Content Advisor Feedback

Ronald Wetherington, 1/22/2021

More comprehensive comments on the following are addressed in my feedback on individual courses.

Guiding Questions

1. Does each course follow a complete and logical development of science concepts presented? If not, what suggestions do you have for improvement?

   Yes. Several have re-sequenced SEs to realign the sequence more logically.

2. Do the standards for the course(s) adequately address scientific concepts? If not, please give examples of how the standards might be improved.

   Generally, yes. In a few cases, I believe improvements are needed, viz., to incorporate some historical context in Astronomy SEs and to address more recent scientific concepts on global warming in Environmental Systems. See specific feedback

3. Are there any gaps or concepts missing that should be addressed? Are there specific areas that need to be updated to reflect current research?

   The most significant gap-bridging will lie in the relationship between Astronomy and the revised Earth Systems course. The group has addressed this well, pending final revisions of the latter. Current research appears to be adequately represented in these four courses.

4. Do these high school course(s) sufficiently prepare students for postsecondary success? If not, please provide suggestions for improving the standards.

   Yes.

5. Does each course include sufficient standards focused on laboratory and field investigation?

   Yes.

6. Are the student expectations clear and specific? If not, please give examples of how the language might be improved.

   The Work Group has specifically addressed clarity and used more specific terms.

7. Are there student expectations that are not essential or unnecessarily duplicative and can be eliminated? If so, please identify by course and student expectation number, e.g. Aquatic Science 5.B.

   The group has suitably accomplished much of this trimming.

Feedback on Aquatic Science

(3)(C) *"engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence."* Remove "applied".

(14)(A) *"analyze the cumulative impact of human population growth on an aquatic system*" is an ambiguous use of "system". Why not replace with "environment" as in the KS statement, or "ecosystem" as in (B)?

(B) "*predict effects of chemical, organic, physical, and thermal changes from humans on the living and nonliving components of an aquatic ecosystem"* is awkward: change "from" to "due to".

(C) "*investigate the role of humans in unbalanced systems such as invasive species, fish farming, cultural eutrophication, or red tides*" is misworded. After "systems" insert "involving phenomena"; (i.e., invasive species contribute to the unbalancing but do not constitute a system).

Feedback on Environmental Systems

(5)(G) "*research and explain the causes of species diversity and predict changes that may occur in an ecosystem if species and genetic diversity are is increased or decreased*" mixes levels of analysis: *species* diversity refers to the number of species in a habitat, while *genetic* diversity refers to the number of genotypes/phenotypes in a species. This should either be modified or split into two SEs.

(7) "*Science concepts. The student knows the sources and flow of energy through an environmental system*." Curiously, I find no SE where the energy pyramid is introduced or trophic levels discussed. Should this not occur in this KS? (7)(D) comes close to asking this.

(8) "*Science concepts. The student knows the relationship between carrying capacity and changes in populations and ecosystems.*" It would be valuable for the student to get some historical perspective in this KS. An intro to Malthus and his + and – checks on population would go especially well with (8)(A) as exponential and logistical growth (equations?) are introduced.

(12)(C) "*analyze how ethical beliefs can be used to influence scientific and engineering practices such as methods for increasing food production;, increasing energy production, and increasing the extraction of minerals*" is grammatically awkward and over-directive. How about "analyze how ethical beliefs can be ~~used~~ **applied** to ~~influence scientific and engineering practices such as~~ methods for increasing food production; increasing energy production, and increasing the extraction of minerals".

(12)(E) "*argue from evidence whether or not a healthy economy and a healthy environment are mutually exclusive*" is mis-targeted. Change to: ***argue from evidence whether or to what extent the competing demands of a healthy economy and a healthy environment can be reconciled.***

(13)(A) While I agree that replacing "analyze" regarding domestic legislation and regulations is desirable, "describe" is much too weak. I strongly urge using parallel construction with (13)(B), to read "*evaluate the goals and effectiveness of past and present*" state and national legislation…etc.

Feedback on Earth Systems Science

This work-in-progress is a much needed revision of the Earth and Space Systems course, which was both too expansive and had too much overlap with the Astronomy course. It is of course inevitable that topics properly common to these two (as well as to Environmental Science and to Aquatic Science, as well) will create some overlap. This is not a liability; rather, it is essential. Since these are electives, I expect few students will take more than one of these. Further, these are not all available in many districts. I look forward to the final statements and rationales from the Work Group.

Deleting the strands eliminates false rigidity. Excellent rationale.

(6)(F) I agree that this should be deleted; I think (C) should probably be deleted, as well.

(7)(D) "evaluate" is too rigorous. "compare and discuss" is more appropriate, or "understand".

(8) The shift in focus in this KS (and in others, as well) is commendable. In exposing students to absolute (A) and relative (B) chronometrics it is important that an understanding of both precision and reliability of the methods be included, as well as the history of refinement of these (e.g., in K/A and ^{14}C). It may be necessary to add this as a specific SE. In the meantime, I recommend:

(8)(A) replace "strengths and limitations" with "precision and reliability".

(8)(E) Rewording here is less ambiguous (and less controversial).

(8)(F) The shift from specific to general is well justified; it also conveys that extinction events go beyond the K-T event and extra-terrestrial causation.

(12)(A) change "Hadley & Ferell" to "Hadley and Ferell". These are different cells.

(12)(D) The statement is grammatically torturous. I recommend "investigate and analyze evidence for climate changes over Earth's history, including the past two centuries, using paleoclimate data, historical records, and measured greenhouse gas levels."

(12)(E) Change "analyze" to "explain" or "understand". Also, this SE requires a "such as" or "including" in order to provide salient examples.

(13) Since "resource use and management" *are* "human activities", change this to read "…Earth's systems affect and are affected by human activities, including resource use and management."

(13)(E) Change "analyze the economics and policies related to…" analyze the policies, including economic, health based) related to…"

Feedback on Astronomy

(6)(B) Delete "changing" in "*measure their positions changing relative to the constellations*".

(6)(C) I agree with the removal of "zodiac" to avoid the use of astrological terms. In this regard, I express regret for the lack of historical context in all of the science courses, thus conveying a misconceived shallowness to the slow development of scientific thought. This contributes to misconceptions of what science *is* and *is not*: Pew research reveals that 30% of the U.S. population believes astrology is scientifically legitimate. I therefore recommend adding a new SE:

(6)(D) understand the reasons for the historical conflation of astronomy and astrology, and their eventual separation.

(9) The reference to a planet's axis and its tilt in the SEs following this KS statement is important, but absent is any student understanding of Milankovitch Cycles and how changes in Earth's tilt have led to past ice ages. I recommend that this be added in a separate SE.