect that feedback from the districts on this standards "map" would be useful in iterating on the map.

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

A. Please provide feedback on the progression for P1: Nature of Matter

B. Please provide feedback on the progression for P2: Interactions of Matter

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

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

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

A. Please provide feedback on the progression for E1: This was pretty close to a broad concept and I couldn't easily break this down into an overarching concept of the Earth

B. Please provide feedback on the progression for E2: The place of the Earth in the Universe.

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

A. Please provide feedback on the progression for L1: Molecular and Cellular basis of life.

B. Please provide feedback on the progression for L2: Sustaining Life

C. Please provide feedback on the progression for L3: Developmental and Genetic basis of life.

D. Please provide feedback on the progression for L4: How life evolves and changes over time.

8. Please provide feedback on Core Ideas for Using Science: - they seemed good – just had a suggestion on U3 wording.

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: The knowledge produced by science is used in engineering to solve problems, develop technologies, and create products.

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.

Thank you for the opportunity to review. My understanding from speaking with teachers is that this is probably a step in the right evolutionary path.