

SCIENCE
ONLINE FEEDBACK
COLORADO
Department of Education

In preparation for the 2018 review and revision of the Colorado Academic Standards, the Colorado Department of Education invited the public to submit comments and suggestions through an online feedback system that was open from October 2016 through April 2017. Below are the unedited comments and suggestions that were submitted for Science. Each feedback item is prefaced with either **Revise**, **Remove**, **Move**, or **Comment**. Only those parts of the standards (Prepared Graduate Competencies, Grade Level Expectations, Evidence Outcomes, etc.) that received feedback are listed below, and as such, some PGCs/GLEs/EOs are missing from this document. For more information on the Colorado Academic Standards and the 2018 review and revision, visit <http://www.cde.state.co.us/standardsandinstruction>.

Prepared Graduate Competencies

PGC: Observe, explain, and predict natural phenomena governed by Newton's laws of motion, acknowledging the limitations of their application to very small or very fast objects

Revise: Add a PGC that is about understanding the nature and importance of science and how it used to explore, gain understanding, and make decisions.

Comment: Keep as is.

Comment: Keep the standards the same.

Comment: Newton's Laws are also limited when talking about gravitational anomalies (example: black holes and their even horizon)

PGC: Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions

Revise: nuclear reactions cover a broad range of processes of varying relevance. this is rote memorization.

Comment: Keep as is.

Comment: Remove the comma from the standard, or better, make a separate standard: Predict outcomes of chemical and nuclear reactions The comma is incorrect punctuation usage.

Comment: Keep the standards the same.

Revise: Ensure that valid science is used in apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions. From National Academy of Science, A growing body of evidence indicates that substantial percentages of published results in some fields are not reproducible, the report says, noting that this is a complex phenomenon and much remains to be learned. While a certain level of irreproducibility due to unknown variables or errors is a normal part of research, data falsification and detrimental research practices -- such as inappropriate use of statistics or after-the-fact fitting of hypotheses to previously collected data -- apparently also play a role. In addition, new forms of detrimental research practices are appearing, such as predatory journals that do little or no editorial review or quality control of papers while charging authors substantial fees. And the number of retractions of journal articles has increased, with a significant percentage of those retractions due to research misconduct. The report cautions, however, that this increase does not necessarily indicate that the incidence of misconduct is increasing, as more-vigilant scrutiny by the community may be a con-

tributing factor. http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=21896&utm_source=NASEM+News+and+Publications&utm_campaign=15d988f9b6-NAP_mail_new_2017.04.17&utm_medium=email&utm_term=0_96101de015-15d988f9b6-104332205&goal=0_96101de015-15d988f9b6-104332205&mc_cid=15d988f9b6&mc_eid=0f163c1e89
http://physics.nyu.edu/sokal/franklin_review_BtH.pdf

Revise: I don't feel that predicting nuclear reactions is necessary at this level.

PGC: Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable

Comment: Keep as is

Comment: Revise standard (grammar): Apply an understanding that energy exists in various forms and the transformation and conservation of energy occur in processes that are predictable and measurable

Comment: Keep the standards the same.

Comment: This standard is the minimum expected for all high school students. There is enough flexibility here that teachers are able to meet the standard for all students. While there appears to be very little physics present in the standards, what is here is what is needed for college and career.

Revise: The student shall ensure that they are not using articles without scientific rigor or those which have been retracted when applying an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable From National Academy of Science, A growing body of evidence indicates that substantial percentages of published results in some fields are not reproducible, the report says, noting that this is a complex phenomenon and much remains to be learned. While a certain level of irreproducibility due to unknown variables or errors is a normal part of research, data falsification and detrimental research practices -- such as inappropriate use of statistics or after-the-fact fitting of hypotheses to previously collected data -- apparently also play a role. In addition, new forms of detrimental research practices are appearing, such as predatory journals that do little or no editorial review or quality control of papers while charging authors substantial fees. And the number of retractions of journal articles has increased, with a significant percentage of those retractions due to research misconduct. The report cautions, however, that this increase does not necessarily indicate that the incidence of misconduct is increasing, as more-vigilant scrutiny by the community may be a contributing factor. http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=21896&utm_source=NASEM+News+and+Publications&utm_campaign=15d988f9b6-NAP_mail_new_2017.04.17&utm_medium=email&utm_term=0_96101de015-15d988f9b6-104332205&goal=0_96101de015-15d988f9b6-104332205&mc_cid=15d988f9b6&mc_eid=0f163c1e89
http://physics.nyu.edu/sokal/franklin_review_BtH.pdf Compounding Error: The Afterlife of Bad Science Authors Authors and affiliations Jaime A. Teixeira da SilvaEmail author Judit Dobránszki Judit Dobránszki, Institutes for Agricultural Research and Educational Farm of the University of Debrecen The failure to discover and correct errors in published scientific papers “poses significant risks for authors, editors, journals, and publishers” as well as for the wider academic pool and the public, and weakens reader and peer confidence in the credibility of scientists and their research. When errors in the published scientific literature are discovered they must be reported, and corrections made “quickly and completely,” urge Jaime A. Teixeira da Silva and Judit Dobránszki, who lay out the case for strengthening post-publication peer review. https://www.nas.org/articles/spring_2017_academic_questions <http://link.springer.com/article/10.1007%2Fs12129-017-9621-0> Article: Highly cited retracted papers ABSTRACT: We examine the number of citations in 10 highly cited retracted papers, and compare their current pre- and post-citation values. We offer some possible explanations for the continued citation of these retracted papers, and point out some of the risks that may be involved for the communities that continue to cite them. In general, retracted papers should not be cited, but often there is fault with unclear publisher web-sites, the existence of pirate web-sites or sites that display copies of the unretracted version of the paper, or even the insistent citation of a retracted paper because the results remain valid, or because the authors (most likely) refuse to accept the retracted status of that paper, or continue to believe that the core findings of the study remain valid. Article · Mar 2017 · Scientometrics https://www.researchgate.net/profile/Judit_Dobranszki

PGC: Explain and illustrate with examples how living systems interact with the biotic and abiotic environment

Remove: Should be combined with another life science concept as a learning outcome. More practical application of concepts students will be needing, using as adults.

Comment: Keep as is.

Comment: Keep the standards the same.

Remove: This standard is accomplished within one of your other ecology based standards written.

PGC: Analyze the relationship between structure and function in living systems at a variety of organizational levels, and recognize living systems' dependence on natural selection

Comment: Keep as is.

Comment: Keep the standards the same.

Revise: I would caution the use of "dependence on natural selection" and change it to the "role of natural selection." There are too many examples of things that play a role in this that are actually manipulated/engineered solely by humans.

Revise: Ensure that the student uses valid science to analyze the relationship between structures and function in living systems at a variety of organizational levels, and recognize systems dependence on natural selection. From National Academy of Science, A growing body of evidence indicates that substantial percentages of published results in some fields are not reproducible, the report says, noting that this is a complex phenomenon and much remains to be learned. While a certain level of irreproducibility due to unknown variables or errors is a normal part of research, data falsification and detrimental research practices -- such as inappropriate use of statistics or after-the-fact fitting of hypotheses to previously collected data -- apparently also play a role. In addition, new forms of detrimental research practices are appearing, such as predatory journals that do little or no editorial review or quality control of papers while charging authors substantial fees. And the number of retractions of journal articles has increased, with a significant percentage of those retractions due to research misconduct. The report cautions, however, that this increase does not necessarily indicate that the incidence of misconduct is increasing, as more-vigilant scrutiny by the community may be a contributing factor. http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=21896&utm_source=NASEM+News+and+Publications&utm_campaign=15d988f9b6-NAP_mail_new_2017.04.17&utm_medium=email&utm_term=0_96101de015-15d988f9b6-104332205&goal=0_96101de015-15d988f9b6-104332205&mc_cid=15d988f9b6&mc_eid=0f163c1e89 http://physics.nyu.edu/sokal/franklin_review_BtH.pdf

Revise: Replace "recognize" with "evaluate" Rationale: I support critical inquiry in the sciences and believe it is crucial to quality science education.

PGC: Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment

Comment: Keep as is.

Comment: Keep the standards the same.

Revise: The student will ensure that the student does not use papers which had an invalid methodology or which had been retracted when analyzing how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment From National Academy of Science, A growing body of evidence indicates that substantial percentages of published results in some fields are not reproducible, the report says, noting that this is a complex phenomenon and much remains to be learned. While a certain level of irreproducibility due to unknown variables or errors is a normal part of research, data falsification and detrimental research practices -- such as inappropriate use of statistics or

after-the-fact fitting of hypotheses to previously collected data -- apparently also play a role. In addition, new forms of detrimental research practices are appearing, such as predatory journals that do little or no editorial review or quality control of papers while charging authors substantial fees. And the number of retractions of journal articles has increased, with a significant percentage of those retractions due to research misconduct. The report cautions, however, that this increase does not necessarily indicate that the incidence of misconduct is increasing, as more-vigilant scrutiny by the community may be a contributing factor. http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=21896&utm_source=NASEM+News+and+Publications&utm_campaign=15d988f9b6-NAP_mail_new_2017.04.17&utm_medium=email&utm_term=0_96101de015-15d988f9b6-104332205&goal=0_96101de015-15d988f9b6-104332205&mc_cid=15d988f9b6&mc_eid=0f163c1e89 http://physics.nyu.edu/sokal/franklin_review_BtH.pdf Compounding Error: The Afterlife of Bad Science Authors Authors and affiliations Jaime A. Teixeira da SilvaEmail author Judit Dobránszki Judit Dobránszki, Institutes for Agricultural Research and Educational Farm of the University of Debrecen The failure to discover and correct errors in published scientific papers "poses significant risks for authors, editors, journals, and publishers" as well as for the wider academic pool and the public, and weakens reader and peer confidence in the credibility of scientists and their research. When errors in the published scientific literature are discovered they must be reported, and corrections made "quickly and completely," urge Jaime A. Teixeira da Silva and Judit Dobránszki, who lay out the case for strengthening post-publication peer review. https://www.nas.org/articles/spring_2017_academic_questions <http://link.springer.com/article/10.1007%2Fs12129-017-9621-0> Article: Highly cited retracted papers ABSTRACT: We examine the number of citations in 10 highly cited retracted papers, and compare their current pre- and post-citation values. We offer some possible explanations for the continued citation of these retracted papers, and point out some of the risks that may be involved for the communities that continue to cite them. In general, retracted papers should not be cited, but often there is fault with unclear publisher web-sites, the existence of pirate web-sites or sites that display copies of the unretracted version of the paper, or even the insistent citation of a retracted paper because the results remain valid, or because the authors (most likely) refuse to accept the retracted status of that paper, or continue to believe that the core findings of the study remain valid. Article · Mar 2017 · Scientometrics https://www.researchgate.net/profile/Judit_Dobranszki

PGC: Explain how biological evolution accounts for the unity and diversity of living organisms

Remove: Should be combined with another life science concept. Modern day, relevant, applicable concepts should be taught for students to understand the world around them and be able to use the information somewhere in their adult life.

Revise: Evolution and natural selection are only one theory of the earth's origins. If these are taught, so should the need for an intelligent designer and the lack of enough evidence to validate evolution

Revise: Be sure to include areas where biological evolution cannot account for the unity and diversity of living organisms. We should be honest about our science.

Comment: Thank you for keeping evolution in our state curriculum. It is supported by over a century and a half of hard scientific evidence. So-called "intelligent design" or whatever it calls itself now is not science, is not based on or supported by scientific evidence, and does not belong in our science curriculum. If it is taught in Colorado, it would belong in a civics or political science class.

Comment: Keep as is.

Comment: Keep the standards the same.

Revise: Revision: "Analyze and evaluate various aspects of biological evolution (including common ancestry and neo-Darwinism) that are used to account for the unity and diversity of living organisms." Rationale: I support critical inquiry in the sciences and believe it is crucial to quality science education.

PGC: Describe and interpret how Earth's geologic history and place in space are relevant to our understanding of the processes that have shaped our planet

Comment: Keep as is.

Comment: Keep the standards the same.

Revise: As this is at PGC level, a "higher" word should be used instead of "describe". Explain and interpret would indicate deeper understanding

Revise: USE EVIDENCE to ..."Describe and interpret how Earth's geologic history and place in space are relevant to our understanding of the processes that have shaped our planet" There should be something added about how systemic failure of Earth's systems equilibria leads to mass extinctions.

Revise: The student will not be required to participate in service projects where the student must provide unpaid services to progressive organizations, the Democrat party, the Green party, etc. when describing and interpret how Earth's geologic history and place in space are relevant to our understanding of the processes that have shaped our planet MAKING CITIZENS: HOW AMERICAN UNIVERSITIES TEACH CIVICS WITH CASE STUDIES OF THE UNIVERSITY OF COLORADO, BOULDER; COLORADO STATE UNIVERSITY; UNIVERSITY OF NORTHERN COLORADO; AND THE UNIVERSITY OF WYOMING The New Civics hopes to accomplish this by teaching students that a good citizen is a radical activist, and it puts political activism at the center of everything that students do in college, including academic study, extra-curricular pursuits, and off-campus ventures. New Civics builds on "service-learning," which is an effort to divert students from the classroom to vocational training as community activists. By rebranding itself as "civic engagement," service earning succeeded in capturing nearly all the funding that formerly supported the old civics. In practice this means that instead of teaching college students the foundations of law, liberty, and self-government, colleges teach students how to organize protests, occupy buildings, and stage demonstrations . These are indeed forms of "civic engagement," but they are far from being a genuine substitute for learning how to be a full participant in our republic https://www.nas.org/images/documents/NAS_makingCitizens_executiveSummary.pdf

PGC: Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system

Comment: Climate change and the human role in causing it is based on a huge body of overwhelming evidence and good science, and must be taught to Colorado students in a science setting. Science does not change its results to pander to economic or political fashions - science is science. Please make sure that climate change is robustly addressed in Colorado science education. It has huge implications for our state, and for the future lives of our students.

Comment: Keep as is.

Comment: Keep the standards the same.

Comment: Many comments have been made since this first version that the systems based approach is appreciated by many geoscientists. It shows the change in our content and highlights the impacts that Earth Science has on everything.

Revise: "Evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system" This should also include aspects of modeling and argumentation. There needs to be a greater emphasis on the feedbacks and forcings that control the systems and bring them into disequilibrium. Climate change science should have a greater emphasis.

Comment: Not sure where else to put this, but it seems there are some major missing proficiency areas under Science. 1- Critical thinking skills and understanding how the scientific method works in practice in "real life" and why it is so reliable in general. Given the alarming contemporary rise of anti-science/science denying propaganda by various interests (climate change denial, anti-vaccination, anti-GMO, etc.) it is critical that we give our kids a better toolset to evaluate rational facts from irrational claims. Our kids need to be able to understand not only what science has already uncovered (which seems to be what the standards are currently covering), but to apply it going forward to new problems their generation will face. Neil

deGrasse Tyson just put together an excellent video blurb on exactly this topic, worth a watch. <https://www.youtube.com/watch?v=8MqTOEospfo> 2- Creative problem solving and learning to "fail successfully". Every top level PGC seems to be focused on mastery of existing knowledge, but not a single one addresses how to dig in and tackle unknown problems and that failure is instrumental to learning. This is an absolutely critical skill, and one that I personally feel my own public education experience completely lacked.

Revise: Ensure that only valid science is used to evaluate evidence that Earth's geosphere, atmosphere, hydrosphere, and biosphere interact as a complex system and ensure that all the relevant factors are included in the analysis both from earth and from the universe. From National Academy of Science, A growing body of evidence indicates that substantial percentages of published results in some fields are not reproducible, the report says, noting that this is a complex phenomenon and much remains to be learned. While a certain level of irreproducibility due to unknown variables or errors is a normal part of research, data falsification and detrimental research practices -- such as inappropriate use of statistics or after-the-fact fitting of hypotheses to previously collected data -- apparently also play a role. In addition, new forms of detrimental research practices are appearing, such as predatory journals that do little or no editorial review or quality control of papers while charging authors substantial fees. And the number of retractions of journal articles has increased, with a significant percentage of those retractions due to research misconduct. The report cautions, however, that this increase does not necessarily indicate that the incidence of misconduct is increasing, as more-vigilant scrutiny by the community may be a contributing factor.

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http://physics.nyu.edu/sokal/franklin_review_BtH.pdf <https://astronomynow.com/2015/07/17/diminishing-solar-activity-may-bring-new-ice-age-by-2030/> <http://www.europhysicsnews.org/articles/epn/pdf/2015/02/e pn2015462p26.pdf> Cosmic rays from the universe may affect global cooling. <http://www.ibtimes.co.uk/earths-mantle-moves-ten-times-faster-previously-thought-1559080> Mantle movements can change ocean currents and other factors affecting weather. http://co2coalition.org/wp-content/uploads/2016/08/The-Climate-Surprise_CO2C-New-Criterion-1.pdf Increased carbon would enhance crop yields in arid areas of the world. <http://press.cern/press-releases/2013/10/cerns-cloud-experiment-shines-new-light-climate-change> <http://petrifiedwoodmuseum.org/PDF/FlorissantFossilBedsNationalMonumentViney2012.pdf> Tsetse flies are found fossilized in Colorado. Now they only exist in Sub-Saharan Africa. Evidence of past global warming.

PGC: Describe how humans are dependent on the diversity of resources provided by Earth and Sun

Revise: Should be focused on renewable energy, and environmental awareness.

Revise: We are ultimately more dependent on the creator of the earth and sun and should not care more for what was made than for the maker.

Comment: Keep as is.

Comment: Keep the standards the same.

Revise: slight grammar squeak - provided by the Earth and the Sun - might make reading and understanding a bit easier

Revise: USE EVIDENCE TO ..."Describe how humans are dependent on the diversity of resources provided by Earth and Sun" Resources are critical to all people but the average American uses a disproportionate amount of resources. This creates environmental justice issues leading to conflict. There should also be a re-envisioning of "waste". In sustainable systems, there is no waste. System components cycle absorbing and releasing energy more effectively than in human systems.

Revise: Too vague.

Science High School

Standard: 1. Physical Science

GLE: 1. Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion - but have limitations

Evidence Outcome: Identify the limitations of Newton's laws in extreme situations

Revise: Be more specific on the "limitations". Add "such as..." to give examples.

Remove: This is likely not necessary for typical high school students.

GLE: 2. Matter has definite structure that determines characteristic physical and chemical properties

Evidence Outcome: Develop, communicate, and justify an evidence-based scientific explanation supporting the current model of an atom

Revise: Does this imply knowing how the models of atoms have changed over history or just the most current, quantum mechanic, model. On state tests they often use a Bohr model which is not the most current model.

Comment: Please provide an example of a proficient response.

Evidence Outcome: Gather, analyze and interpret data on chemical and physical properties of elements such as density, melting point, boiling point, and conductivity

Comment: What chemical properties would be expected?

Comment: Only lists physical properties

Evidence Outcome: Use characteristic physical and chemical properties to develop predictions and supporting claims about elements' positions on the periodic table

Comment: Please be more specific regarding how in depth students should be able to do this. Electronegativity? Valence electrons? Metals and non? etc.

Comment: This is a very broad statement. More specifics as to types of characteristics might be helpful.

Evidence Outcome: Develop a model that differentiates atoms and molecules, elements and compounds, and pure substances and mixtures

Comment: Not sure how students are supposed to develop a model. Perhaps providing a possible assessment example would be helpful.

Comment: Wording "develop a model" is unclear to me. What do you want students to do?

Inquiry Questions:

Revise: why are nanoscale particles called out for specific inquiry/investigation? Why are nanoparticles any more important than other manufactured materials?

Revise: why are nanoscale particles called out for specific inquiry/investigation? Why are nanoparticles any more important than other manufactured materials?

Relevance and Application:

Revise: Carbon can be added to iron to make the interstitial alloy, carbon steel. Adding small amounts of metals such as chromium and nickel to iron make the substitutional alloy, stainless steel.

GLE: 3. Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy

Evidence Outcome: Recognize, analyze, interpret, and balance chemical equations (synthesis, decomposition, combustion, and replacement) or nuclear equations (fusion and fission)

Revise: instead of 'or' nuclear reaction can this be revised to 'and' nuclear reactions so that teachers can expect this to be assessed

Remove: balancing nuclear reactions is not a core competency.

Revise: What is the difference between analyze and interpret in terms of chemical reactions?

Evidence Outcome: Predict reactants and products for different types of chemical and nuclear reactions

Revise: Identifying specific types of nuclear reactions beyond the most basic observations that nuclear reactions result in the release of energy that can be used for heating water (power generation) or that can be released as x-rays or gamma rays is just memorization. Nuclear fusion only takes place on stars like the sun and is not likely to be a useful energy source in the next decade.

Revise: This is far too broad. Being able to predict products in all types of chemical reactions is beyond the scope of a traditional 1 year chemistry course.

Evidence Outcome: Predict and calculate the amount of products produced in a chemical reaction based on the amount of reactants

Revise: Specify if students will need to calculate moles of substances in order to meet this expectation.

Evidence Outcome: Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate the conservation of mass and energy

Remove: How are students using media sources to investigate conservation of mass? Not clear on how this meets the PGC.

Comment: This is confusing. Perhaps it needs to be separated out to be more clear or an example assessment could be provided.

Comment: This seems like an difficult topic to research and present information on.

GLE: 4. Atoms bond in different ways to form molecules and compounds that have definite properties

Evidence Outcome: Develop, communicate, and justify an evidence-based scientific explanation supporting the current models of chemical bonding

Revise: What are the "current models of chemical bonding"? This is very unclear.

GLE: 5. Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined

Relevance and Application:

Revise: Add natural gas to #3. Add economics to #4.

Revise: Add natural gas to #3 and add economics to #4.

Revise: In relevance and Application: Add natural gas to #3 and Add economics to #4.

GLE: 6. When energy changes form, it is neither created nor destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases

Revise: not all energy loss is to heat, per se. Entropy is a difficult concept, however, so maybe this simplification is necessary.

Standard: 2. Life Science

GLE: 2. The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem

Comment: The standards consistently promote a closed world view that science has all the answers, man is an alien/unnatural force on the planet whose impact is outside of the natural circle of life, oddly these two are in direct philosophical opposition. Through science man has repeatedly attempted to “fix” /alter things in nature and resulted in very large unintended consequences. The 21st century competencies drill down is too specific and frequently outdated especially in the area of scientific advancements – don’t require a certain understanding of specific things such as role of fats or carbs in diet as a standard because this understanding is changing. Standard should be more general –scientific insights frequently effect consumer choices, and frequently do not survive the test of time.

Evidence Outcome: Describe or evaluate communities in terms of primary and secondary succession as they progress over time

Revise: Describe or evaluate communities in terms of climate change as it progresses over time

Revise: Revise Evidence Outcome B to: Describe or evaluate communities in terms of climate change as it progresses over time

Evidence Outcome: Evaluate data and assumptions regarding different scenarios for future human population growth and their projected consequences

Revise:

Evidence Outcome: Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate ecosystem interactions

Revise: Add an evidence outcome: Evaluate your personal impact on immediate surroundings and wider global environment.

Revise: Add Evidence Outcomes: "Describe or evaluate communities in terms of global climate change as it progresses over time." "Evaluate your personal impact on immediate surroundings and wider global environment."

Revise: Add an evidence outcome: Evaluate your personal impact on immediate surroundings and wider global environment.

Relevance and Application:

Revise: 2. The extraction of resources, INTRODUCTION OF SPECIES OR NEW RESOURCES, OR ELIMINATION OF NATURAL PREDATORS for ANY SPECIES impacts nature ecosystems. 3. THROUGH WILDLIFE MANAGEMENT, HUMANS HAVE MAINTAINED A BALANCE IN THE USE OF RESOURCES SO THAT SPECIES CAN COEXIST WITHOUT OVER OR UNDERPOPULATION. (ex: deer population control allows food availability for maintenance of species) general comment: overpopulation of any species creates a new dynamic that effects the other pieces of the ecosystems, this can occur through either through elimination of natural predators, (in the case of humans, advancement in medicine, and science has enabled higher survival rates, throughout earth history various species have thrived to point of overpopulation which then lead to their die off due to food shortages or other imbalances necessary for survival. These changes have contributed to the evolution of life on the planet.)

GLE: 3. Cellular metabolic activities are carried out by biomolecules produced by organisms

Comment: The standards consistently promote a closed world view that science has all the answers, man is an alien/unnatural force on the planet whose impact is outside of the natural circle of life, oddly these two are in direct philosophical opposition. Through science man has repeatedly attempted to “fix” /alter things in nature and resulted in very large unintended consequences. The 21st century competencies drill down is too specific and frequently outdated especially in the area of scientific advancements – don’t require a cer-

tain understanding of specific things such as role of fats or carbs in diet as a standard because this understanding is changing. Standard should be more general –scientific insights frequently effect consumer choices, and frequently do not survive the test of time.

Relevance and Application:

Revise: REVISE: 1. Apply knowledge of biomolecular structure and activity to make consumer decisions, AND HOW THIS HAS CHANGED OVERTIME AS MEDICAL AND SCIENTIFIC UNDERSTANDING DEVELOPS, especially about diet with respect to saturated and unsaturated fatty acids, essential and nonessential amino acids, simple and complex carbohydrates AND SODIUM AND POTASSIUM. 4. GIVE EXAMPLES OF SCIENTIFIC INSIGHTS THAT EFFECTED CONSUMER CHOICES AND DID NOT SURVIVE THE TEST OF TIME/ ONLY TO BE REVERSED IN LATER SCIENTIFIC INSIGHTS. WHAT CAN BE LEARNED FROM THIS? GENERAL COMMENT: As currently written this standard promotes agenda rather than teaches critical analytical thinking via broader perspective. Important to give students understanding that scientific understanding of how food is metabolized/processed has evolved over time and how elimination of certain foods once thought to be of no use or even dangerous (eg. see the origin of wide use of white flour vs whole wheat flour) to the body resulted in other complications because science simply did not yet understand the role that element played in whole system body functions. For example the essential role fats play in the health of the Myelin sheath and the effect of fats on formation and maintenance of the neurological system in utero and later in life (Alzheimer's, dementia and seizures -- see true story "First Do No Harm" using fats to successfully control seizures.) Concrete example: coconut oil was eliminated in popular production of popcorn because that type of fat was deemed dangerous, but now coconut oil has been discovered to be valuable in treatment of Alzheimer's and healthy part of diet. Also salt was widely discouraged and many were encouraged to eliminate it from diet, but now it has been discovered that too little salt can be more dangerous than too much salt -- the necessity of the sodium potassium balance in the body for cellular function. learning objective: Importance of moderation and reluctance to embrace extremes due to the latest scientific "fad" in recognition that there is much we know, but much more we do not know.

GLE: 4. The energy for life primarily derives from the interrelated processes of photosynthesis and cellular respiration. Photosynthesis transforms the sun's light energy into the chemical energy of molecular bonds. Cellular respiration allows cells to utilize chemical energy when these bonds are broken.

Revise: REVISE: 4. Primary producers such as marine phytoplankton and rainforest flora CURRENTLY play an integral role in sustaining all life on Earth AT THIS POINT IN THE EVOLUTIONARY PROCESS. GENERAL COMMENT: Critical for the next generation to understand the context of the current conditions of plant life on earth and the consistent dynamic flux of the earth now and throughout its history --- long before man, conditions on earth have fundamentally shifted and life has adapted to maintain existence.

Nature Of:

Revise: REVISE: 1. Recognize that the current understanding of photosynthesis and cellular respiration has developed over time AND WILL CONTINUE TO DEVELOP and become more sophisticated as new technologies have lead to new evidence IT IS CRITICAL TO MAINTAIN PERSPECTIVE AS SCIENCE DOES NOT YET KNOW WHAT IT DOESN'T KNOW AND PAST PRESUMPTIONS OF CAUSATION WITHOUT UNDERSTANDING ALL RELEVANT VARIABLES HAVE HAD SERIOUS CONSEQUENCES.

GLE: 6. Cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments

Revise: REVISE: 1. Research and present findings about the results of dietary deficiencies or excesses COMPARED TO THE EFFECTS OF STRESS. GENERAL COMMENT: Introduce the future doctors and scientists to thinking in the larger context that life systems are not closed systems of pure chemical causation but in fact the chemical functions themselves are effected by environmental factors such as stress and the efficacy of future medicine will depend on science's ability to factor these variables into the study. REVISE ADD 4. GIVE EXAMPLES OF SUBSTANCES APPROVED AS SAFE BY THE FDA AND LATER TAKEN OFF THE MARKET AND/OR

WERE PART OF A CLASS ACTION LAWSUIT FOR DEVASTATING SIDE-EFFECTS AND DISCUSS REASONS THIS MAY OCCUR.

GLE: 7. Physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes, many of which encode instructions for the production of proteins

Revise: Physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes, many of which encode instructions for the production of proteins. Some of these characteristics are also influenced by non-genetic factors.

Revise: [Add to end of paragraph] Some of these characteristics are also influenced by non-genetic factors.
Rationale: Please see rationale in suggested revisions in PGCs.

Inquiry Questions:

Revise: INQUIRY QUESTION ADD: 4. HOW COULD THE INSIGHTS OF THE NEW SCIENCE OF EPIGENETICS AFFECT TRADITIONAL UNDERSTANDINGS OF GENETIC PROCESSES? 5. WITH THEIR UNDERSTANDING OF THE COMPLEXITY OF THE DNA CHAIN WHAT IS THE PROBABILITY OF RANDOM MUTATION RESULTING IN MACROEVOLUTION
General comments: failure to address these topics critically and analytically by factoring in new scientific approaches, presumes bias in favor of old status quo

GLE: 8. Multicellularity makes possible a division of labor at the cellular level through the expression of select genes, but not the entire genome.

Nature Of:

Revise: Revise: 3. Debate the ethical and political issues associated with the stem cell research and how these affect research, and how life could be effected if research proceeded without regard for these ethical and political issues. General comment: this is subtle but deeply biased, begging the student to answer simply – research is inhibited by eithical considerations and research is a good in itself... consider rewording to allow the student to critically analyze and balance the very real consequences of both sides of the issue, not just the side that inhibits research.

GLE: 9. Evolution occurs as the heritable characteristics of populations change across generations and can lead populations to become better adapted to their environment

(PGC Feedback) Remove: Political agenda The last time I read a scientific journal on evolution, it is still discussed as a "Theory" not fact. As such, evidence for and against evolution should be the topic, not an assumption of fact.

Comment: GENERAL COMMENTS: IT IS IMPORTANT FOR THE NEXT GENERATION TO UNDERSTAND ALL THE FACTS, EVEN THOSE THAT DON'T CLEANLY FIT INTO CURRENT THEORIES SO THAT THEY MAY BE EQUIPPED WITH THE BUILDING BLOCKS FOR THINKING OUTSIDE CURRENT BOXES AND PARADIGMS AND POTENTIALLY COMING UP WITH NEW SOLUTIONS TO OLD PROBLEMS. REGARDING BIOLOGICAL EVOLUTION, THE STUDENTS SHOULD UNDERSTAND THE FULL RANGE OF SCIENTIFIC VIEWS THAT EXIST, WHY SUCH TOPICS CAN GENERATE CONTROVERSY, AND HOW SCIENTIFIC DISCOVERIES CAN PROFOUNDLY AFFECT SOCIETY.

Remove: Political agenda The last time I read a scientific journal on evolution, it is still discussed as a "Theory" not fact. As such, evidence for and against evolution should be the topic, not an assumption of fact.

Evidence Outcome: Develop, communicate, and justify an evidence-based scientific explanation for how Earth's diverse life forms today evolved from common ancestors

Revise: revise: Develop, communicate, and critically evaluate explanations for the concept that Earth's diverse life forms today evolved from common ancestors, using evidence. general comment: Graham Lawton, "Why Darwin was wrong about the tree of life," New Scientist (January 21, 2009). "For a long time the holy grail was to build a tree of life," says Eric Bapteste, an evolutionary biologist at the Pierre and Marie Curie University in Paris, France. A few years ago it looked as though the grail was within reach. But today the project lies in tatters, torn to pieces by an onslaught of negative evidence. Many biologists now argue that the tree concept is obsolete and needs to be discarded. "We have no evidence at all that the tree of

life is a reality," says Baptiste. That bombshell has even persuaded some that our fundamental view of biology needs to change. general comment: as currently worded this is a biased, one-sided (only requires supporting evidence discussion) and therefore is non critical, non analytical

Revise: [Revise] Develop, communicate, and critically evaluate explanations for the concept that Earth's diverse life forms today evolved from common ancestors, using evidence. Rationale: Please see rationale in suggested revisions in PGCs.

Evidence Outcome: Analyze and interpret multiple lines of evidence supporting the idea that all species are related by common ancestry such as molecular studies, comparative anatomy, biogeography, fossil record and embryology

Revise: Revise: Analyze and evaluate multiple lines of evidence concerning the idea that all species are related by common ancestry such as molecular studies, comparative anatomy, biogeography, and the fossil record. general comment: as currently worded this is a biased, one-sided (only requires supporting evidence discussion) and therefore is non critical, non analytical approach.

Revise: [Revise] Analyze and evaluate multiple lines of evidence concerning the idea that all species are related by common ancestry such as molecular studies, comparative anatomy, biogeography and the fossil record. Rationale: Please see rationale in suggested revisions in PGCs.

Evidence Outcome: Analyze and interpret data suggesting that over geologic time, discrete bursts of rapid genetic changes and gradual changes have resulted in speciation

Revise: Analyze and evaluate whether, over geologic time, discrete bursts of rapid genetic changes and gradual changes have resulted in speciation. Comment: Jeffrey Schwartz, evolutionary anthropologist. *Sudden Origins: Fossils, Genes, and the Emergence of Species*, p. 3 (Wiley, 1999). "[W]e are still in the dark about the origin of most major groups of organisms. They appear in the fossil record as Athena did from the head of Zeus — full-blown and raring to go, in contradiction to Darwin's depiction of evolution as resulting from the gradual accumulation of countless infinitesimally minute variations. . ." general comment: the failure to require students to account for the archeological evidence uncovered for example in the Cambrian Explosion, results in a biased one-sided non-critical and non-analytical presentation.

Revise: [Revise] Analyze and evaluate whether, over geologic time, discrete bursts of rapid genetic changes and gradual changes have resulted in speciation. Rationale: Please see rationale in suggested revisions in PGCs.

Evidence Outcome: Analyze and interpret data on how evolution can be driven by three key components of natural selection - heritability, genetic variation, and differential survival and reproduction

Revise: Analyze and evaluate data regarding natural selection (specifically, its components of heritability, genetic variation, and differential survival and reproduction) and its relationship to evolution. general comment: Current standard is biased and factually incomplete. Science should present students with all relevant facts and test past conclusions based on subsequent relevant factors. The next generation of scientists need to have all the facts to think outside of current boxes and come to new conclusions and new insights.

Revise: [Revise] Analyze and evaluate data regarding natural selection (specifically, its components of heritability, genetic variation, and differential survival and reproduction) and its relationship to evolution. Rationale: Please see rationale in suggested revisions in PGCs.

Remove: Political agenda The last time I read a scientific journal on evolution, it is still discussed as a "Theory" not fact. As such, evidence for and against evolution should be the topic, not an assumption of fact.

Evidence Outcome: Generate a model - an evolutionary tree - showing how a group of organisms is most likely diverged from common ancestry

Revise: e. HOW DO DISCOVERIES IN THE FOSSIL RECORD WHICH LACK THE TRANSITIONAL FORMS EFFECT THE THEORY OF MACROEVOLUTION. or revise: e. Generate, analyze and evaluate a model - an evolutionary tree - showing how a group of organisms may have diverged from common ancestry. /or/ f. Generate a model - an evolutionary tree - showing how a group of organisms is most likely diverged from common ancestry AND SHOW HOW THE FOSSIL RECORD OF THE CAMBRIAN EXPLOSION EFFECTS this likelihood.

general comment: current standard is biased and lacks scientific critical analytical accounting of all archeological facts.

Revise: [Revise] Generate, analyze and evaluate a model - an evolutionary tree - showing how a group of organisms may have diverged from common ancestry. Rationale: Please see rationale in suggested revisions in PGCs.

Standard: 3. Earth Systems Science

GLE: 1. The history of the universe, solar system and Earth can be inferred from evidence left from past events

(PGC Feedback) Comment: Unfortunately, most Colorado high school students are not taking a course in the Earth/Space Sciences. These standards need to be elevated. Adopting the NGSS would place the Earth and Space Sciences on an equal playing field with Life and Physical Sciences.

Revise: This should be split up. We have very different evidence for the history of the earth than for the history of the solar system/universe.

Evidence Outcome: Develop, communicate, and justify an evidence-based scientific explanation addressing questions about Earth's history

Remove: addressing questions? what questions? this is basically just saying use evidence to support claims

Comment: This applies to all of the first statements on all of the standards, so I only have to input it once. This was our attempt at incorporating the nature of science directly into a standards. We later realized that these were difficult to interpret - but I still feel that these are better statements than the NOS examples that were provided.

Evidence Outcome: Analyze and interpret data regarding Earth's history using direct and indirect evidence

Revise: clarify types of data students should analyze. how is it different than the data that is looked at to interpret the past in earlier grade levels?

Revise: there is misunderstanding of direct and indirect evidence - this should possibly just be "evidence"

Evidence Outcome: Analyze and interpret data regarding the history of the universe using direct and indirect evidence

Comment: While this is very similar to the EO directly above, it should remain separate as the topics are not typically nor easily combined.

Evidence Outcome: Seek, evaluate, and use a variety of specialized resources available from libraries, the Internet, and the community to find scientific information on Earth's history

Revise: take out the word "specialized" - update to use science literacy term

Relevance and Application:

Comment: This section is often overlooked by teachers, intentionally or not. With trying to plan curriculum using the standards, these EXAMPLES aren't really needed on this document. They may be helpful in giving clarification, but could maybe be addressed in other methods and tools.

Nature Of:

Comment: I will put this on the first one only - but this comment applies to ALL NOS statements. I was on the standard writing committee - these statements were NEVER intended to be assessed. They were written as EXAMPLES of what this standard may look like in the classroom. Also, at this point in time, continuing to assess NOS should NOT be necessary as an inquiry approach is much more common. NOS should still be encouraged and embedded, but these statements should NOT be aligned to assessment items. This holds true for ALL levels of science as well, not just high school.

GLE: 4. Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere

Evidence Outcome: Analyze and interpret data on Earth's climate

Revise: Analyze and interpret data on Earth's climate as impacted by human activity (e.g. energy and water usage)

Revise: Revise Evidence Outcome B to: Analyze and interpret data on Earth's climate as impacted by human activity (e.g. energy and water usage)

Evidence Outcome: Interpret evidence from weather stations, buoys, satellites, radars, ice and ocean sediment cores, tree rings, cave deposits, native knowledge, and other sources in relation to climate change

Revise: Add evidence outcome: Predict impact of climate change and strategies on local and regional ecosystems.

Revise: Climate change is a very well supported scientific fact that will have huge implications for Colorado and for the lives of these students. Add evidence outcomes: "Predict impact of global climate change and strategies on local and regional ecosystems and human populations." "Predict impact of climate change and strategies on local and regional ecosystems."

Revise: Add evidence outcome: Predict impact of climate change and strategies on local and regional ecosystems

Inquiry Questions:

Revise: How can changes in the ocean effect climate? "climate change" is a politically charged phrase that is a controversial topic associated with the discussion of global warming. Oceans have effected climate long before the industrial revolution and the effect of the oceans should be understood separate and apart from the discussion of the greenhouse effect.

Relevance and Application:

Revise: Remove might from #2

Revise: #2 "Might?" The science here is pretty clear. Please remove the word "might."

Revise: With regard to relevance & application number 2, the word "might" needs to be removed. There is no question from the scientific community about the burning of fossil fuels contributing to climate change, it is an objective fact. The revised sentence would just be "Human actions such as burning fossil fuels impacts Earth's climate."

Revise: Revise Relevance and Application Statement #2: Remove "might"

Nature Of:

Remove: Political agenda The last scientific journal I read on climate change referred to it as a theory, not fact. Do not treat theories and hypotheses as facts. If we are to encourage true scientific thinking, we cannot have any biases.

GLE: 5. There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources

Revise: A cost and a consequence seem synonymous. Remove consequence and only include costs and benefits, so as to encourage equal evaluation, not just negative evaluation, of exploration, development, and consumption of renewable and nonrenewable resources.

GLE: 6. The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes

Revise: I recently ran into confusion with another colleague around this one - they didn't realize that this GLE is trying to move HS students towards land use decisions - not just weathering and erosion (which has been taught elsewhere)

GLE: 7. Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms

Revise: GLE needs to be revised and strengthened to include more specifics about hazards and how to extend learning in HS vs basic middle school - this is also a GLE that should be embedded throughout ALL of earth science and not treated as a separate unit of study

Science Eighth Grade

Standard: 1. Physical Science

GLE: 1. Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object's change of motion

Comment: There are entirely too many GLEs for 8th grade science to realistically cover in the academic year prior to CMAS (which is given a month before school ends). Put life science back in 7th grade and leave the earth systems and physical for 8th. Unfortunately, the climate you've created with high-stakes testing is "What can I squeeze in before CMAS testing."

Nature Of:

Comment: I am concerned about #2. This gives affluent districts a huge advantage when resources are not made available across the board. On paper, this idea looks great. In actuality, this is near impossible to do. This seems like an actionable target, but in practice, there are too many assumptions to make it a practical endeavor.

GLE: 2. There are different forms of energy, and those forms of energy can be changed from one form to another - but total energy is conserved

Comment: There are entirely too many GLEs for 8th grade science to realistically cover in the academic year prior to CMAS (which is given a month before school ends). Put life science back in 7th grade and leave the earth systems and physical for 8th. Unfortunately, the climate you've created with high-stakes testing is "What can I squeeze in before CMAS testing."

Evidence Outcome: Develop a research-based analysis of different forms of energy and energy transfer

Revise: add in a local setting, such as schools or homes

Revise: Add "...in a local setting, such as schools or homes."

Revise: Evidence Outcome B: add in a local setting, such as schools or homes

Evidence Outcome: Use research-based models to describe energy transfer mechanisms, and predict amounts of energy transferred

Comment: Where exactly would one find reputable research models? What is the expectation? What should students specifically show to demonstrate mastery? This is way too vague and sounds like a lot of fancy language without an actual target. How would you put this on a Marzano performance scale?

GLE: 3. Distinguish between physical and chemical changes, noting that mass is conserved during any change

Comment: There are entirely too many GLEs for 8th grade science to realistically cover in the academic year prior to CMAS (which is given a month before school ends). Put life science back in 7th grade and leave the earth systems and physical for 8th. Unfortunately, the climate you've created with high-stakes testing is "What can I squeeze in before CMAS testing."

Comment: Why isn't this in the 7th grade standards?

Evidence Outcome: Identify the distinguishing characteristics between a chemical and a physical change

Revise: Change Identify to contrast

Evidence Outcome: Identify evidence that suggests that matter is always conserved in physical and chemical changes

Revise: Change identify to evaluate

GLE: 4. Recognize that waves such as electromagnetic, sound, seismic, and water have common characteristics and unique properties

Comment: There are entirely too many GLEs for 8th grade science to realistically cover in the academic year prior to CMAS (which is given a month before school ends). Put life science back in 7th grade and leave the earth systems and physical for 8th. Unfortunately, the climate you've created with high-stakes testing is "What can I squeeze in before CMAS testing."

Standard: 2. Life Science

GLE: 1. Human activities can deliberately or inadvertently alter ecosystems and their resiliency

Comment: Put life science back in 7th grade and leave the earth systems and physical for 8th. The life science does not flow into into the physical or space systems GLEs. It's an abrupt change of mindset that students don't relate or adapt to well.

Comment: To be honest, this would fit better in the 6th grade.

Evidence Outcome: Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate an environmental issue

Comment: Really wish the CDE would provide a resource for agreed-upon, reputable sources to be used. Otherwise, this expectation has very little meat.

GLE: 2. Organisms reproduce and transmit genetic information (genes) to offspring, which influences individuals' traits in the next generation

Comment: Put life science back in 7th grade and leave the earth systems and physical for 8th. The life science does not flow into into the physical or space systems GLEs. It's an abrupt change of mindset that students don't relate or adapt to well.

Comment: This would really be more appropriate in the 7th grade curriculum. There is no smooth link in the 8th grade- it's like a random, "Oh yeah, we are going to cover this, even though it doesn't neatly tie into anything else."

Standard: 3. Earth Systems Science

GLE: 1. Weather is a result of complex interactions of Earth's atmosphere, land and water, that are driven by energy from the sun, and can be predicted and described through complex models

Comment: There are entirely too many GLEs for 8th grade science to realistically cover in the academic year prior to CMAS (which is given a month before school ends). Put life science back in 7th grade and leave the earth systems and physical for 8th. Unfortunately, the climate you've created with high-stakes testing is "What can I squeeze in before CMAS testing."

Evidence Outcome: Use models to develop and communicate a weather prediction

Revise: Use various weather data, weather maps, weather information products, and weather models to analyze and interpret current weather conditions as well as develop and communicate a future weather prediction. "Use models" is way too vague.

Revise: Use models to develop and communicate the probability of certain weather conditions

Revise: Revise Evidence Outcome C to read: Use models to develop and communicate the probability of certain weather conditions

Inquiry Questions:

Revise: "Strengths and limitations of different weather models". Middle school students are not ready to critique complex weather models. I've never quite understood this question. "What are the variables..."
 Revise to say, "What are the variables that affect the weather, and what makes weather prediction challenging?"

Relevance and Application:

Revise: Buoys: why are buoys listed 2nd? We live in Colorado -- there are no weather buoys here. Revise: place at end of list, and maybe say "weather buoys at sea" or "weather buoys in the ocean".

Nature Of:

Revise: I don't think evaluating the accuracy of weather forecasting tools is appropriate or important. Better for students to learn about the variety of weather tools that we use to track weather conditions and make accurate, detailed weather forecasts.

GLE: 2. Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location

Comment: There are entirely too many GLEs for 8th grade science to realistically cover in the academic year prior to CMAS (which is given a month before school ends). Put life science back in 7th grade and leave the earth systems and physical for 8th. Unfortunately, the climate you've created with high-stakes testing is "What can I squeeze in before CMAS testing."

Comment: This seems more appropriate for 6th grade

Revise: revise to read: Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, wind, and greenhouse gasses that have changed over time in a particular location.

Evidence Outcome: Examine, evaluate, and question information from a variety of sources and media to investigate how climates vary from one location to another on Earth

Revise: Include "scientific data" in addition to information -- not all "information" is scientific or relevant to climate change conversation.

Revise: Add evidence outcome "Use a carbon calculators to calculate carbon footprints; brainstorm ways to minimize carbon footprints."

Revise: Add evidence outcomes: "What are natural and human processes that add and remove carbon dioxide from the atmosphere, and relative speed of these processes?" "Use a carbon calculators to calculate carbon footprints; brainstorm ways to minimize carbon footprints." "How do sources of water influence climate?"

Revise: Add evidence outcome "Use a carbon calculators to calculate carbon footprints; brainstorm ways to minimize carbon footprints."

Inquiry Questions:

Revise: Emphasis on scientific evidence that supports climate changes and its impacts on the planet. Do not include anything about "contradictory evidence" that is unscientific or driven by climate deniers. Denialism is dangerous.

Revise: Add: How do sources of water influence climate? What are natural and human processes that add and remove carbon dioxide and relative speed of these processes.

Revise: Add Inquiry Questions: How do sources of water influence climate? And What are natural and human processes that add and remove carbon dioxide and relative speed of these processes?

Relevance and Application:

Revise: Computer models -- which rely on historical and current data as well as mathematical representation of Earth's atmosphere -- help people...

GLE: 3. The solar system is comprised of various objects that orbit the Sun and are classified based on their characteristics

Comment: There are entirely too many GLEs for 8th grade science to realistically cover in the academic year prior to CMAS (which is given a month before school ends). Put life science back in 7th grade and leave the earth systems and physical for 8th. Unfortunately, the climate you've created with high-stakes testing is "What can I squeeze in before CMAS testing."

Relevance and Application:

Revise: Various passive and active technological methods and equipment... include mention of spacecraft (orbiters, landers, rovers), not just telescopes Planetariums... include mention of online simulators and apps that further permit students to explore and understand the solar system.

Nature Of:

Revise: "continued scientific investigations and advances..." Add: active exploration of our solar system.

GLE: 4. The relative positions and motions of Earth, Moon, and Sun can be used to explain observable effects such as seasons, eclipses, and Moon phases

Revise: Add: the uneven heating of our planet (which affects our weather and climate)

Comment: There are entirely too many GLEs for 8th grade science to realistically cover in the academic year prior to CMAS (which is given a month before school ends). Put life science back in 7th grade and leave the earth systems and physical for 8th. Unfortunately, the climate you've created with high-stakes testing is "What can I squeeze in before CMAS testing."

Inquiry Questions:

Revise: "Natural phenomenon" ... such as? Give examples...

Science Seventh Grade

Standard: 2. Life Science

GLE: 2. The human body is composed of atoms, molecules, cells, tissues, organs, and organ systems that have specific functions and interactions

Comment: It would make sense to put punnett squares and pedigree charts here- it doesn't flow smoothly at all in the 8th grade curriculum.

GLE: 5. Multiple lines of evidence show the evolution of organisms over geologic time

Revise: I love this - thank you!

Evidence Outcome: Analyze and interpret data that show human evolution

Revise: Delete human evolution at middle school--should be in high school standards after students have had a chance to study fossils and show evolutionary trends.

Revise: Add and how organisms co-evolve.

Revise: add "...and how organisms co-evolve."

Revise: Edit Evidence Outcome C: Analyze and interpret data that show human evolution Add "and how organisms co-evolve".

Relevance and Application:

Revise: Add "there is a growing awareness that organisms such as infectious bacteria and insect pests can quickly evolve resistance to our efforts to control them."

Standard: 3. Earth Systems Science

GLE: 1. Major geologic events such as earthquakes, volcanic eruptions, mid-ocean ridges, and mountain formation are associated with plate boundaries and attributed to plate motions

Revise: Reorder Evidence Outcomes - Put earthquakes and volcanoes first - geographic distribution of earthquakes and volcanoes worldwide help define plate boundaries.

Revise: Add Tsunami

Revise: Add Tsunami to GLE

Evidence Outcome: Identify, interpret, and explain models of plates motions on Earth

Revise: Plate versus plates motion

Evidence Outcome: Use web-based or other technology tools to show connections and patterns in data about tectonic plate boundaries and earthquakes, volcanic eruptions, and mountain formation

Revise: Add evidence outcome: Assess the risk of human activity with relation to location.

Revise: Add evidence outcome: Assess the risk of human activity with relation to location.

Revise: Add evidence outcome: Assess the risk of human activity with relation to location.

GLE: 2. Geologic time, history, and changing life forms are indicated by fossils and successive sedimentation, folding, faulting, and uplifting of layers of sedimentary rock

Revise: Add: "uplifting of various types of rocks." Not just sedimentary rocks!

Evidence Outcome: Identify and describe the impact of major geologic events on life on Earth

Remove: Remove "b" as it is incorporated in "c"

Inquiry Questions:

Revise: "How can we interpret data from different kinds of rocks?" (layers of rocks implies only sedimentary rock and all kinds of rock are formed in geologic time and through plate tectonics)

Relevance and Application:

Revise: Delete "Knowledge of Earth's structure....where to mine for gold and drill for oil..." and add to RE-SOURCES (where ever that is in the Earth Science Systems standards)

Science Sixth Grade

Standard: 1. Physical Science

GLE: 1. All matter is made of atoms, which are far too small to see directly through a light microscope. Elements have unique atoms and thus, unique properties. Atoms themselves are made of even smaller particles

Evidence Outcome: Use the particle model of matter to illustrate characteristics of different substances

Revise: Like the physical states for that matter.

Evidence Outcome: Find and evaluate appropriate information from reference books, journals, magazines, online references, and databases to compare and contrast historical explanations for the nature of matter

Comment: Although this is ideal, as a classroom teacher, this is a nightmare to reinforce. It would be extremely helpful if the CDE had some source information that would help support this. Otherwise, an expectation such as this one tends to not be followed with consistency throughout districts with lower socioeconomic classes being highly represented.

Inquiry Questions:

Revise: Perhaps add: How is our world made of both things we can observe with our eyes, and even smaller particles we cannot see with our eyes alone?

Nature Of:

Comment: This is an excellent blend of science and writing. I am thrilled to see it being required.

GLE: 2. Atoms may stick together in well-defined molecules or be packed together in large arrays. Different arrangements of atoms into groups compose all substances

Revise: "chemically combined" rather than "stick together"

Relevance and Application:

Revise: "provide" is awkward and does not show the relationship between arrangements and properties. Do you mean correspond, cause or correlate or something else?

Nature Of:

Move: Please create an additional "Nature of Science" standard that incorporates all of the science thinking and skills that are currently housed in the 'Nature of' section of the standards.

GLE: 4. Distinguish among, explain, and apply the relationships among mass, weight, volume, and density

(PGC Feedback) Comment: Are the people writing these standards aware of the developmental capabilities of the typical 6th grade brain?

Comment: These are mathematical relationships that 6th graders will struggle with. 8th graders struggle with it and they are more developed.

Standard: 3. Earth Systems Science**GLE: 1. Complex interrelationships exist between Earth's structure and natural processes that over time are both constructive and destructive**

Comment: This really seems to tie in better with 7th grade

GLE: 2. Water on Earth is distributed and circulated through oceans, glaciers, rivers, ground water, and the atmosphere

Evidence Outcome: Gather and analyze data from a variety of print resources and investigations to account for local and world-wide water circulation and distribution patterns

Revise: It might be worth adding something about learning to assess the quality of information / to verify and be skeptical of information - we have to teach kids how to identify reputable sources of information.

Inquiry Questions:

Revise: Add inquiry question: What is the impact of moving water from one region to another?

Revise: Add inquiry question: What is the impact of moving water from one watershed to another?"

Revise: Add inquiry question: What is the impact of moving water from one watershed to another?

Science Fifth Grade

Standard: 1. Physical Science

GLE: 1. Mixtures of matter can be separated regardless of how they were created; all weight and mass of the mixture are the same as the sum of weight and mass of its parts

Evidence Outcome: Share evidence-based conclusions and an understanding of the impact on the weight/mass of a liquid or gas mixture before and after it is separated into parts

Revise: This standard is hard to understand. Also, the concept of weight/mass is best explored through liquid/solid or solid/ solid mixtures. In order to take liquids out of liquids or gas out of gas, you would need special equipment. Most elementary schools do not have access to this equipment. The purpose of this standard is for students to understand that the weight and mass of a mixture are the sum of all the parts in the mixture. With a little revision, this standard can be much clear and very doable in the classroom.

Nature Of:

Move: Please create an additional "Nature of Science" standard that incorporates all of the science thinking and skills that are currently housed in the 'Nature of' section of the standards.

Standard: 2. Life Science

GLE: 1. All organisms have structures and systems with separate functions

Evidence Outcome: Develop and communicate an evidence-based scientific explanation of the role of different organs or structures that are important for an organism's survival - in both plants and animals

Revise: delete - both plants and animals. Insert - across all five kingdoms of life on earth.

Evidence Outcome: Analyze and interpret data to generate evidence that all organisms have structures that are required for survival in both plants and animals

Revise: delete animals and plants, insert a variety of living things.

GLE: 2. Human body systems have basic structures, functions, and needs

Evidence Outcome: Assess further scientific explanations regarding basic human body system functions

Revise: delete further

Evidence Outcome: Compare and contrast a human system to that of another organism, and provide hypotheses about why the similarities and differences exist

Revise: delete "provide hypotheses about why", insert "analyze ideas about"

Standard: 3. Earth Systems Science

GLE: 1. Earth and Sun provide a diversity of renewable and nonrenewable resources

Evidence Outcome: Analyze and interpret a variety of data to understand the origin, utilization, and concerns associated with natural resources

Revise: Add Evidence Outcome "Compare and contrast different sources of energy, the resources involved in using them, their reliability, and cost-e.g. mining, transportation, infrastructure, environmental impact."

Revise: Add as an Evidence Outcome: "Compare and contrast different sources of energy, the resources involved in using them, their reliability, and cost-e.g. mining, transportation, infrastructure, environmental impact."

Revise: Add Evidence Outcome "Compare and contrast different sources of energy, the resources involved in using them, their reliability, and cost-e.g. mining, transportation, infrastructure, environmental impact."

Inquiry Questions:

Revise: Reorder these questions: question 3 should be first.

Revise: : Add Inquiry Question "What types of and how much renewable and nonrenewable energy are being produced in Colorado?" Add inquiry question: "How do you make choices about energy every day?"

Revise: Add as Inquiry Questions "What types of and how much renewable and nonrenewable energy are being produced in Colorado?" "How do you make choices about energy every day?"

Revise: Add Inquiry Question "What types of and how much renewable and nonrenewable energy are being produced in Colorado?" Add inquiry question: "How do you make choices about energy every day?"

Nature Of:

Comment: Thank you for ".to be scientifically accurate." In a world of false news, it's vital to teach kids from an early age to pay attention to the credibility of their information sources.

GLE: 2. Earth's surface changes constantly through a variety of processes and forces

Evidence Outcome: Analyze and interpret data identifying ways Earth's surface is constantly changing through a variety of processes and forces such as plate tectonics, erosion, deposition, solar influences, climate, and human activity

Revise: Delete plate tectonics, solar influences, and climate from the statement. These are all very abstract things that middle school and high school students should be studying. "Changing through a variety of processes such as erosion, deposition, and human activity (5th graders can observe these three processes)."

Relevance and Application:

Revise: Delete earthquakes from this expectation--very abstract and not observable like flooding, weathering and erosion, etc. Delete mention of the Richter scale--belongs in middle school or high school with earthquakes.

Science Fourth Grade

Standard: 1. Physical Science

GLE: 1. Energy comes in many forms such as light, heat, sound, magnetic, chemical, and electrical

Inquiry Questions:

Revise: Add the Inquiry Questions "How does using energy impact the environment?" and "How does this change when using more/or using less energy?"

Revise: Add the Inquiry Questions "How does using energy impact the environment?" "How do different sources of energy affect the environment?" "How does this change when using more/or using less energy?" - These are critical questions for students to explore if they are going to make informed decisions about energy use and sources of energy.

Revise: Add the Inquiry Questions "How does using energy impact the environment?" and "How does this change when using more/or using less energy?"

Nature Of:

Move: Please create and additional "Nature of Science" standard that incorporates all of the science thinking and skills that are currently housed in the 'Nature of' section of the the standards.

Standard: 2. Life Science

GLE: 1. All living things share similar characteristics, but they also have differences that can be described and classified

Relevance and Application:

Revise: used

GLE: 2. Comparing fossils to each other or to living organisms reveals features of pre-historic environments and provides information about organisms today

Inquiry Questions:

Revise: Instead of saying the "negative," state the question in the positive. "What are some things fossils CAN tell us?" 1. Fish fossils tell us that water was present in the past. 2. Dinosaur fossils tell us that dinosaurs lived at that place in the past. 3. Particular fossils tell us whether there was a water environment or a land environment. 4. Palm frond fossils found in Colorado indicate the climate was much warmer and wetter in the past.

Science Third Grade

Standard: 1. Physical Science

GLE: 1. Matter exists in different states such as solids, liquids, and gases and can change from one state to another by heating and cooling

Evidence Outcome: Identify the state of any sample of matter

Revise: Recommendation: Add Evidence Outcome "Discover the sources of water in Colorado?"

Revise: Add Evidence Outcome "Identify sources of water in Colorado"

Comment: Add Evidence Outcome "Identify sources of water in Colorado?"

Inquiry Questions:

Revise: Add inquiry question, "Where can you find different forms of water outside?" Add Inquiry Question "How do Coloradans use water on a typical day, week, month, year?"

Revise: Add inquiry question, "Where can you find different forms of water outside?" Add Inquiry Question "How do Coloradans use water on a typical day, week, month, or year?"

Comment: Add inquiry question, "Where can you find different forms of water outside?" Add Inquiry Question "How do Coloradans use water on a typical day, week, month, or year?"

Nature Of:

Move: Please create an additional "Nature of Science" standard that incorporates all of the science thinking and skills that are currently housed in the 'Nature of' section of the standards.

Standard: 2. Life Science

GLE: 1. The duration and timing of life cycle events such as reproduction and longevity vary across organisms and species

Revise: Evaluate the ways in which students ARE scientists.....

Standard: 3. Earth Systems Science

GLE: 1. Earth's materials can be broken down and/or combined into different materials such as rocks, minerals, rock cycle, formation of soil, and sand - some of which are usable resources for human activity

(PGC Feedback) Move: This is equal to a fifth grade Next Generation Science Standard Performance Expectation.

Revise: Change wording as "earth materials" are concrete materials such as rocks, minerals, soil. The "rock cycle" and "soil formation" are processes. The rock cycle is not a usable resource. "Earth's materials can be broken down and/or combined into different materials such as minerals, rocks, and soil--some of which are usable resources for human activity."

Evidence Outcome: Investigate and identify two or more ways that Earth's materials can be broken down and/or combined in different ways such as minerals into rocks, rock cycle, formation of soil, and sand

Revise: Change "a" to read as follows. "Investigate and identify two more ways that Earth's materials can be broken down and/or combined in different ways such as rocks breaking down into gravel and sand, or minerals combining to form rocks."

Inquiry Questions:

Revise: Add Inquiry Question "How do you make responsible choices about resources to use?"

Revise: "How do rocks cycle to form different types of rocks?"

Revise: Add Inquiry Question "How do you make responsible choices about resources to use?"

Revise: Add Inquiry Question "How do you make responsible choices about resources to use?"

Relevance and Application:

Revise: "Extended processes and time are required to convert petroleum to useful products such as gasoline whereas coal and granite are useful after they are mined."

Science Second Grade

Standard: 1. Physical Science

GLE: 1. Changes in speed or direction of motion are caused by forces such as pushes and pulls

Nature Of:

Move: Please create an additional "Nature of Science" standard that incorporates all of the science thinking and skills that are currently housed in the 'Nature of' section of the standards.

Standard: 2. Life Science

GLE: 1. Organisms depend on their habitat's nonliving parts to satisfy their needs

Evidence Outcome: Use evidence to develop a scientific explanation about how organisms depend on their habitat.

Comment: n/a

Evidence Outcome: Assess and provide feedback on other scientific explanations regarding why an organism can survive in its habitat

Revise: delete other scientific explanations

Revise: Assess and provide feedback on other scientific explanations regarding why an organism can survive in its habitat. Delete "other scientific explanations"

Evidence Outcome: Use instruments to make observations about habitat components - for example, data can be collected from a fish tank to assess the environmental health (dissolved oxygen, pH, Nitrogen content).

Revise: Use instruments to make observations about habitat components - for example, data can be collected from a fish tank/local stream/pond to assess the environmental health (dissolved oxygen, pH, Nitrogen content). Add evidence outcome: Design features to make your school yard a suitable habitat for insect life.

Revise: add "...or a local stream or pond" after fish tank - it's important to find ways to get kids outside experiencing and learning from nature directly whenever possible.

Revise: Revise Evidence Outcome B to read: Use instruments to make observations about habitat components - for example, data can be collected from a fish tank to assess the environmental health (dissolved oxygen, pH, Nitrogen content). Add fish tank or local stream/pond

Inquiry Questions:

Revise: Recommendation: Add an Inquiry Question "What makes a habitat healthy?"

Revise: Add an Inquiry Question "What makes a habitat healthy?" and consider what human beings need in their habitat to be healthy.

Revise: add... "What makes a habitat healthy?"

GLE: 2. Each plant or animal has different structures or behaviors that serve different functions

Revise: Recommendation: Add an Inquiry Question in "How are living things interconnected?"

Standard: 3. Earth Systems Science

GLE: 1. Weather and the changing seasons impact the environment and organisms such as humans, plants, and other animals

Evidence Outcome: Analyze and interpret data such as temperatures in different locations (Sun or shade) at different times and seasons as evidence of how organisms and the environment are influenced by the weather and changing seasons

Revise: Insert: Interpret data collected outdoors

Revise: Edit Evidence Outcome B to read: Analyze and interpret data such as temperatures in different locations (Sun or shade) at different times and seasons as evidence of how organisms and the environment are influenced by the weather and changing seasons. Insert: Interpret data collected outdoors

Science First Grade

Standard: 1. Physical Science

GLE: 1. Solids and liquids have unique properties that distinguish them

Evidence Outcome: Classify solids and liquids based on their properties, and justify your choice based on evidence

Revise: Add evidence outcome: specifically about water for example: Explain how Ice and Water are different and impact living things around them.

Comment: Add evidence outcome: specifically about water for example: Explain how Ice and Water are different and impact living things around them.

Nature Of:

Move: Please create an additional "Nature of Science" standard that incorporates all of the science thinking and skills that are currently housed in the 'Nature of' section of the standards.

Standard: 3. Earth Systems Science

GLE: 1. Earth's materials can be compared and classified based on their properties

Evidence Outcome: Make predictions about how a material on Earth might be useful based on its properties

Revise: Add limits on resources for all living things (not just humans)

Evidence Outcome: Analyze the impact of reducing, reusing, and recycling various materials

Revise: Revise: Analyze the impact consumption of earth materials including reducing, reusing, and recycling various materials

Revise: Revise Evidence Outcome F to read: Analyze the impact of consuming earth's materials including reducing, reusing, and recycling various materials

Revise: Revise Evidence Outcome F to read: Analyze the impact consumption of earth materials including reducing, reusing, and recycling various materials

Inquiry Questions:

Revise: 4. How would you redesign the recycling strategy in your school?

Revise: Added Inquiry Question 4. What earth materials could you recycle or reuse at your school? Add Relevance and Application statement "Everyday items are made from natural resources."

Revise: Add Inquiry Question 4. What earth materials could you recycle or reuse at school?

Relevance and Application:

Revise: Add Relevance and Application statement "Everyday items are made from natural resources."

Revise: Add Relevance and Application statement "Everyday items are made from natural resources."

Science Kindergarten

Standard: 1. Physical Science

GLE: 1. Objects can move in a variety of ways that can be described by speed and direction

Inquiry Questions:

Comment: n/a

Relevance and Application:

Comment: n/a

Nature Of:

Move: Please create an additional "Nature of Science" standard that incorporates all of the science thinking and skills that are currently housed in the 'Nature of' section of the standards.

GLE: 2. Objects can be sorted by physical properties, which can be observed and measured

Inquiry Questions:

Revise: Add an Inquiry Question "How do the physical characteristics of something help us make decisions (for example: what type of material to use)?"

Revise: Add an Inquiry Question "How do the physical characteristics of something help us make decisions (for example: what type of material to use)?"

Relevance and Application:

Revise: Add a Relevance and Application statement "The properties of objects can be used to sort items for recycling."

Revise: Add a Relevance and Application statement “The properties of objects can be used to sort items for recycling.”

Standard: 2. Life Science

GLE: 1. Organisms can be described and sorted by their physical characteristics

Evidence Outcome: Communicate and justify an evidence-based scientific rationale for sorting organisms into categories

Revise: Add an Evidence Outcome: “Describe the characteristics of the living and nonliving things around your school.”

Revise: Add an Evidence Outcome: “Describe the characteristics of the living and nonliving things around your school.”

Revise: Add an Evidence Outcome: “Describe the characteristics of the living and nonliving things around your school.”

Standard: 3. Earth Systems Science

GLE: 1. The Sun provides heat and light to Earth

Evidence Outcome: Investigate and communicate the effect of varying heat and light on the growth of plants through a scientific study

Revise: Add Evidence Outcome: Explain that the sun is an energy source for food and all living things.

Revise: Add Evidence Outcome: Explain that the sun is an energy source for all our food, and for nearly all living things.

Comment: Add Evidence Outcome: Explain that the sun is an energy source for food and all living things

Science Preschool

Standard: 1. Physical Science

GLE: 1. Objects have properties and characteristics

(PGC Feedback) Comment: With the P-12 strands for physical, life, and earth systems science it would be extremely helpful for the state to possibly align with NGSS.

Evidence Outcome: Use senses to gather information about objects

Revise: Add "in an outdoor setting"

Revise: add "...in both indoor and outdoor settings."

Revise: Use senses to gather information about objects- Add "in an outdoor setting"

Evidence Outcome: Collect, describe, and record information through discussion, drawings, and charts

Comment: I believe that we should add technology to our objectives. As today's children are digital natives, we need to foster this ability and encourage children to use technology when appropriate. "Students can collect, describe, and record information through discussion, drawings, charts, and technology."

Relevance and Application:

Revise: add both indoors and outdoors.

Comment: Add "technology" to list of scientific tools.

Revise: Use scientific tools such as magnets, magnifying glasses, scales, and rulers in investigations and play. Add Both Indoors and Outdoors

GLE: 2. There are cause-and-effect relationships in everyday experiences

Comment: Add "technology" to list of scientific tools.

Standard: 2. Life Science**GLE: 1. Living things have characteristics and basic needs**

Evidence Outcome: Use senses to gather information about living things

Revise: add "...using local environments, in both indoor and outdoor settings."

Revise: Observe and explore the natural processes of growing, changing, and adapting to the environment.
Add "using local environments"

Evidence Outcome: Observe and explore the natural processes of growing, changing, and adapting to the environment

Revise: using local environments.

Evidence Outcome: Collect, describe, and record information about living things through discussion, drawings, and charts

Revise: Add "in a local environment"

Revise: Collect, describe, and record information about living things through discussion, drawings, and charts: Add "in Local environments"

Standard: 3. Earth Systems Science**GLE: 1. Earth's materials have properties and characteristics that affect how we use those materials**

Revise: Add a verb- Describe or Explain

Evidence Outcome: Use senses to gather information about Earth's materials

Revise: add "...when possible, in an outdoor or natural setting."

Relevance and Application:

Revise: add "...in both indoor and outdoor settings."

GLE: 2. Events such as night, day, the movement of objects in the sky, weather, and seasons have patterns

Revise: Add a verb- describe or explain