

Brian Foley & David Kretschmer
Michael D. Eisner College of Education
California State University Northridge
April 17, 2020

Joe Radabaugh
Governing Board President
La Cañada Unified School District

Dear Mr. Radabaugh,

As per your request, we reviewed the National Geographic curriculum for Grade 1 and the STEMScopes curricula for Grades 2 & 5 that the La Cañada Unified School District (LCUSD) faculty has recommended and the comments from the LCUSD reviewers. Our goal was to see if the concerns outlined in the reviews are at a level where the recommendations should be rejected.

We found that there are in fact a number of mistakes and inconsistencies with the curriculum but neither the amount of mistakes nor the level of errors were at a level that would make the curriculum ineffective. The majority of the mistakes were poorly worded sentences that could easily be fixed in future versions of the curricula. Some of these have already been addressed in the online curriculum. An analysis of the errors that we found is included. We did not attempt to compare this curriculum to others, and we are not claiming this to be the best possible curriculum. What we do find is that the recommended curricula are of sufficient quality to support students' mastery of the Next Generation Science Standards (NGSS) to the level that LCUSD students have done in the past.

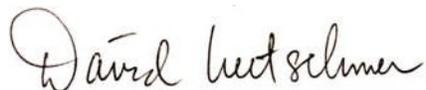
Textbook analysis has a long history, with the majority of studies finding numerous errors are textbooks lacking quality (Tyson-Bernstein, 1989). We are not surprised to find errors in the text, but the concern is that the number of errors in this curriculum might be too high, causing significant damage to students' understanding. In looking at the curriculum we relied on our understanding of science, effective science pedagogy, and the NGSS as well as the literature for evaluating curriculum (Devetak & Vogrinc, 2013). We are also cognizant that textbooks do not stand on their own. Teachers play a critical role in mediating how students learn with the textbooks and presumably are able to mitigate the potential damage of errors in the textbook (Abimbola, & Baba, 1996). In this case, the STEMScopes text is supplemented with a workbook and online activities. These activities provide opportunities for teachers to correct misunderstandings, including those caused by the textbook.

Our analysis of the curriculum showed that there are a number of errors, especially in the STEMScopes curriculum which seems to have had poor editing. But only a few of these errors are very serious and teachers should be able to address them readily in the classroom. With the National Geographic curriculum there were few factual errors, but there are aspects of the curriculum where the chosen activities and examples could be greatly improved. We weigh these concerns against an organized exploration of the topics in the NGSS that utilizes the 5E model of science instruction to create a student-centered science learning experience supported by textbook, notebook and online activities. These results

suggest that the recommended curriculum will be valuable tools for LCUSD science classes, but that teachers must play a key role in helping students interpret and utilize the text effectively.

We conclude that the concerns raised by the reviewers are valid but do not rise to the level at which we would reject the curriculum from being adopted by the District.

Sincerely,



David Kretschmer
Professor, Elementary Education Department
California State University Northridge



Brian Foley
Professor Secondary Education Department
California State University Northridge

April 17, 2020

Report to the LCUSD School Board on the recommendation of science curricula for grades 1 (National Geographic Exploring Science Grade 1, California Edition), 2 and 5 (STEMScopes). This document summarizes our analysis of the curriculum and the reviews of the LCUSD reviewers.

Issues with the National Geographic curriculum

The National Geographic curriculum for grade 1 offers students exposure to a variety of topics relevant to six year old learners. The curriculum closely aligns with the NGSS standards for the grade-level and is consistent with the developmental levels of 6 year olds. Upon review, we did not find serious errors in the information presented. Rather, our evaluation highlighted issues with the articulation of the curriculum across topics and certain examples selected to demonstrate a concept or principle. We believe that the curriculum meets minimum criteria

We do not concur with the review and comments that the National Geographic curriculum has “very little science content.” In fact, the authors have been careful to include content that is not typically addressed in the elementary science curriculum, such as using a science journal and the nature of science. Also, a number of the science activities for students break from a single approach to investigating in the sciences (a standard, “scientific method”). A different interpretation is that the text does not present very good science in the form of appropriate examples. This is a pedagogical issue as is the organization of content. We found many missed opportunities to connect topics in one area of the textbook to other areas. This is problematic. There is little sense of a well-defined scope and sequence to the curriculum.

Details on the National Geographic review for Grade 1 are described below.

Life Science/Plants

P. 28-29: Investigation into Plants and Light – This activity seems premature. Students would benefit from observing a sample of plants in the context of the previous discussion of plant parts. It seems reasonable to introduce the “plant in a box” activity following to investigate different variables on the growth of a plant.

P. 32-33: Life Cycle of a Tomato Plant - Could be done in class with a bean seed, radish seeds, or other plant that has a short life-cycle. This is the second place in the chapter where seeds are discussed, but nowhere in the chapter is discussed what a seed is. Students could observe a lima bean seed soaked overnight in water and then gently dissected with a toothpick to reveal the embryo plant inside the seed.

P. 36-37: Plants can be different. Zinnias was a poor choice as an example of how plants can be different. Text discusses how the flowers look different but all of the plants have the same kinds of leaves. A variety of different flowers would have been a better choice. A minor issue is that what is presented as a single flower is actually a “flower head” or pseudanthium as is a daisy or sunflower (same family).

P. 38-39: How are plants alike and different? (Compare young versus older plants). Students select a plant and observe and compare a young and older sample of the plant. Not much direction here and

question the feasibility in conducting this investigation. Chapter section does not present much information, but extends into an activity in which students select a type of plant to observe and document.

Animal Parts

P. 46-55: Chapter discusses how animals see and hear, grasp, protect, move, and find what they need. Each of these different sections present information seemingly in isolation from other abilities. Text could have made stronger conceptual connection, for example, in a discussion of “animals find what they need.” Text should refer back to animal’s ability to move, see and hear, etc.

P. 60-61: Animal Senses – Why was this not introduced in the discussion about how animals “see and hear.” This is an example of poor articulation of the content of the text.

P. 70. This section begins a discussion of the care that many animals provide their young, a factor important to survival. There is no mention of that as an introduction. This would have been a good opportunity to help children connect with the science they are learning, the lack of which is a common criticism of science curricula – students studying a science that seems to be irrelevant to them, they cannot connect to.

Page 88: What is a type of animal? Students are directed to make observations of young animals and their parents. Directions are to “choose four different types of animals.” What is a “type” of animal? Could this include a jellyfish? An earthworm?

Earth Science

Topics at the start of this chapter look to be addressed in satisfactory fashion – the sun, moon, stars.

P. 124-125: Design a sundial – Here, the text introduces the design of a sundial and quickly moves into a discussion about how the earth spins on its imaginary axis and how this accounts for the movement of the sun across the sky. Is this the only context in which first graders are to understand the movement of the earth? In addition, the text states that “shadows move.” Do children know what a shadow is?

P. 130-131: Citizen science – Important topic, but out of context. This is an articulation issue referred to earlier.

P. 132-133: Make Observations – This came across as a suggested activity, but is actually a good one to tackle in the classroom. Why is this not a topic to be explored in the classroom? There are some many dimensions to studying the seasons – changes to sunrise and sunset time, observing a deciduous tree over the course of a year, tracking changes in temperature across the seasons. Many teachers at the primary level (K-2) have their students keep a calendar that includes weather data.

Physical Science

Waves: Light and sounds.

P. 146-147: Plan and Investigate – Too little direction here and therefore sense of purpose may be lost with students: “Think of things that make sound when they vibrate.”

Light

P. 162-167: Section discusses how light shines through some materials, but other materials block some or all light. Earlier in the text, the notion of shadows was introduced. Why was this not introduced earlier? Or why no connection made to the earlier section on Earth and Space Science?

P. 169-170: Reflecting light - Not a good demonstration of reflected light.

People Communicate

P. 172-173: Text states that “people communicate by talking and writing. They use gestures like nodding and smiling.” Yet the image shows two young boys communicating using cell phones. Not an appropriate example. What about the Deaf and Hard of Hearing? Members of the DHH community use facial expressions and gestures in a formal language called sign language.

Minor errors that do not lead to significant misconceptions

P. 70 - The section on “animals protect” is a misleading. Animals have features that protect them, and many are very protective of their young, but this was not the discussion.

P 116-117: Star patterns - Though the text discusses how “people imagine that stars are connected together to make a pattern”, there is insufficient discussion to indicate that these constellations ARE the imagination of the human mind. Humans have identified the stars in the star pattern (constellation) that they call Orion.

P. 118-119: Stars in the Sky – Text states that “some stars seem to move in the sky.” Most do and this was the observation that early philosophers made of the heavens and the basis for early astronomical theorizing.

P. 126-129: Seasons – Text states that “in some places there are four seasons.” Yes, at times in California it does not seem as though we cycle through the seasons over the course of the year, but we actually do. Seasons are astronomical events and we experience the impact of these occurrences on earth as a change in weather, seasonal temperatures.

P. 144-145: Sound - Simple effective introductory activity. Students stretch a rubber band around a box, predict what will happen when plucked, and then pluck string and observe (see and hear). Minor point, but students are asked to predict outcome of plucking the rubber band. We do not predict in a vacuum without any basis: prior experiences, previous test, etc.

P. 140: While this chapter on physical science suggests that it will entail a study of “waves”, nowhere in the chapter are light and sound as waves discussed.

Issues with the STEMScopes curricula:

The district reviewers raised a number of concerns about the STEMScopes curriculum for grades 2 & 5 and a few issues with the National Geographic curriculum for 1st grade. We concur with the reviewers on a number of these cases. The curricula includes STEMScopedia (Grade 2, 86 pages, Grade 5, 123 pages) and the Student Notebook (Grade 2, 375 pages, Grade 5, 462 pages) and the online materials. We identified a total of 8 errors in the text that we describe as serious (giving students incorrect ideas about science concepts or phenomena). You never want to see these errors in a textbook, but unfortunately they are not unknown.

We made no effort to assess the source of the errors. It is likely that in many cases these are due to poor editing rather than misunderstanding of the science. The key question is how damaging are these errors to students' developing understanding. Some errors are likely to cause more damage than others. For example, the error that plants only need sunlight and water to grow (STEMScopes Grade 2 p. 66) can lead to a misunderstanding of the role of carbon dioxide, which later can interfere with learning about global warming and the role of plants in reducing greenhouse gases. This is a serious error. However, stating that low tides occur when the moon is away from your side of the earth (STEMScopes Grade 5 Notebook, p. 403) is incorrect, but there are no further implications of this wrong statement. Thus we rate this as a minor error.

Also the addition of the online curriculum allows some mistakes to be corrected before another book is published. For example, there is a serious error with dissolving sugar into water. The textbook (STEMScopes Grade 5 p. 11) says that the volume of the water/sugar combination will be the added volume of the original ingredients (should have said "mass" instead of "volume"). This mistake is not repeated in the online version of this activity.

Our categorization of issues identified by the LCUSD reviewers:

- **Serious Science Errors** – errors that are incorrect and can encourage students to develop misconceptions.
- **Minor errors that do not lead to significant misconceptions** – many of these are caused by statements that need qualification (e.g. Mammals give live birth)
- **Awkwardly worded but not incorrect** - poorly written statements that are not technically wrong but could be improved
- **Scientific simplifications appropriate for grade level** – some variations from the scientific cannon are intentional because they are better understood in a simple form at lower grades.
- **Sloppy editing** – Errors in spelling, grammar, incorrect data or wording that is obviously wrong and should have been corrected in editing.

In addition to the errors that were identified in the texts, there are more holistic concerns about the curriculum that need to be addressed. There were several concerns voiced by the reviewers about STEMScopes that the curriculum is below grade level, that it presents science in a sexist way and that the STEMScopes materials are poorly written and poorly edited.

With regard to the level of the materials, we find that both the Grade 2 and Grade 5 curricula follow closely with the California Science Framework (CDE, 2016) using all the same learning segments and many of the same examples. There are only a few occasions where the STEMScopes Curriculum goes beyond the standards for the grade level. For example, in Grade 5, STEMScopes includes discussion of evidence of chemical changes (p.23) which goes beyond the 5th grade standard. However these examples are relatively few. The Standards are intended to be the minimum that should be taught to all students, not a limit. Teachers need to understand that some students will be able to go beyond what is in the text and to supplement with additional materials.

We did not find evidence to support the concern that the text was sexist. We see numerous examples of girls and women engaged in science successfully.

We do find evidence that the STEMScopes curricula was poorly edited. Numerous examples of mistakes and obvious errors suggest that the text was put together quickly without proper care for accuracy and coherence. These errors are likely to be fixed in later editions of the text and even sooner with the online curriculum. These mistakes are unfortunate, but would not be enough to overrule the recommendations of the faculty who felt this curriculum best fit their needs.

Details on the STEMScopes review for both Grade 2 and 5 are described below.

Serious Science Errors

Grade 2 STEMScopes

P. 31-35 – Building Blocks of Matter

This chapter relates to the following second grade standard:

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.

The standard represents a developmental step to understanding basic chemistry principles, atoms, molecules, compounds, through more of an engineering design approach. Text goes into other areas not implied by the standard, such as gravity, balance, and shape. Curriculum could make a simple yet direct connection to atoms and molecules without taxing little minds.

P. 66 – What do plants need to grow? Text lists ONLY two needs: sunlight and water. We know from the research on children’s ideas in science that even college level students do not fully understand that the mass of a plant is the result of chemical processes that pack carbon molecules tightly together. Plants need CO₂.

P. 79 – Every Habitat Must be Balanced

Text states that “If the habitat is not balanced, the organisms living there could die or grow too large for their environment.” This is simply not true.

Grade 5 STEMScopes

From STEMScopidia Text

P. 6 –“Emphasize to your child that even though the dough is gooey and easy to mold, it is still a solid.” Pizza dough (assumed to be malleable) is a mixture of solids and liquids. Once the water evaporates then it would be a solid (pizza crust).

P.11 - “Stir 50 mL of sugar or salt into 200 mL of warm water. ... What is the volume of liquid in the container? It should be 250 mL, because the matter has been conserved, even though the solid seemed to disappear.” This is both factually wrong and misleading. It suggests that the volume of water/sugar is conserved rather than the mass of the water/sugar. Note, this mistake is not repeated in the online curriculum (Explore 1: Activity – Where is the Sugar?).

P. 11 – “Now it is time to weigh the filled bowl. Remember, if you had six different ingredients in the mix or salad, then you will have 750 mL in the bowl.” The text says to weigh the mixture, but then uses the units of volume (mL) instead of grams. While this is likely an editing mistake, it is too egregious to ignore.

P. 79 - “We need, therefore, to save as much fresh water as we can so there is enough for future generations.” This gives the impression that water is a limited resource that can be saved for years instead of a resource that cycles throughout the earth. Saving water is important for the current and near future, but it will not impact future generations.

From Student Notebook

P. 98 - “Even though it might be warm inside the house, the window will be cold. The window allows warm air from inside the house to move to the colder air outdoors. This leaves the glass feeling cold.” This gives the impression that warm air is going through the window (the phrase “move to” is ambiguous but the vision of warm air moving to cold seems clear). In fact the outside air cools the glass which then cools the inside air near the window.

Minor errors that do not lead to significant misconceptions

Grade 2 STEMScopes

P. 27 – Heavy and light, short and long are relative terms and the image of objects considered to be light and heavy is misleading. A brick is light when compared to a truck, a beach ball is heavy when compared to a grain of sand. Text confuses mass and weight, and though certainly related (weight is a function of mass and gravitational pull), we have to be careful how we teach about mass. Students have been shown to confuse mass and volume as well, thinking that an object with more mass (heavier) takes up more space (Labinowicz, 1979).

P. 48 – What Do You Think? Text implies that all volcanic eruptions spew lava. Picture is of Mount Saint Helens which did not spew lava. It was a pyroclastic eruption. This section could have contrasted the Hawaiian eruptions that do spew lava.

P. 51-56 – Slow Changes to Land (Weathering and Erosion)

Chapter states that “Weathering, erosion, and deposition are happening all over the world. They often happen at about the same time. These processes are so slow, it takes many years to notice a change in the land.” This statement is not always true when it comes to erosion. Some erosion events happen very quickly such as the debris flow in Montecito.

P. 80 – Connecting with your child. Text states that soil is not living. This is an overstatement. Soil (not dirt!) has bacteria and fungi growing in it. Yes, there are many non-living ingredients in soil, but soil also contains many living organisms.

Grade 5 STEMScopes

From STEMScopidia Text

P. 11. “How can we prove matter is conserved?” As the reviewers point out, it is not possible to prove a statement like this. Text should have said “How can we *demonstrate* that matter is conserved?”

P. 39. “When the zebra dies, a decomposer, such as a dung beetle, will break its body down.” The statement about decomposers is correct, but dung beetles are not an example of a decomposer.

P. 97 – “Astronauts aboard a spacecraft have to adapt to the weak force of gravity.” Astronauts do have to adapt to a low-gravity environment, but this is due to the motion of the spacecraft in orbit and not the lack of gravitational force. The correct explanation is beyond 5th grade standards, so we categorize this as minor (changing the language to low-gravity environment would be preferred).

P. 101 – Earth makes one complete rotation on its axis every 23 hours and 56 minutes, which is rounded to 24 hours.” The length of the day is intentionally longer than the rotation to account for the movement of earth around the sun (it is the length of the sun returning to the position in the sky). This has nothing to do with rounding.

P. 109 - “The farther away a star is from Earth, the smaller it will appear.” Human eyes can only perceive the difference in brightness, not the apparent size.

P. 111 - “Rank the stars in order from brightest to dimmest when viewed from Earth.” This activity asks students to rank stars on their brightness and only gives information on distance – which is correlated but not the same as brightness. If the text had asked students to “predict” the brightness it would be a fine activity. Elsewhere the text references the brightness of a star relates to the distance “even though the farther start may actually be the brightest.” This is not well explained. Some stars appear brighter than

other stars that are closer. These nuances are not a critical distinction for 5th graders, but see much opportunity for improvement in this section.

p.121 – [Glossary] “Chemical reaction - a property or characteristic of a substance that is observed or measured during a reaction in which the chemical composition or identity of the substance is changed.” We find this definition to be nonsensical. A chemical reaction is a process.

From Student Notebook

P. 293 - “Acid rain did not exist until the Industrial Revolution” Natural sources for acid rain (e.g. volcanos) predated the Industrial Revolution.

P. 403 – “When the moon is not facing our part of the Earth, its pull is not as strong. That is when low tides occur.” This is vague enough not to be wrong but it implies that the side of the earth away from the moon has low tides. In fact high tides occur on the side of the earth facing the moon and the opposite side of the planet simultaneously. This is a serious mistake, but there are no significant implications of this misconception.

Scientific simplifications appropriate for grade level

Grade 2 STEMScopes

P. 39-43 – Change of State

Smooth water is misleading and not sure if a property of liquid water is smooth. We can talk about the smooth surface of a lake or a gently flowing river, but not of water resulting from melting ice cubes.

One of the concerns expressed about this chapter related to the idea that melted butter that is allowed to harden (become a solid) is not a reversible change. However, the standard states that cooling butter into a solid is an example of a reversible change:

2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures

We think that these examples of simple reversible and non-reversible changes of state are appropriate for the second grade.

P. 42-43 - Connecting With Your Child – This is the first introduction to gasses in this chapter on changes of state and does not really address gasses as representing a “state.” It is really about the kinetic energy of gasses. The activity references “particles” which could have been addressed in the earlier chapter on the building blocks of matter.

Grade 5 STEMScopes

From STEMScopidia Text

P. 17 - “Ability to conduct thermal energy or electric energy.” Reviewers objected to the term “thermal energy” in favor of the term “heat” which is generally used in thermodynamics. There is actually quite a bit of research on this specific term with different researchers arguing both sides (Lewis, & Linn, 1994;

2003; Wiser, & Amin, 2001; Pushkin, 1996). A strong case can be made that the term “thermal energy” is easier for students to use in context.

P 22 - “You cannot change rust back into iron.” This is a widely used example on an irreversible reaction. However it is true that scientists have found a way to recover iron from iron oxide (aka rust). This is not a true reversal of the process. These details are too complex for elementary students. We feel this is stated correctly.

P. 97 - “The farther an object is from the center of Earth, the weaker the force of gravity is.” This is correct for any object above the surface of the earth (including on top of a mountain). An object in a deep hole would actually experience less gravitational force.

From Student Notebook

P. 365 – [Analogy of magnetic force to gravitational force] One reviewer did not feel this analogy was appropriate given the differences between magnetism (bipolar) and gravitation (unipolar). We disagree. The modeling of forces at a distance and the reduction of force over distance and the ability of forces to act in many directions at once are all important parts of understanding gravity. The similarities make this a productive analogy for students.

Awkwardly worded but not incorrect

Grade 2 STEMScopes

P. 45 – 50 - Quick Changes to Land

The text uses “dirt” in some places and “soil” in another. Author/s need to be consistent. There are many definitions of “dirt” and only one is in reference to earth or soil. Dirt has a different connotation than soil (see also page 59).

P. 67 – Text asks “What do plants need to drink?” The idea that plants “drink” is misleading. We usually think of drinking as a conscientious process that we do not attribute to plants.

P. 72 – Text states that “Other plants use gravity and hope that their seeds fall in a good area to grow in.” This is an example of anthropocentric reasoning. Plants do not “hope.”

Grade 5 STEMScopes

From STEMScopidia Text

P. 3 - “The particles of matter are too small to see, but they are still there. You would need a microscope to see them!” The text does not specify what particles they are talking about. But then goes on to discuss molecules which are too small to be seen, even with a microscope.

P. 10 - “Heating something will cause the particles to move faster and farther apart. They can move so fast and far apart that you cannot see the substance anymore!” Technically this is correct – all substances

will turn to gas at a high enough temperature. But for some substances the temperature is thousands of degrees, outside of people's experience.

P. 15 - "Most cake recipes include flour and sugar to make the cake fluffy and sweet." The flour does not contribute to the fluffiness or sweetness of cakes.

P. 23 - "When food is cooked, there is a temperature change." Seems to imply a backwards causality.

P. 95 - "Gravity is a force that pulls every object toward the center of Earth." This is true of the Earth's gravity, but not of gravity in general.

P. 98 - Proposed comparing dropping a ping pong ball to a golf ball. This is likely to result in the observation that the golf ball falls faster. But there is no discussion of air resistance, possibly leading to a misconception about gravity. In the online curriculum this is replaced with a different activity.

Sloppy editing

Grade 2 STEMScopes

P. 28 - Text refers to the sneakers on page 2 but they are actually on page 26.

P. 29 - Connecting with Your Child

In principle, these are great ways for children and parents to connect around the science curriculum. They add an educational element to outings, online searches for information, etc. However, some of the excursions are unrealistic, such as taking your child to a national park. The suggested activity on page 62 is reasonable and quite a good activity for children and their families.

P. 71 - Text refers to a very poor picture example of a habitat and asks what else besides identified organisms live there? It is difficult to tell the various features of the habitat. Just not a good pictorial example. A different picture shows a hummingbird sipping nectar from a flower in the context of a discussion about pollination, yet does not show the hummingbird as taking pollen away from the flower.

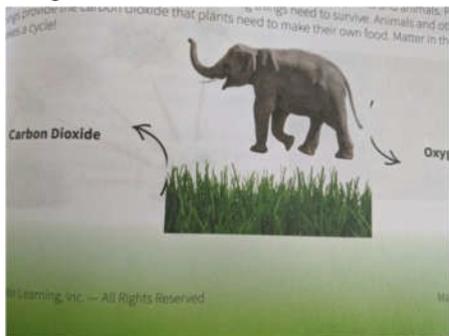
Grade 5 STEMScopes

From STEMScopidia Text

P. 4 - "All states of matter are made up of tiny particles..." Should read "matter in any state is made up of tiny particles" [was stated correctly a few sentences before]

P. 32 - "Wrap aluminum foil around the outside of your soda bottle to ensure the health of your plant". We were puzzled by this too, but found an explanation on <https://www.epicgardening.com/hydroponics-for-kids>. "If you don't cover the bottom of the 2 liter bottle with something opaque, light will get in and your garden will start growing algae in the water reservoir - no good! Aluminum foil helps to block out the light." It should be explained.

P. 53 – Strange picture with arrows going in strange, and wrong, directions. Oxygen should come from the grass and carbon dioxide from the elephant.



P. 97 – ““We know an object high in the air will be pulled to the ground by gravity.” Objects are pulled towards the ground by gravity, but not necessarily to the ground.

P. 109 - “There are probably billions and billions of stars in the universe.” There are undoubtedly many more than that. Estimates put the number at 10^{21} stars (more than a billion billions).

P. 110 - “A light-year is equal to about 5,878,499,810,000 miles, or 9,500,000,000,000 km.” Numbers should be rounded equivalently.

P. 111 – Table shows distance in light years “Betelgeuse – 1,400”. However the actual distance is about 640 light years. (repeated in the Notebook P. 423)

P. 117 - “When the whole surface of the Moon is visible to us on Earth, it is called a full moon.” Only half of the moon’s surface is visible.

P. 122 – [Glossary] “Apparent brightness” was not listed in alphabetical order.

STEMScopes Notebook

P. 345 - “Earth provides all the things that living plants and animals need.” This is incorrect (sunlight is needed for living things) but such an obvious error that we attribute this to editing. A 5th grader should be able to catch the mistake.

Summary of Findings

We found that there are in fact a number of mistakes and inconsistencies with the curriculum but neither the amount of mistakes nor the level of errors were at a level that would make the curriculum ineffective. The majority of the mistakes were poorly worded sentences that could easily be fixed in future versions of the curricula. Some of these have already been addressed in the online curriculum. An analysis of the errors that we found is included. We did not attempt to compare this curriculum to others, and we are not

claiming this to be the best possible curriculum. What we do find is that the recommended curricula are of sufficient quality to support students' mastery of the Next Generation Science Standards (NGSS) to the level that LCUSD students have done in the past.

Our analysis of the curriculum showed that there are a number of errors, especially in the STEMScopes curriculum which seems to have had poor editing. But only a few of these errors are very serious and teachers should be able to address them readily in the classroom. With the National Geographic curriculum there were few factual errors, but there are aspects of the curriculum where the chosen activities and examples could be greatly improved. We weigh these concerns against an organized exploration of the topics in the NGSS that utilizes the 5E model of science instruction to create a student-centered science learning experience supported by textbook, notebook and online activities. These results suggest that the recommended curriculum will be valuable tools for LCUSD science classes, but that teachers must play a key role in helping students interpret and utilize the text effectively.

We conclude that the concerns raised by the reviewers are valid, but do not rise to the level at which we would reject the curriculum from being adopted by the district.

Dr. David Kretschmer
Professor, Elementary Education Department
California State University Northridge

Dr. Brian Foley
Professor, Secondary Education Department
California State University Northridge

March 16, 2020

References

Abimbola, I. O., & Baba, S. (1996). Misconceptions & alternative conceptions in science textbooks: The role of teachers as filters. *The American Biology Teacher*, 14-19.

<https://www.jstor.org/stable/4450067?seq=1>

California Department of Education (CDE, 2016) *2016 Science Framework for California Public Schools*, Adopted by the California State Board of Education on November 3, 2016.

<https://www.cde.ca.gov/ci/sc/cf/cascienceframework2016.asp>

Devetak, I., & Vogrinc, J. (2013). The criteria for evaluating the quality of the science textbooks. In *Critical analysis of science textbooks* (pp. 3-15). Springer, Dordrecht.

https://link.springer.com/chapter/10.1007/978-94-007-4168-3_1

Labinowicz, E. (1980). *The Piaget Primer: Thinking, Learning, Teaching*. Boston: Addison-Wesley.

Lewis, E. L., & Linn, M. C. (1994). Heat energy and temperature concepts of adolescents, adults, and experts: Implications for curricular improvements. *Journal of Research in Science Teaching*, 31(6), 657-677.

Lewis, E. L., & Linn, M. C. (2003). Heat Energy and Temperature Concepts of Adolescents, Adults, and Experts: Implications for Curricular Improvements. *Journal of Research in Science Teaching*, 40.

Pushkin, D. B. (1996). A comment on the need to use scientific terminology appropriately in conception studies. *Journal of Research in Science Teaching*, 33(2), 223-224.

Tyson-Bernstein, H. (1989). Textbook development in the United States: How good ideas become bad textbooks. In Farrell & Heynemann (Eds.) *Textbooks in the Developing World*, p. 72-87.

Wiser, M., & Amin, T. (2001). "Is heat hot?" Inducing conceptual change by integrating everyday and scientific perspectives on thermal phenomena. *Learning and Instruction*, 11(4-5), 331-355.