

PE Code and title--topics arrangement

clarification statement for a needs work--both need energy, nutrients, water and air...clarifications and lists of examples seem like different things...d) the students are doing the sharing?--this seems like a separate, but related performance expectation c)--both for plants and animals--for plants, making the distinction between energy and nutrients

K.OTE Organisms and Their Environments

...not fond of the separation of humans from plants and animals

a) don't like "could" in clarification statements; should be should and should be an assessment boundary

b) Communicate and compare...

c)--clarification statement...within parameters safe in the classroom (what won't phase change until the right conditions?)

d)...not sure what the "evidence" and the "opinions" would be here

e)example is very narrowing to extremely basic types of objects d) practice seems tacked on to the rest and lots of overlap with e

rather the same verbs at different grade levels, but meaning different things (sometimes even within levels), it would be helpful to use the language that is specific to the grade band. For example rather than saying "Asking questions" at all levels, at the K-2 level, use "Develop simple descriptive questions about ___ that can be tested" otherwise asking questions just becomes a KWL activity. Use the verbs from the grade band description of the practice rather

K.SPM Structure and Properties of Matter

than always just using the bold words.

d) to determine where types of severe whether are more likely to occur...

e) is extraneous...still don't like how "asking questions" is being used; seems to just be student raises hand in class rather than deliberate construction/revision of question

K.WEA Weather

it seems that clarification statements should be different than just examples, g)awkward wording--what is the student actually doing?, f) to demonstrate (not explain)

1.SF Structure and Function

1.LS Light and Sound

don't like the phrase "Investigate to describe;" investigate seems forced since the word is in the practices, but these end up sounding very proscriptive

a) this is very similar to 3.SFS f)...more in a redundant or spiraling way than in a laying the foundation that is later built upon sort of way.

b)wording is too proscriptive...Investigate what happens to light when it strikes the surface of different materials. Students should make a claim as to whether a material allows light to pass through, allows some light to pass through, or blocks all light and support it with direct observation evidence.

f) add to this by saying they will design a device given certain parameters (materials)

g) is not essential/core information that students need to know

1.PC Patterns and Cycles

again--investigate is not used consistently--in "a" it means gather information

b) weather events? natural events?

b and c are very general--to the extent that it will be very difficult to assess without results being confounded by differences in background knowledge

d) analyzing and sharing observations of pictures of sunrise and sunset might work...

e) not communicating that are tools--want students to communicate about one of the tools

It's difficult to see from the PE statements how the observations and sharing lead to the understanding of the content

a) Communicate that water...

Investigate

c) if they are designing and testing, it seems they would always have a physical model...

2.ECS Earth's Changing Surface

2.SPM Structures, Properties, and Interactions of Matter

2.IOS Interdependence of Organisms and Their Surroundings

collaborative planning may be a bit high for this age range

2.PP Pushes and Pulls

Forgive the pun, but "pushes and pulls" seems a bit elementary and it makes the K-12 progression less visible; d and e seem like they are both a part of f; they should be combined into 1

3.WCI Weather, Climate and Impacts

a) not sure I would actually call this using mathematics and computational thinking...even though it technically fits; c) not really a prediction, just more of remembering; d) what are they evaluating about the information?

3.EIO Environmental Impacts on Organisms

a) what type of questions? e)and some changes can be harmful...

	too much reading, listening, and regurgitating science in this standard--not enough using science to solve problems/answer questions; name of standard should better parallel MS and HS; c) is data analysis needed for this?
	c) "an external structure"? this seems unnecessarily vague
	d) unclear how models are to be used here
3.SFS Structure, Function and Stimuli	e) only obtain? how will we know they've obtained it? need communication of some sort
	f and g seem like a better fit for a physics standard whereas this is LS at upper grades...; Investigate seems to mean something very different between a, f, and g; f and g--students should be able to gather information about these claims and compare their evidence to that presented by the teacher from their investigation--teacher models student process...rather than teacher micro-managing student performance for desired result
3.IF Interactions of Forces	c) not sure what use models means in this context
	3 is effectively the same as a PE from 2nd grade--let's build from grade to grade!
	a)..use of investigate is not consistent across standards; vague and broad PE; not sure how "investigate in this sense would/could be assessed b) what evidence is being used? evidence that they are genetic/environmental? epigenetics really muddies these waters c) from the SAME parents; the later explanatory power is significantly diminished for students with siblings from different parents unless this clarification is made here d)unclear if you want a focus on differences that are in homologous structures e) does the assessment boundary mean that it's not important for students at this stage to have a firm grasp on whether or not the trait is genetic or not, or just that don't have to know about chromosomes and meiosis
4.LCT Life Cycles and Traits	f) could see this PE leading to enhancing misconceptions about individuals evolving g)obtaining by itself is not a positive practice...it screams lecture about this; the explaining is the important part here h)communicate is the important part here; would be much more interested in students designing an invention based on an organisms characteristic than just learning about them...pick a unique organism characteristic and propose a product based on this characteristic..good place to incorporate some aspects of engineering design
4.PSE Processes That Shape the Earth	a) best use of asking questions that I've seen yet!
4.E Energy	too many PEs for one standard; though they are pretty solid, trimming is necessary
	a) what types of patterns should be identified? f) wording is confusing g) what info is being obtained and communicated?
4.WAV Waves	
5.SPM Structures, Properties and Interactions of Matter	a) Use the partial model (explain it in clarification statement and not in sentence)
	b) make sure this is thoughtfully built off earlier similar Pes; The use of the word "investigate" continues to be inconsistent
	a) not clear what is wanted in these food webs in terms of "inter-relationships--energy flow? b) is the "model" here just a representational one, or is something more intended? c--sub-point of b; d...just getting them to ask questions about a specific bit of content doesn't seem that valuable; need more clarity on "use models" h) very general and seems to consume other PEs
5.MEE Matter and Energy in Ecosystems	c is redundant and incorporated in b; d) asking questions in this PE is more just like an intro activity to a class period; this seems contrived--the asking questions should be for the purpose of defining a problem, or setting up an experiment; h) this PE seemd to encompass several others--trim to just this one; pretty well constructed standard, but too many PEs making depth difficult
5.ESI Earth's Systems and Their Interactions	
5.SSS Stars and the Solar System	e) what is done with the information obtained?
	a) have them use data/models to predict rather than just gathering the info
MS.PS-SPM	c) to determine what happens to temperature and particle motion when thermal energy...
	b) don't like the idea of generating evidence to support a claim--smacks of cookie cutter lab; plan investigation to generate evidence to test the claim...; d) is this an argument or just an explanation...?
MS.PS-CR Chemical Reactions	It's not that these are necessarily bad pairings but this standard is completely missing any emphasis on doing experiments--and at the high school level as well B), for example, could easily been about carrying out an investigation to determine if new substances had been formed and supporting the claim with evidence, but it's just about explanations...; the carbon cycle comes up in quite a number of standards--HS.LS-MEOE, MS.ESS-WK, MS.LS-MEOE, and this one; it makes sense that it comes up under a variety of content strands, but it seems to be treated in a similar fashion everywhere--build the model, which makes the standards redundant

MS.PS-FM Forces and Motion	<p>a) too much in one PE--questions and investigation--leads to convoluted syntax; f) data-based scenarios rather than just data</p> <p>a. too much in one PE--maybe formulate questions to drive investigations... c. What if their data doesn't support due to equipment or reader error? And what do they do with the data they have collected? Collect data to evaluate the claim of Newton's Law that when two objects interact, they exert equal and opposite forces on each other. Evaluation should include analysis of potential error in data collection procedure.</p>
MS.PS-IF Interactions of Forces MS.PS-E Energy	<p>c) This is really just a carry out rather than a plan and carry out; d) use data, but not quantitative? e) small changes in what?</p> <p>a) conceptual rather than qualitative?</p> <p>d) and/or? how about just construct; c) this PE would likely be a carry out rather than a plan and carry out</p> <p>b) media instead of mediums</p> <p>d) to evaluate the claim</p>
MS.PS-WER Waves and Electromagnetic Radiation	<p>e) how will students know to ask questions that can be explained by a wave model?</p> <p>f) not clear exactly what is to be explained</p>
MS.LS-SFIP Structure, Function and Information Processing	<p>Investigate is very unclear in this PE--does it mean conducting an ivesitagtion, or gather info, or either? c)run-on; 1 explanation or one for each? this standard has generally awkward phrasing</p> <p>need uniform use of "investigate"; lots of overlap between a and c; it seems that the evidence for a is c; b) doesn't require generating evidence...just drawing on life experiences; what is the difference from providing and constructing explanations? (c and e); c)just dressed up regurgitation</p>
MS.LS-GDRO Growth, Development and Reproduction of Organisms	<p>d) if specific models are desired, they should be named; e) add an "a' after how;</p> <p>b) "Investigate implies conducting an investigation...really just obtaining info; d) not an investigation; this is obtaining info; too much of just "using models" in standards in general just when models have to be used because things are microscopic; focus is needed in PEs on looking at limitations and applications of models rather than just using them to explain--if you know the limitations of the model, you know what the model is representing (and what it can't); In general, I would use language to indicate that evidence supports a CLAIM and the Argument is the explanation of HOW the evidence supports the claim; f and g need assessment boundaries; What is the difference between providing explanations and communicating explanations (f,g,h)? clarify or eliminate one; lots of "explaining" in this standard</p>
MS.LS-MEOE Matter and Energy in Organisms and Ecosystems	<p>f) evidence supports a claim thatwill result...</p> <p>a) is a forced practice--what is really looked for as written is communicating understanding rather than really developing anything; b)Explain should be the lead verb; students aren't investigating this--obtaining information maybe; c and d are redundant; combine into one PE...actually b,c, and d should all be</p>
MS.LS-IRE Interdependent Relationships in Ecosystems	<p>f) why not researchable here?</p> <p>a) "using a model here comes across like, running a computer simulation--changing the amount of a resource and seeing what happens; c) like the idea of "researchable" questions...is this a term used throughout? in particular content areas? grade levels?; e) an argument; e seems like a good opportunity for more deliberate engineering integration rather than "constructing arguments"</p>
MS.LS-NSA Natural Selection and Adaptations	<p>b)clarification statement makes this too proscriptive; c) remove "some" ...should actually be many if not most; like c)</p> <p>this and the comparable high school standard should have the same name; more emphasis is needed on molecular evidence--both because it is powerful evidence and to lay a foundation for the high school level; a) change to "Analyze and interpret how..."; f) this seems very similar to HS.LS-NSE Natural Selection and Evolution (c) but actually reversed in complexity--using models in MS and just analyzing data in HS; don't like how the arrangement of PEs here mimics a typical textbook progression through the evidence..mix it up at least, but preferably highlight molecular evidence; g) will need exemplar data (This is Matt-specific) I understand the tendency to avoid openness in this standard, but I think that we sterilize one of the most fascinating and essential topics in science. For example, despite the potential for misinterpretation, argumentation is a practice here that is absolutely essential for students to be able to participate in. If argumentation can't be used with topics that are controversial, then argumentation is of no use as a scientific practice. I would much rather highlight it here and then make this standard the focus of professional development rather than shy away from it. Right now, the performance expectations for this standard (and at the high school level) are too close to regurgitation under the cover of better verbs. I would rather we push the envelope, but then support with pages of foot notes that explain this and climate change and how the practices should be used rather than hiding the most powerful practices from these topics...</p>

MS.ESS-SS Space Systems	d) Evaluate models that support...or explain how the models support...
MS.ESS-HE History of Earth	a) explanations of the patterns d) not sure what the student is doing/producing here that could be measured
MS.ESS-EIP Earth's Interior Processes	f) too many clauses
MS.ESS-ESP Earth's Surface Processes	b) different use of the word model is confusing c)--plan and conduct should be plan and carry out; e) this is too grand of a design project--it is much more meaningful to have students design something smaller scale that they actually might have the background knowledge to accomplish; f) this PE is too broad
MS.ESS-WC Weather and Climate	a) confusing phrasing; b) are they constructing models here or just explaining existing models?; e) drop everything after the comma; h) wording is unclear; too many clauses carbon cycle is in other PEs--make sure this is coordinated to avoid unnecessary repetition
MS.ESS-HI Human Impacts	b) Generate and revise qualitative explanations from data for the impacts of human population and rates of consumption on Earth's systems. c) drop "engineering" from the PE Would like to see argumentation used here Performance expectation d: Clarification statement should include an example of how they will note that the simulation may be limited in accurately modeling the real world. This is critical to learn – learning how to recognize those limitations and work within the confines of those limitations. Important that an example be given to help teachers with this (and communicate its importance). Somewhere in here clearly describe/distinguish simulation as consisting of computer models/simulations, mathematical models/simulations and physical models/simulations. Distinguish between testing in the lab and field testing under real world conditions. School buildings themselves offer students multiple opportunities for testing building related technologies “in the field”. These PEs would become much more relevant if they were incorporated into the other content strands. As it is, it reminds one of learning the steps to the scientific method--incorporate them and then show them here as well. Let's not do inquiry over again. Both MS and HS engineering standards should be integrated. This would improve both the engineering PEs and the content area standards (the engineering PEs there would be better).
MS.ETS-ED Engineering Design	
MS.ETS-ETSS Links Among Engineering, Technology, Science and Society	b)...that draws on natural resources and was designed to improve health of people and/or...; d) move (positive and negative) to the end of the sentence. Performance Expectation b: Also include technologies and practices applied to communities/societies (sometimes imposed by others outside the community/society in question) that were developed and originally applied in another society. Such applications when not modified for local factors – social/cultural, economic, education, intellectual traditions, etc., often have negative impacts that have to be rectified later. The discipline of anthropology has numerous examples that can be used here. Performance Expectation d: “health of people” should also refer to a society's social/cultural fabric, continuity of intellectual traditions and identity.
HS.PS-SPM	put parentheses around "obtained from measuring the bulk properties of various substances" Neither chemistry standard at high school level has any planning and carrying out investigations...this seems to be an egregious error; The fit for the SEPs to these practices isn't necessarily bad, but it is lacking a hands-on focus for this standard. a) to check the support for claims...; hopefully this data is readily available c) in this situation we want students to link the claim (given in the PE) to the evidence they are analyzing and interpreting--in other words, construct the argument e) awkward wording
HS.PS-CR Chemical Reactions	This is a huge standard--trim or split...or both Lots of explaining with words and models and not much call to experimenting --just looking this standard, one could get the impression that labs weren't even necessary in chemistry
HS.PS-NP Nuclear Processes	c) they can't just stop at making claims, constructing the argument that links to the evidence to the claims is essential here. b) is "generate data" different than "carry out investigation"?
HS.PS-FM Forces and Motion	e) defining force "that exist inside and outside the system" confusing...inside and outside a given system?

a) would prefer, "Carry out investigations to determine the algebraic formulation..."

clarification statements and/or examples would be helpful here

HS.PS-IF Interactions of Forces

a) seems like the mathematical expressions is squeezed in to make an old standard look like a new PE

e) not clear--would like fewer obtain, evaluate, and communicates

c,d, and e split up the practices verbs; requiring obtain, evaluate, and communicate every time is overwhelming in terms of implementation; plan and carry out also don't always have to be paired either--this allows for more teacher ownership--and making sure we don't overfill with practices what we trimmed from content

b) of a given system

HS.PS-E Energy

c) to check for support for...

d)awkward wording!

e) redundant with ecosystems energy transfer; we don't need similar PEs in both places, but highlight the links...the one in this standard should focus on the idea that the "energy" in this standard connects with the "energy talked about in bio--just redoing a similar PE doesn't do that

HS.PS-FE Forces and Energy

lots of constructing models in this standard...it's not that it's necessarily a bad match in any PE, but would like a better spread of practices

c) an example here would be beneficial

a) It seems that if the goal is so specific, that this should really be just carry out investigations

c) just evaluating them seems a bit like naval gazing; would like students to do something with the analysis--make suggestions for improved efficiency?

HS.PS-W Waves

a) love it!

d) to demonstrate rather than to explain

this standard is one of the best for really pushing toward best practices in science education--clean, simple, yet challenging

a)...of a given phenomena

b and c) ...the findings of scientific literature--students aren't communicating the literature

c) ...about the effects on matter when diff wavelengths of ER are absorbed.

HS.PS-ER Electromagnetic Radiation

b) not sure that going to the literature for this topic is really warranted--seems like a practice better reserved for something with a bigger hook--students will struggle with the literature

This standard looks like a higher level of regurgitation--too much of students just stating what the literature says...fodder for lectures

e) seems like a good target for a more engineering focused PE

g) has potential to be relevant, but pairing of practice submarines this

HS.LS-SFIP Structures, Function, and Information Processing

modeling is much better fit for d than c

the brain/behavior focus of the last few seem a bit shoe-horned in

g) practice isn't a good match; would rather have students construct an explanation for a particular species pattern of behavior by analyzing the rewards/punishments, etc involved.

HS.LS-MEOE Matter and Energy in Organisms and Ecosystems

a)"may" in a clarification statement is not helpful

e) "Use matdata is redundant with mathematical model and makes for an awkward sentence

d seems a bit factoidy...maybe eliminate it

f seems like a good place for modeling and c and a not as much; the match between content and practice needs work in this standard

- HS.LS-IRE Interdependent Relationships in Ecosystems
- b) love this PE! would like it "promoted to "a" though we know that the order is not supposed to indicate priority, this PE could be the context for all the rest
 - d) clarifications statement--could needs to be should/shouldn't for assessment boundary
 - e) awk...not sure what the explanations are here...would drop this part
 - f) concern about "Argue from evidence" becoming "debate"
 - a) "could?" either it should , or it shouldn't for assessment purposes
- would like b) and e) to be connected--the design solutions should be taking into account how humans impact the env
- This is a more general comment about writing the standards, but especially with new verbs, we will have to provide examples of data sets and what is meant by models, etc. I (this is Matt specific) would actually prefer that these examples aren't specifically "in" the standards, but they need to be linked and they need to be there when the standards are released.
- what is the difference between "construct arguments form evidence (d) and Argue from evidence (f)?
this will either need to be carefully clarified or unify the language
- HS.LS-IVT Inheritance and Variation of Traits
- g) practice here is potentially a bit difficult to accomplish in some settings
 - a) not sure what questions students would be asking in this context that would be meaningful
 - e) would like clarifying sttement or addition to assessment boundary on whether the intent is to include crossing over
 - g) mathematical probability, or just qualitative comparisons (more/less likely)?
- HS.LS-NSE Natural Selection and Evolution
- a) not sure what types of questions students will ask here...
 - e and f) seemd that the "communicate" implies a higher level of thinking than is really demanded here
 - b) not sure how evidence will be used to support the process...
 - c) analyze and interpret to explain is an awkward phrase that sort of reminds one of a cookie cutter lab--this is the answer that you need to get, now jump through these hoops to "discover" the answers yourself (see suggestion for improving in other comment box)
 - d) would say "have affected" rather than "can affect"
 - a) if it's use rather than create models (which makes sense here), it would be good for teachers to give examples of what is meant
 - b) this would be enhanced if it invoked imagination--using evidence to support predictions of what would be expected to happen to a (mythical?) species in a carefully defined environment; this changes it from applying knowledge to a known situation (less motivating and potentially more likel to provoke an emotional response) to a more creative realm (more motivating for students and a safer emotional place)
 - c)would like this more to be about analyzing data to determine what the advantageous trait was--with students supporting their claim using evidence; in general, for successful implementation, whenever we say "analyze and interpret data, we're going to have to provide sample data sets (or facilitate a process for finding them) or many teachers won't know where to start.
 - e) is there tons of new technology information about anatomical structures? not amino acids? would still like a stronger emphasis on molecular evidence in this area.
- Disciplinary Core Idea: LS2.D: Social Interactions and Group Behavior • More emphasis needs to be placed on this as part of multi-level selection theory or group selection theory. There is no mention of either terminology relative to evolutionary theory or natural selection. Nor any discussion of multi-level selection theory relative to gene focused or individual focused selection, and the historical arguments between these various evolutionary camps.
- HS.ESS-SS Space Systems
- c) seems like constructing an argument for the claim...
 - b) not sure what the student is exactly responsible to do here; this seems like a lower level version of e)
- HS.ESS-HE History of Earth
- a) do we need valid and reliable--aren't those supposed to be what we are always aiming for with scientific claims; if not, why just here?
 - d) a scientific argument rather than "scientific arguments"
- HS.ESS-ES Earth's Systems
- e) "evidence-based claim"? Is this different than a scientific claim?
 - g) too many practices lumped together

Though clearly students will need to use models of the earth's interior, the SEP they are using is really the second verb in many of these PEs. On a, b, and d, students are just explaining...

a) that has occurred?

d) not clear what "critical reading" is; is this supposed to be an "or"? If so, why is the list needed?

f) why an e.g. here instead of a clarification statement?

HS.ESS-CC Climate Change

a) is the expectation that students communicate on all of them? If so, this is too broad

c) Analyze geologic evidence to determine the range of time scales for past climate changes. [Clarification statement: In examining evidence from ice core data, the fossil record, sea level fluctuations, glacial features, students should determine that climate change has happened over a wide range of time scales.

d) how would a teacher know if a student is doing this--what exactly is meant by "critical reading?"

e) remove section after comma

c) too many clauses in this sentence; simplify the syntax

HS.ESS-HS Human Sustainability

g) why "scientific arguments" on d and "arguments" on g?

b) like local application

c) this PE is not at all clear; not sure how to fix, but part of it might be that this isn't the right marriage of practice and dci

f) :production and consumption of natural resources" makes it sounds like they are two parts of the same process--the same "person" is doing both

g) too many phrases

Construct arguments about how engineering solutions are designed and implemented to mitigate local or global environmental impacts.

h) would like a communicate in this PE

HS.ETS-ED Engineering Design

- Performance Expectation b: "Constraints" also include end user social/cultural backgrounds, education levels, economic status, etc.
- Performance Expectation b: This should not just be used to improve the system's performance, but also the original modeling done to design and build the system.
- Performance Expectation d: Make sure it is explicit that the results of previous rounds of testing/simulation are used to refine subsequent tests.
- Performance Expectation e: Make sure it is explicit that the what is learned from comparing the results to the real world is fed back into improving the model/computational thinking.
- Performance Expectation f: Other factors included health, productivity, comfort, first cost, operational costs, energy/water

clarification statements are visually distracting. Would it be possible to have a little icon for clarification statements that you could click on? a) could easily be incorporated in several other standards and would instantly become more meaningful--AND the other standards would be better off as well.

The following are specific pieces of feedback from the KS team, but many of these would be addressed by incorporating the engineering PEs into the other core area standards:

HS.ETS-ETSS Links Among Engineering, Technology, Science and Society

Performance Expectation b: Analyses of the spread of technology provides an excellent opportunity for a connection with HS.LS-NSE Natural Selection and Evolution, HS.LS-IRE.f. Interdependent Relationships in Ecosystems, 1.SF Structure and Function, 3.EIO.f. Environmental Impacts on Organisms and 4.LCT Life Cycles and Traits by looking at the connection between the spread of technology and the selective advantage it offers humans at the level of the individual and group. There is a large body of work in archaeology and anthropology dealing with this to draw upon here.

- Performance Expectation c: Impacts examined aren't just environmental in nature, but also social/cultural and economic. And the scale of these impacts is at the individual level, business/organization, community, state, nation and globe.
- Performance Expectation d: Add communication to this list per the relevant disciplinary core idea. Also, meant to add the following comment in the general comments, but forgot before I submitted: Disciplinary Core Idea: ETS2.B: Interactions of Engineering, Technology, Science, Society, and the Natural Environment
- The widespread adoption of technology in the end depends on what evolutionary selective advantage it offers to humans at the level of the individual and larger group within the given social/cultural, physical environmental, and economic contexts at play. This should be addressed here and tied into the relevant life sciences standards.