

Data Review Committee
Report and Recommendations from Feedback Regarding
Draft 2 of Proposed 2023 K-12 Science Standards
April, 2023
Office of Academic Standards/K-12 Science

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Introduction

In February, 2022, the NC State Board of Education approved the [North Carolina Standard Course of Study - Internal Procedures Manual](#). The manual outlines specific procedures for the review, revision, and implementation of each content area's standard course of study. The manual was revised in April, 2023.

The manual provides that the review and revision phases should each take one year to complete with each content area using a five-to-seven-year cycle for the review, revision, and implementation of the standards. Delays in initiating the review of the K-12 Science Standards required a blended approach and a consolidated timeline for the review and revision phases, with both phases being completed within a year. The review and revisions phases for the Science Standards were conducted prior to the April 2023 revisions being approved and therefore followed guidance from the February 2022 version up to that time..

The review process is designed to ensure clear, rigorous, and measurable standards that are easily understood by teachers, parents, and students, and are articulated K-12 by grade, proficiency level, and/or course. The review phase began in the Spring and early Summer of 2022 and included:

- Collecting and reviewing feedback through various methods from stakeholders, including but not limited to educators, administrators, parents, community members, students, institutions of higher education, business/industry, education agencies in other states and/or national organizations for the specific content area.
- Analyzing contemporary and current research on standards in the content area being reviewed.

In July and August of 2022, staff from across the NC Department of Public Instruction (NCDPI) utilized a blind application and screening process to establish a Data Review Committee (DRC). The DRC had representatives from all eight State Board regions and consisted of classroom teachers, instructional coaches, district leaders, and members from institutes of higher education.

In September of 2022 the DRC convened to review and analyze the feedback collected through interviews, focus groups, and surveys. The DRC analyzed all data points looking for trends or themes in the data, and completed a final report with recommendations for revisions to the 2009 standards. DRC members used a data reporting template to organize data and corresponding recommendations. This report was provided to the Standards Writing Team (SWT) which began the first part of the revision phase in early October of 2022.

The first draft of the proposed 2023 K-12 Science Standards was released on November 17, 2022 for stakeholder and individual public school unit (PSU) feedback. Stakeholder and PSU surveys were open for thirty days and closed on December 18, 2022. Per the NCSCOS Internal Manual, an Advisory Team consisting of classroom teachers, district leaders, and members of post-secondary institutions also provided feedback during this same window of time. The

Advisory Team utilized a rubric provided to them from the NCSCOS Internal manual to share broad feedback on the proposed 2023 standards.

As required by the NCSCOS Internal Manual, the DRC was reconvened in January 2023 to review and analyze feedback from the stakeholder and PSU surveys regarding the first draft of proposed 2023 K-12 Science Standards. To support the DRC, the raw data from both surveys was shared with the NCDPI Office of Learning Recovery which provided quantitative and qualitative analysis of the feedback as well as the feedback provided by the members of the Advisory Team.

DRC analysis and recommendations were finalized in a report that was shared with the SWT in February of 2023. The report was used to make revisions and complete a second draft of 2023 proposed K-12 Science standards. That draft was released for public comment and input on February 23, 2023 and remained open until March 26, 2023. Per the NCSCOS Internal Manual, the release of the 2nd Draft of Proposed 2023 K-12 Science Standards included a single survey to collect comment and input from all stakeholders. There was not a separate survey specific to PSUs.

Per the NCSCOS Internal Manual, the DRC was reconvened in April, 2023 to review and analyze feedback from the stakeholder and PSU surveys regarding the second draft of proposed 2023 K-12 Science Standards. This report contains the DRC's conclusions and recommendations based on the most recent survey data. To support the DRC, the raw data from the survey was shared with the NCDPI Office of Learning Recovery which provided quantitative and qualitative analysis of the feedback.

How to read/use this report:

This report is set up based on the methods and approaches utilized to gather feedback from stakeholders across North Carolina. The report is separated into sections aligned to qualitative and quantitative data gathered through responses and comments shared within the Draft 2 surveys.

The first section, methodology, provides an overview of how data was gathered. It provides an explanation of how the data was analyzed and prepared for review. The actual data, and initial analysis, are found in the second section. DRC members used this information and then determined conclusions and recommendations for additional revisions and writing of a third draft of proposed 2023 K-12 Science Standards. The information in these sections was prepared ahead of time through collaboration between the Office of Academic Standards and the Office of Learning Recovery.

The final two sections (Conclusions and Recommendations) were completed by the DRC team members.

The Scope of Work/The Task

The DRC followed the prescribed steps outlined in the NC Standard Course of Study Procedures Manual. The DRC reviewed the extensive data collected through Draft 2 All Stakeholder survey. In grade bands (or course) groups, the DRC compiled their recommendations for the Standards Writing Team. This could include which standards or objectives the data indicates should be kept with no changes, when some standards or objectives should be removed, as well as when standards or objectives need additional modifications.

Methodology for Data Collection

Previous releases of surveys intended to gather feedback regarding the 2009 K-12 Science Standards and the first draft of the proposed 2023 K-12 Science Survey included the use of two surveys, one specific to PSUs and one for all stakeholders. The surveys were designed to solicit feedback for each objective.

Per the NCSCOS Internal Manual, the release of the 2nd Draft of Proposed 2023 K-12 Science Standards included a single survey available to all stakeholders. This survey posed a series of ten questions covering the standards and objectives for each grade level/course as a whole. Participants were also able to provide general comments for each grade level/course. The survey was released on February 23rd and closed on March 26th.

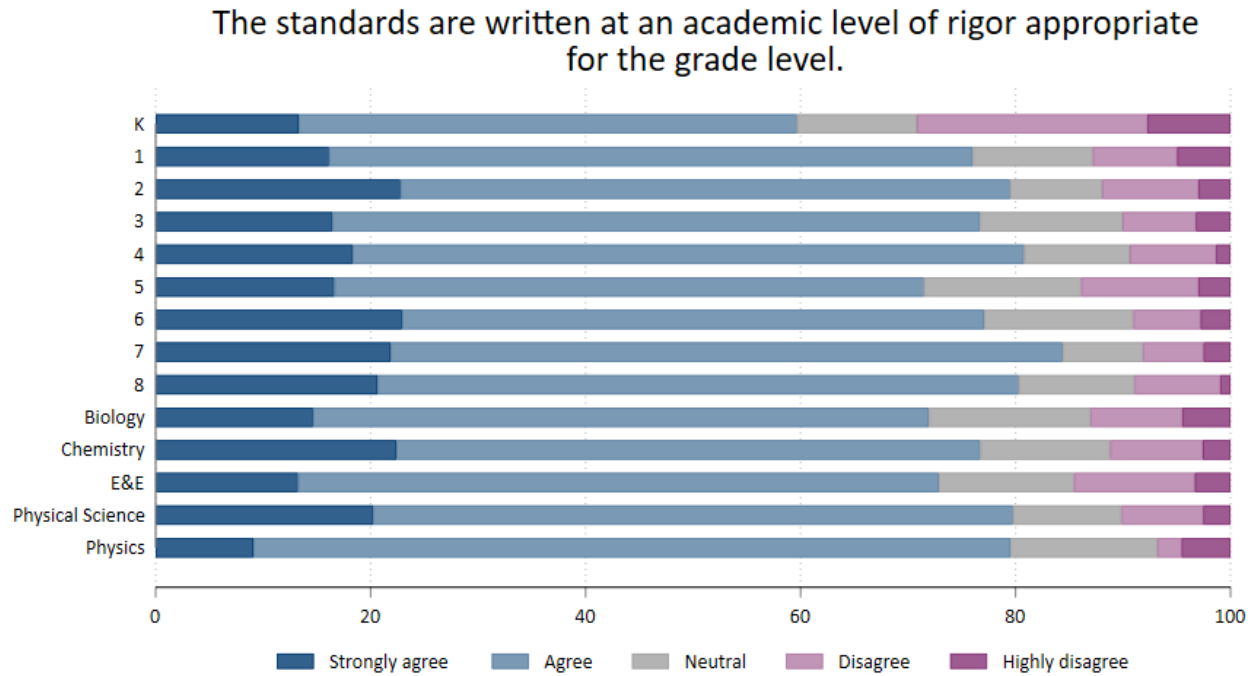
Data Results

Following its analysis of the raw data, the Office of Learning Recovery provided the following graphic representation of the data. Each of the following bar graphs represents the percentage of respondents who responded by rating their level of agreement to that guiding question. All grade levels/contents had the same ten guiding questions.

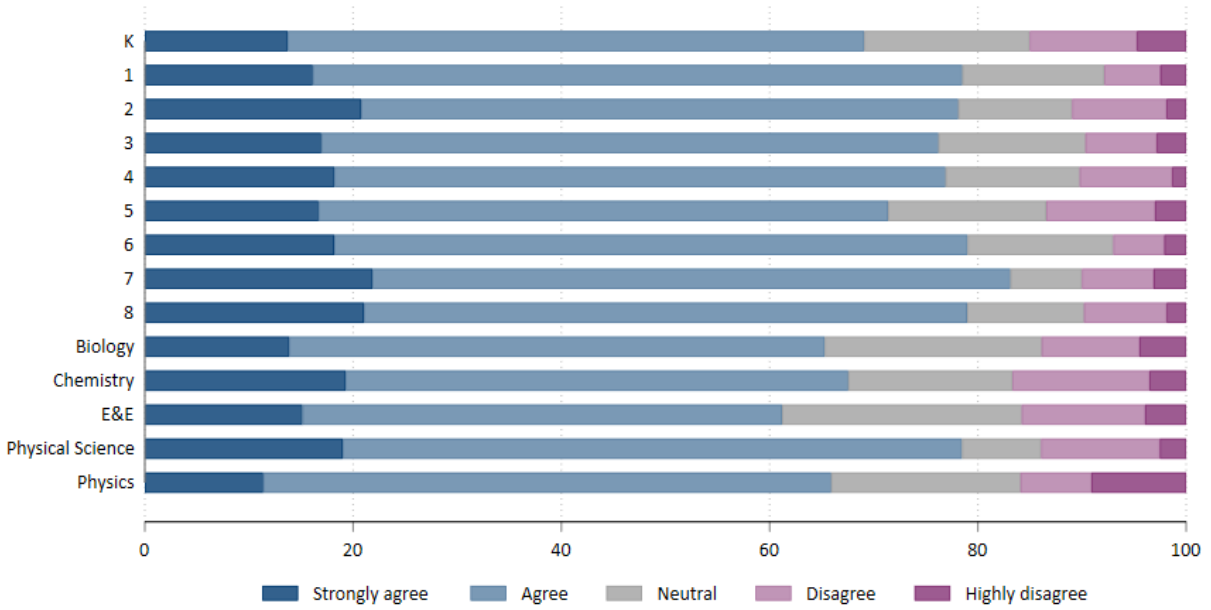
The graphs are presented in the same order the questions were presented in the survey. The spreadsheet with the detailed responses and comments is linked in the [Appendix](#) of this report.

Quantitative Findings for Draft 2 of the Proposed 2023 K-12 Science Standards

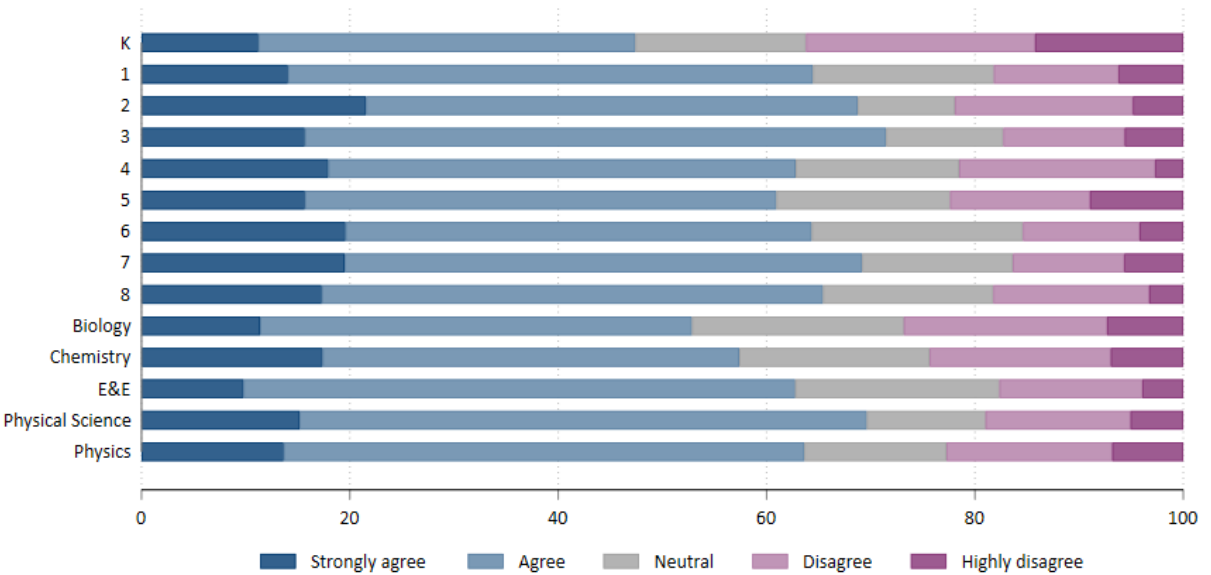
The Draft 2 of Proposed K-12 2023 Science Standards survey was organized into sections by grade and high school course. Within each section participants rated their level agreement to ten questions. The same ten questions were for each section. The NCDPI Office of Learning Recovery provided the charts below to visually summarize the quantitative results per grade/course for each question. The charts are shown in the order of the questions posed within the survey.



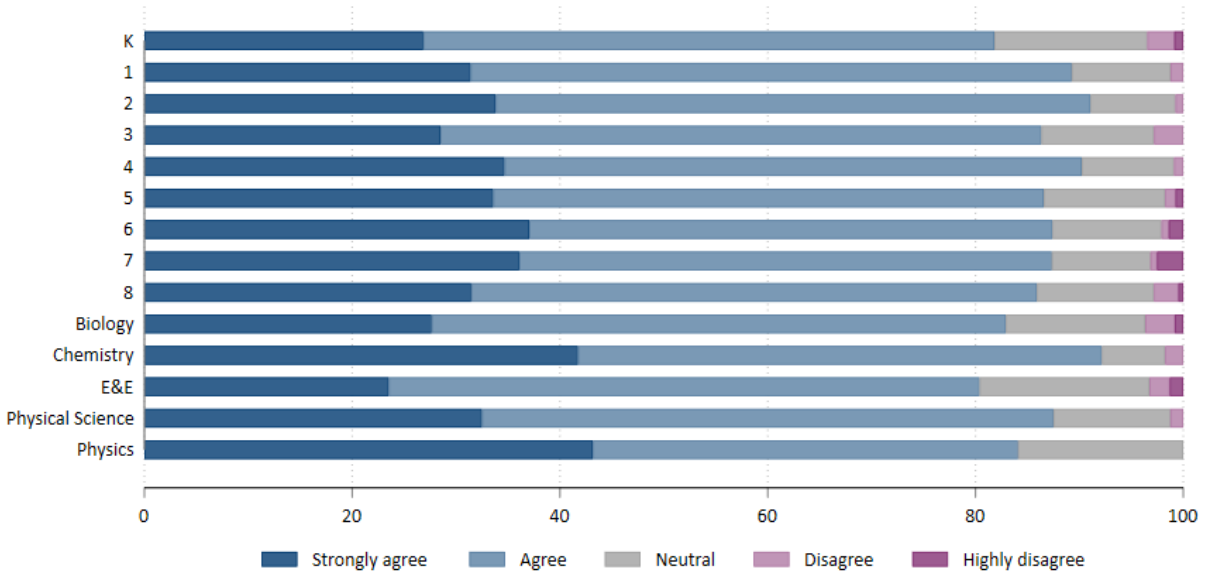
The standards demonstrate appropriate depth and complexity.



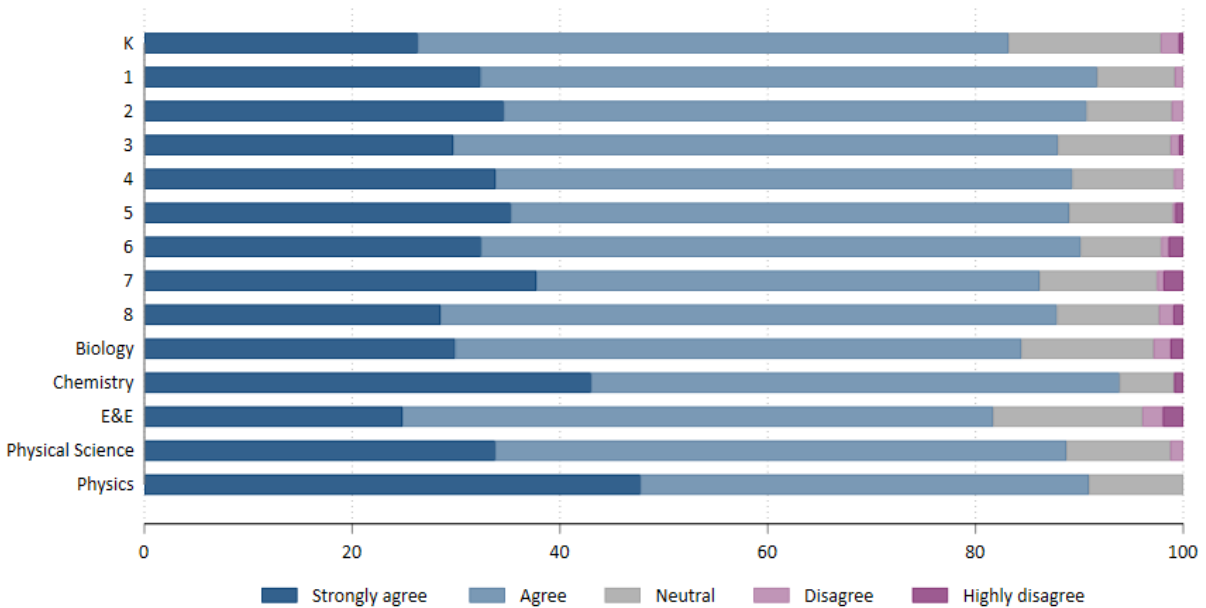
The standards are written clearly and concisely for a variety of audiences parents teachers community members students etc.



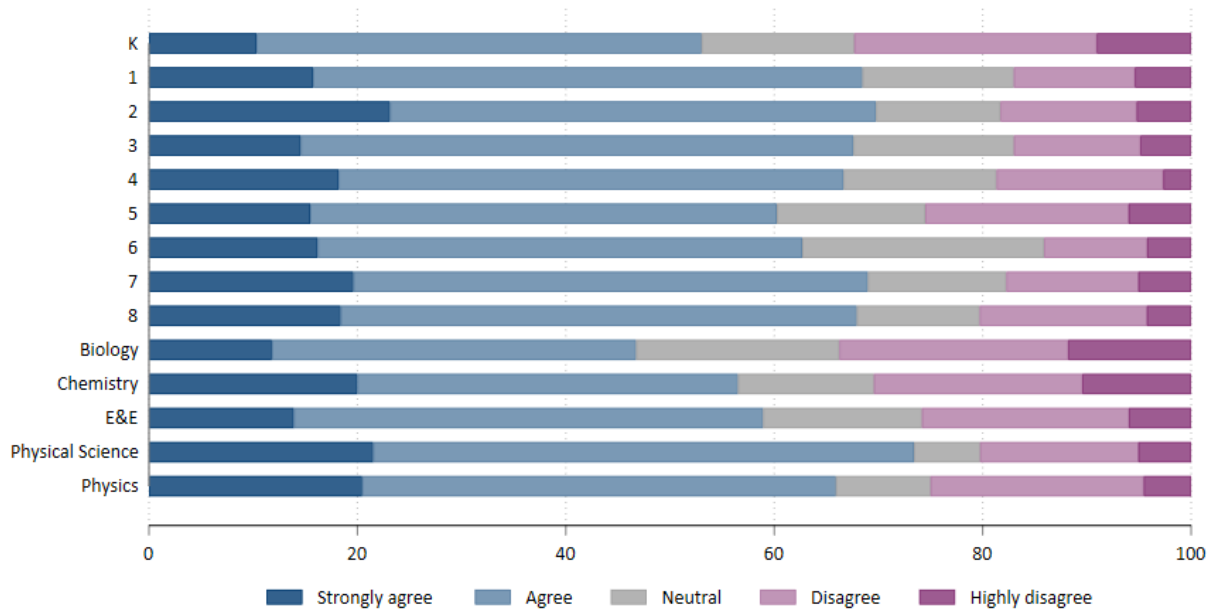
The standards are impartial and free of discrimination on the basis of gender ethnicity and or disability.



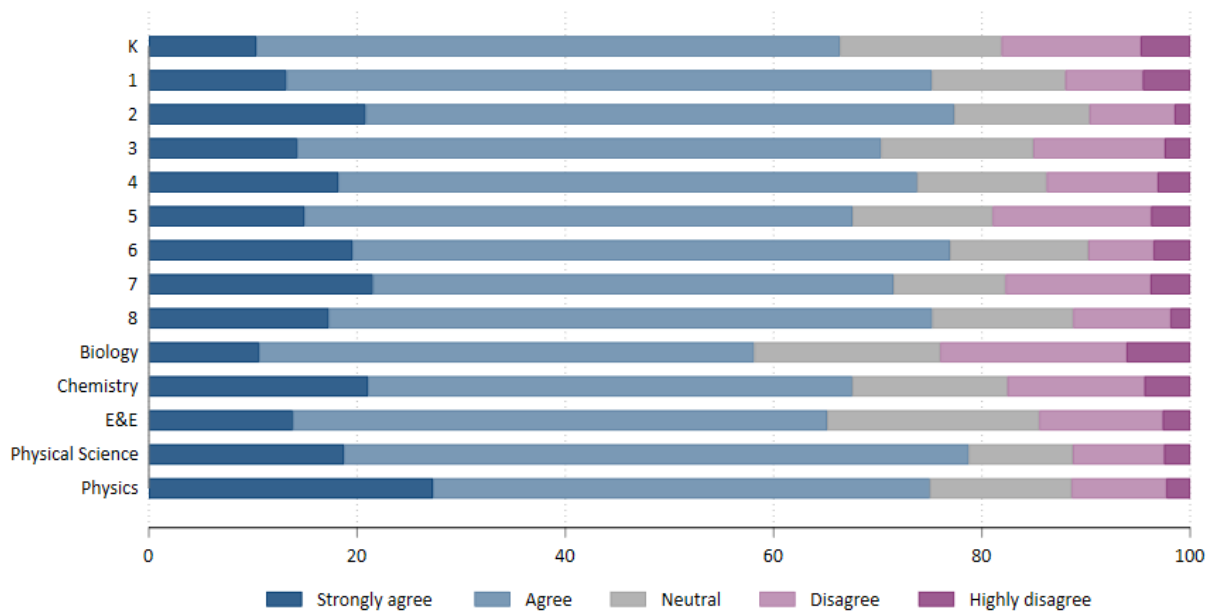
The standards are free of language that might be culturally insensitive.



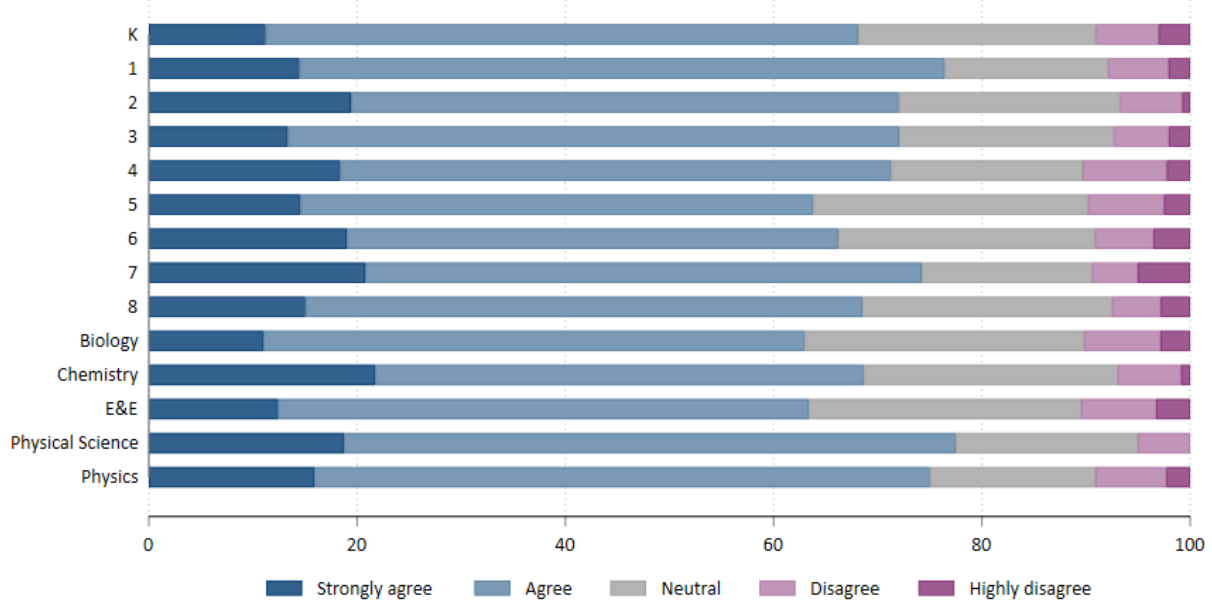
The standards are free of ambiguity and confusion.



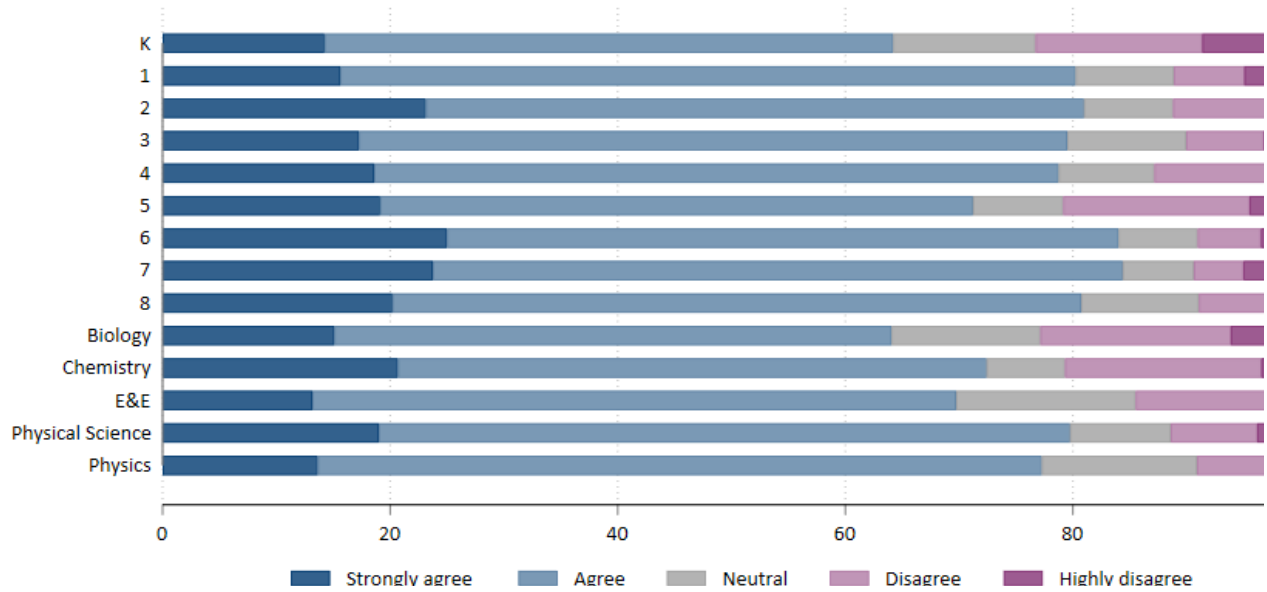
The standards are observable and measurable.



The standards progress appropriately across grades and or courses.



The standards are clear statements of what the student should be able to do or understand.



Qualitative Findings

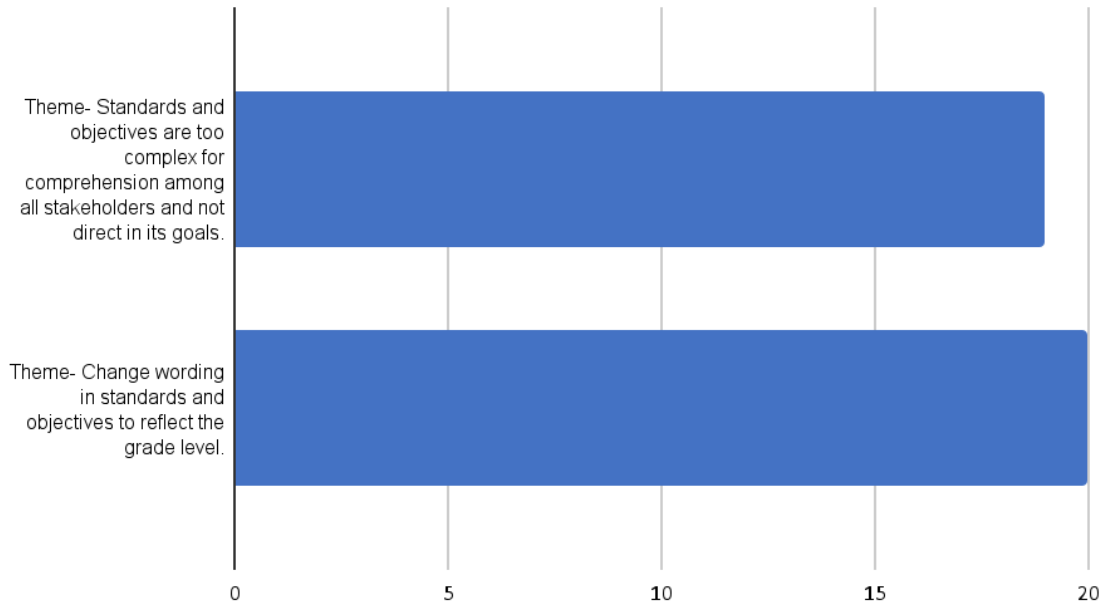
Qualitative analysis was provided under the direction of the Office of Learning Recovery, with the assistance from an interning qualitative analyst. The 2nd Draft of Proposed 2023 K-12 Science Standards survey contained 10 questions with each grade level/course having an additional question asking the participant to rate their overall satisfaction. Participants were then provided an open ended question at the end of each grade/course to provide any general concerns, insights, and comments.

All comments received through the survey were reviewed to identify key qualitative themes for each grade level/course. In order to focus on areas for potential refinement or improvement, an emphasis in the qualitative review was placed on comments received from participants who responded with concerns or additional edits and suggested improvements. DRC members had access to, and reviewed, all comments provided by participants.

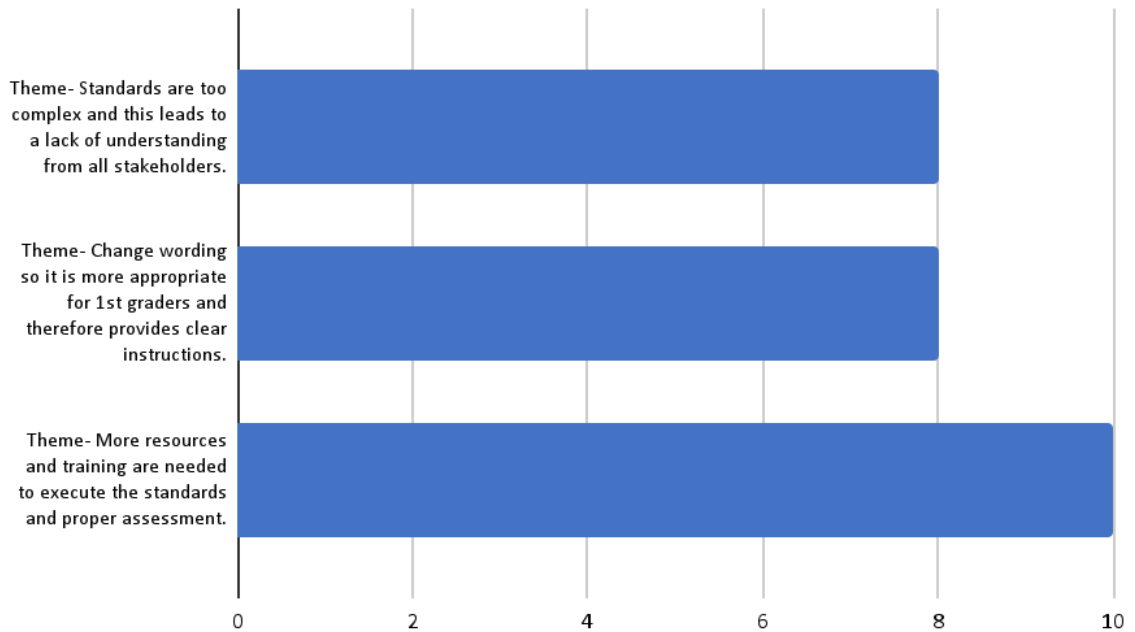
The charts are presented in grade level order from Kindergarten through Eighth grade and then alphabetically for high school courses. . The charts show the most commonly identified theme or themes within each grade level/course among respondents who expressed concerns or disagreement. For some grade levels or courses only one major theme was identified from the comments submitted. DRC members reviewed all comments to support their conclusions and recommendations

All comments provided by participants can be found in [Appendix A.1](#) (All Stakeholder Standard-by-Standard Survey Raw Data). The comments utilized for the charts below can be found in [Appendix B](#) (Draft 2 Qualitative Review).

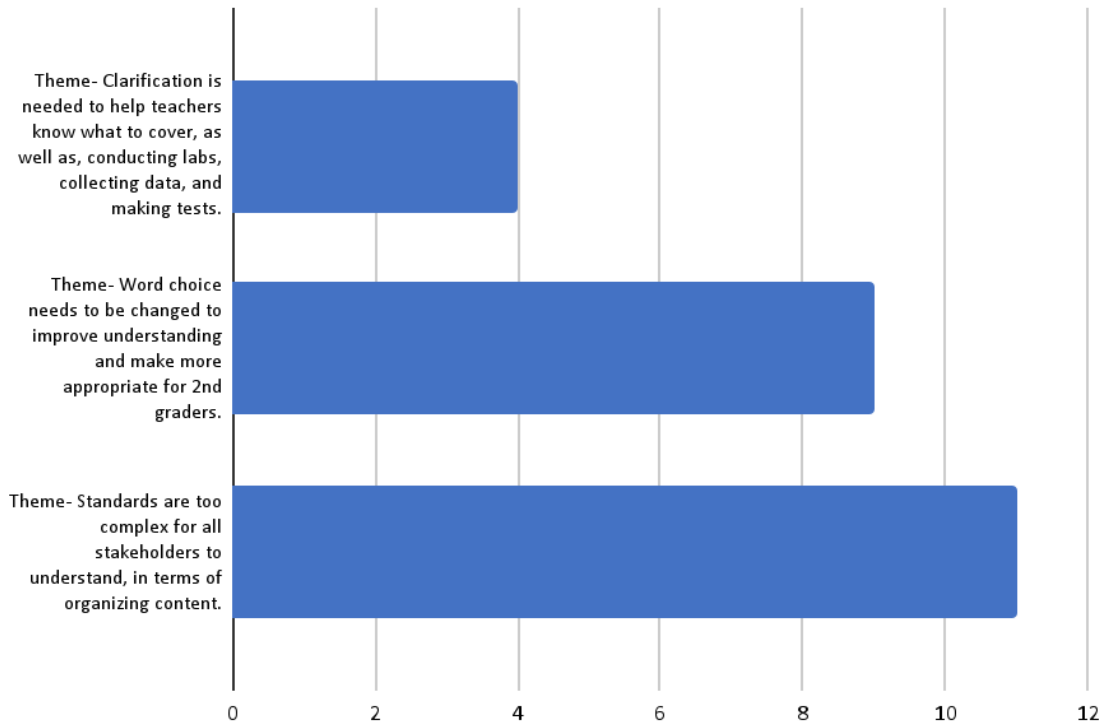
Kindergarten



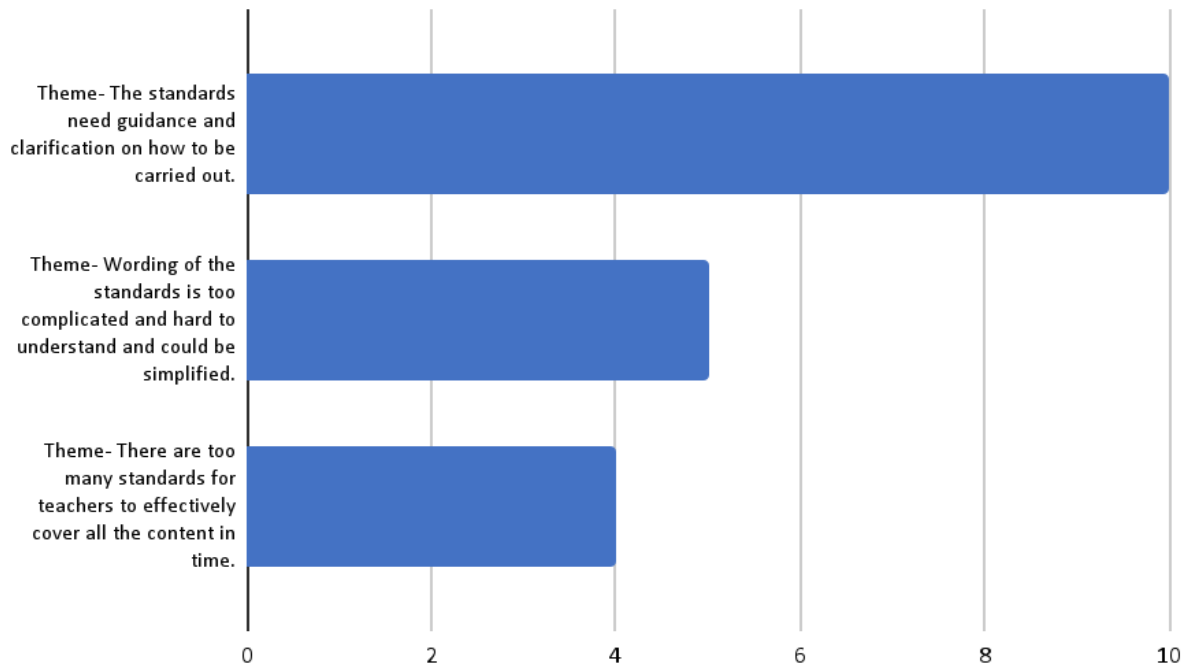
First Grade



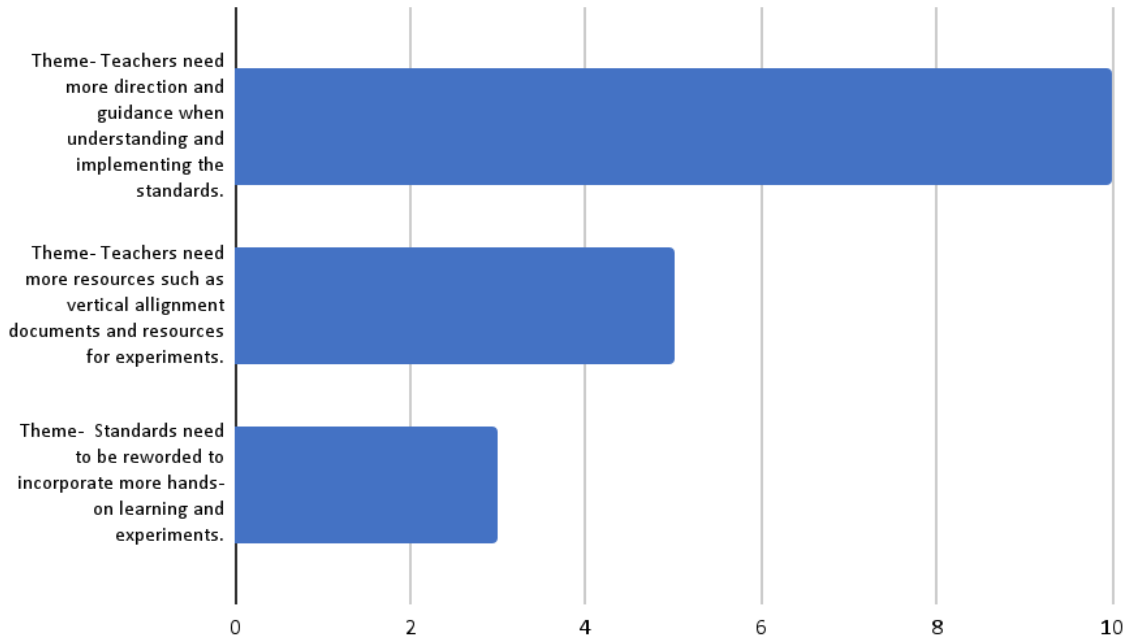
Second Grade



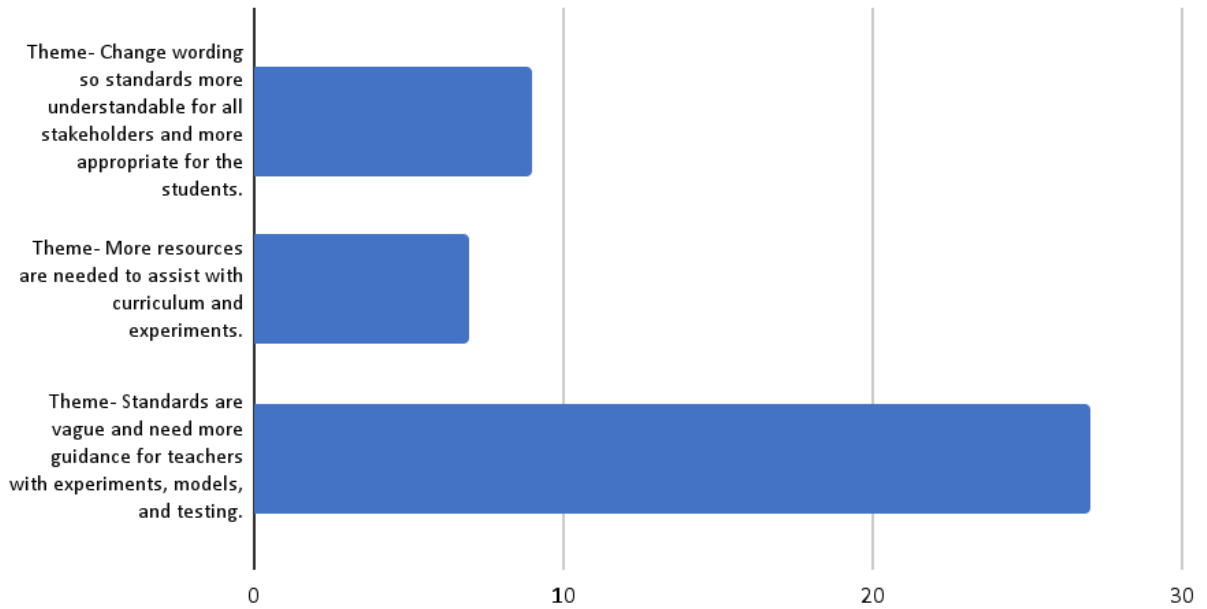
Third Grade



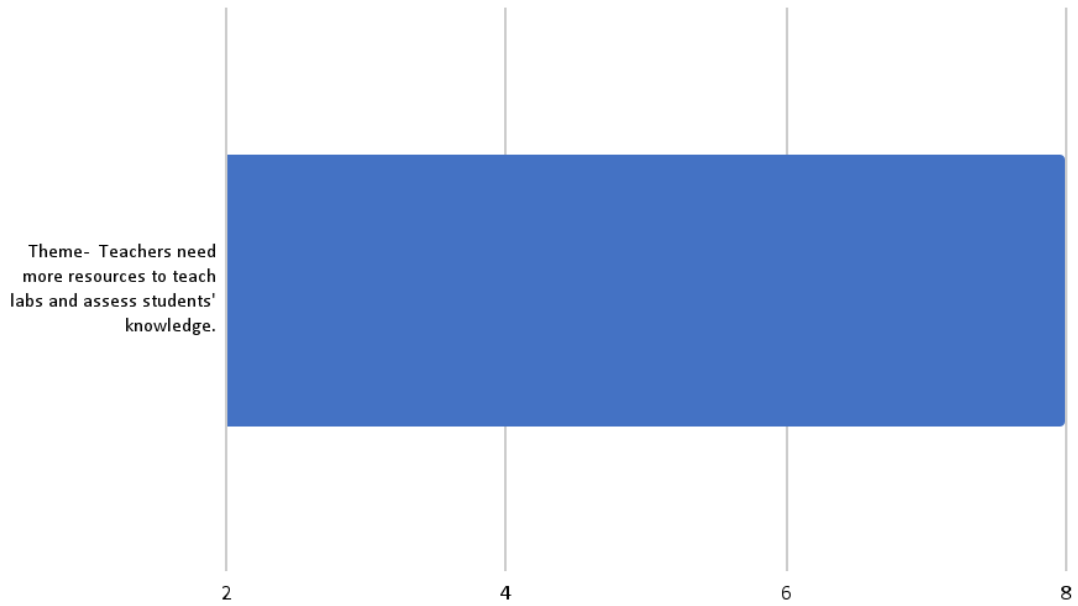
Fourth Grade



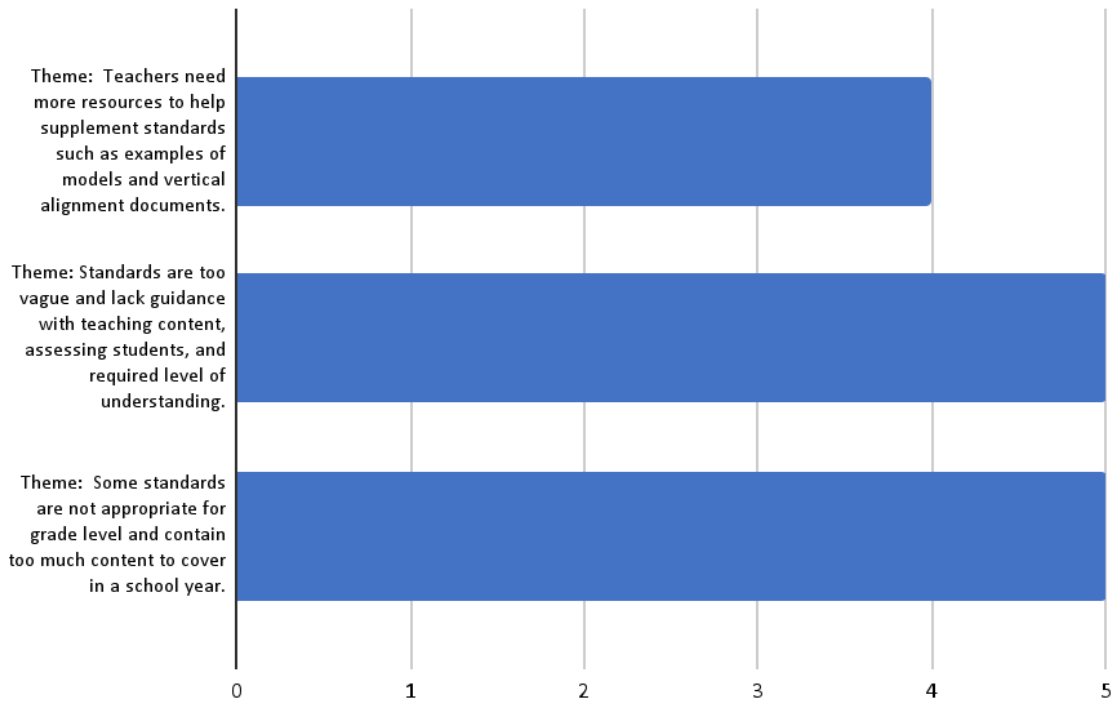
Fifth Grade



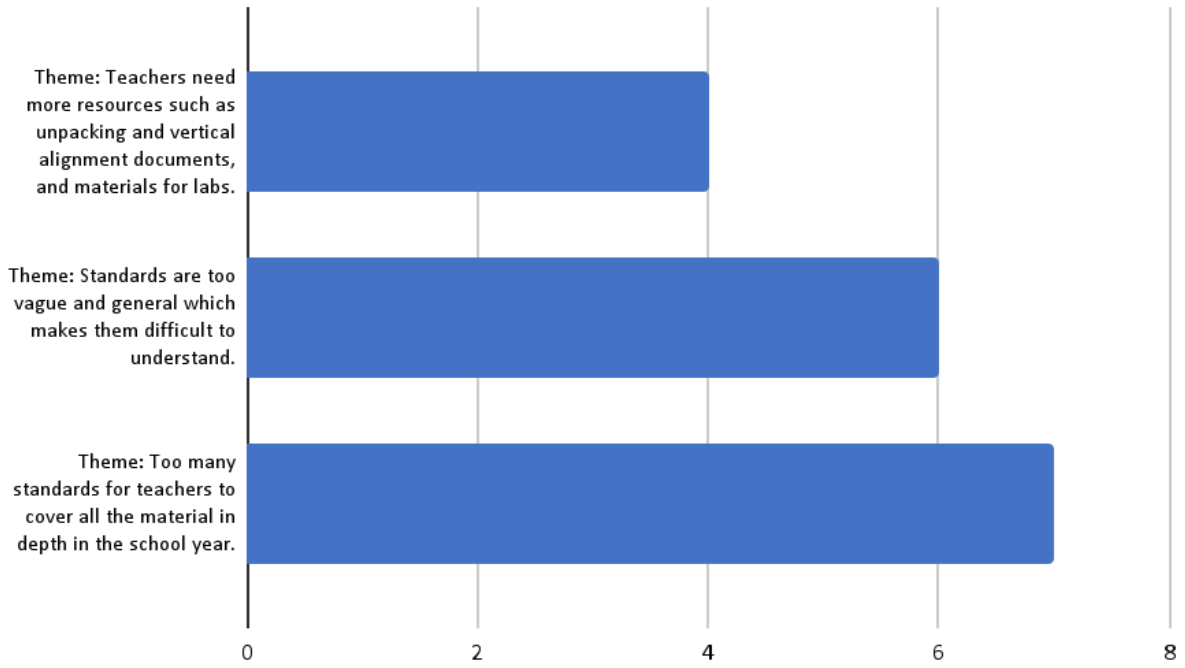
Sixth Grade



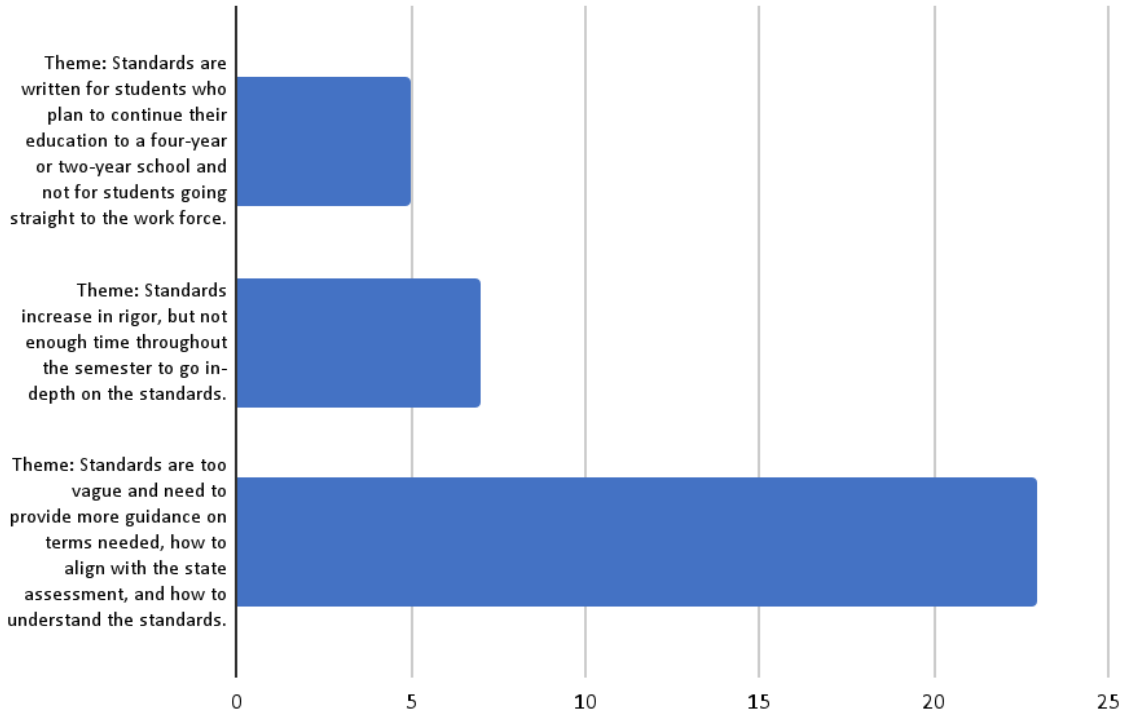
Seventh Grade



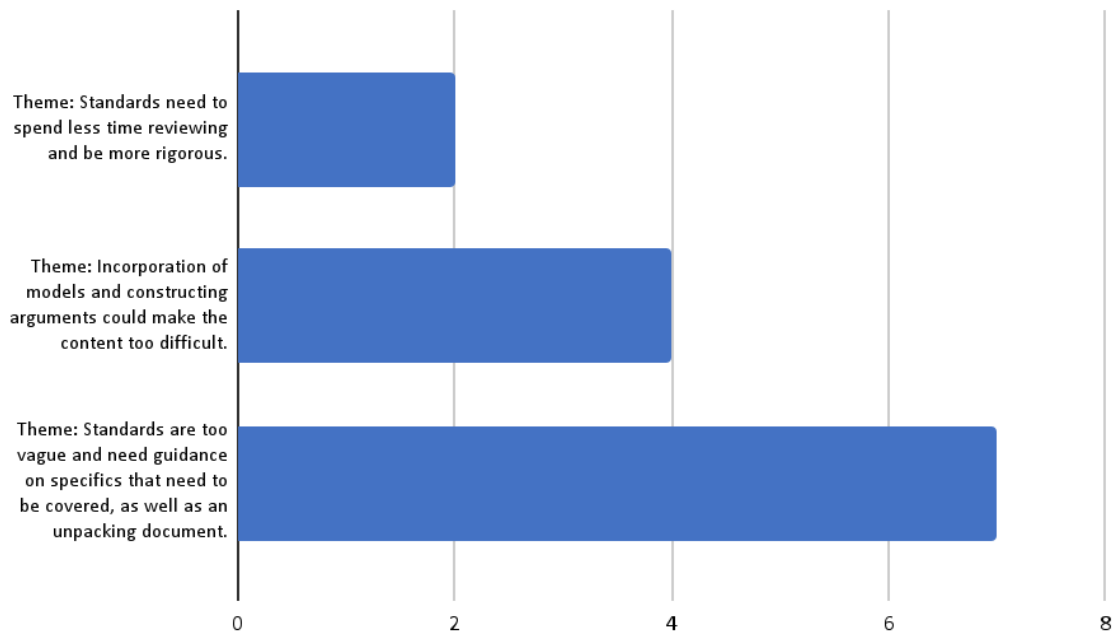
Eighth Grade



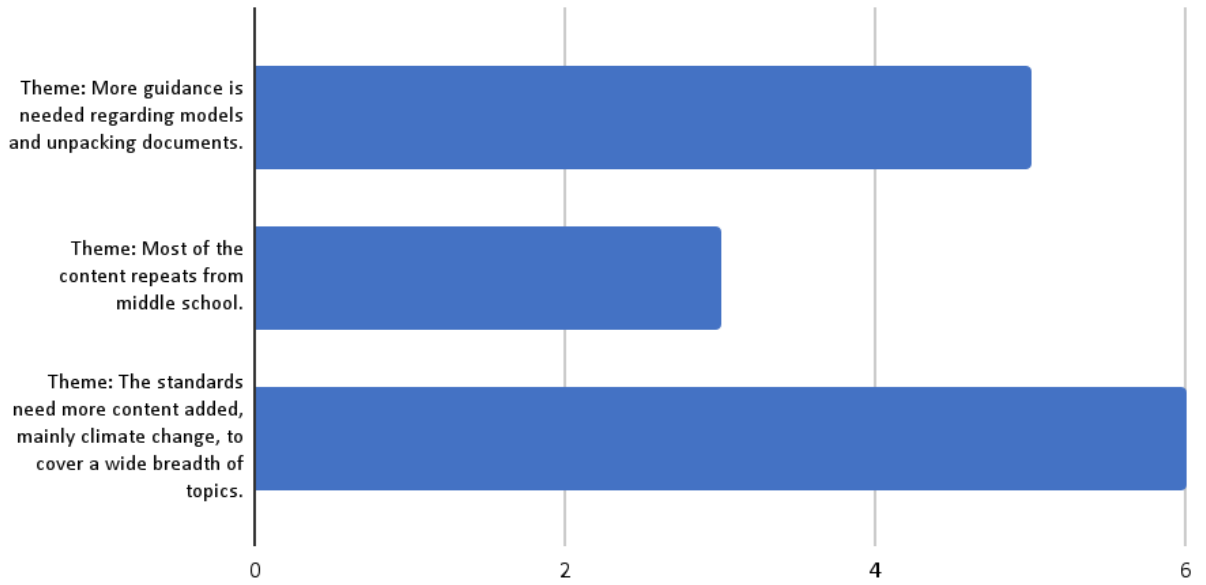
Biology



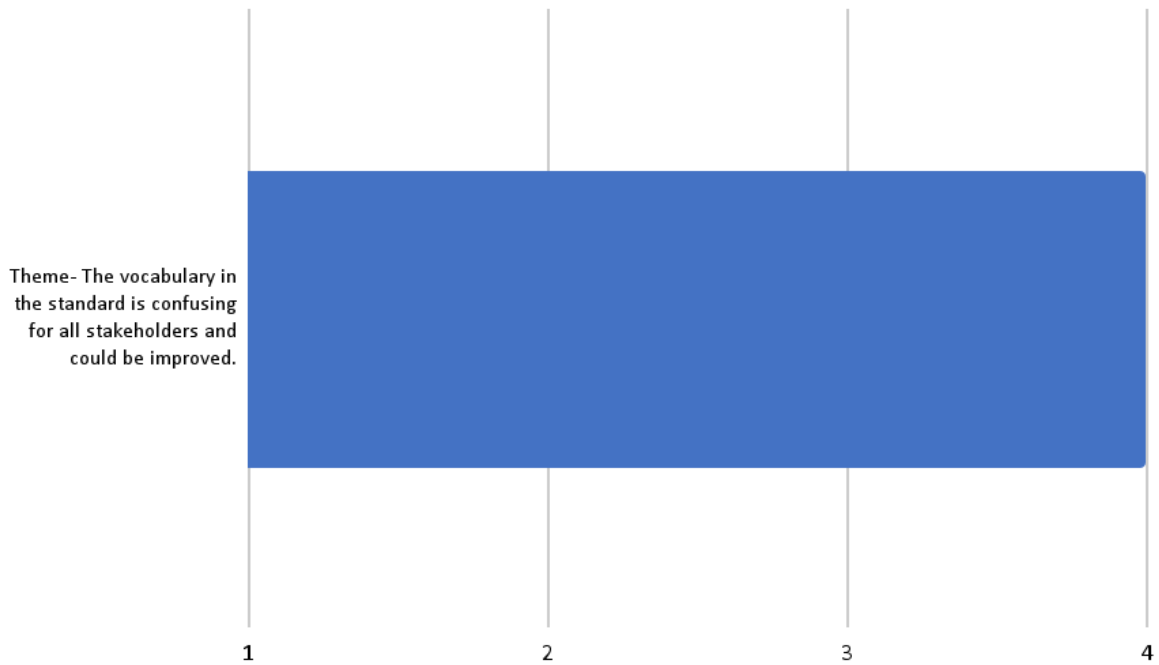
Chemistry



Earth/Environmental Science



Physical Science



Physics

Theme- A couple of the standards are vague and could use clarification.

1

2

3



Data Review Committee Recommendations

The following Data Review Committee recommendations provide a high level review of the suggestions made for each course, or grade level, within the K-12 Science Standard Course of Study. The recommendations were completed by the Data Review Committee members after their extensive review of feedback and input for each standard and objective. The specific standard-by-standard suggestions can be found in the next section of this report.

K-2

Thank you to the writing committee for taking our recommendations, research, findings, and conclusions into consideration during this revision process.

The major concerns expressed in the stakeholder feedback survey regarding Draft 2 of the proposed K-2 science standards are as follows: (1) Stakeholders need more direction and guidance to support their understanding of the standards, specifically the SEPs (2) Stakeholders expressed the need for resources including support documents and classroom resources and materials (3) Concerns were raised that the academic language currently being used is not accessible to all stakeholders

Mostly minor changes are needed for the wording of some objectives and the Science and Engineering Practices (e.g., singular/plural) are needed. Two objectives need revision.

Kindergarten

- Engage in an argument from evidence to summarize the characteristics of living organisms and nonliving things in terms of their: structure, growth, changes, movement, basic needs.(Minor)
- Obtain, evaluate and communicate information to compare characteristics of animals.(Minor)
- Analyze and interpret data to compare plants according to their features. (Minor)

First Grade:

- Obtain, evaluate and communicate information to summarize how the needs of different plants and animals can be met in their environment. (Minor)
- Analyze and interpret data to compare the basic needs (including air, water, nutrients, and light) of plants and animals in different environments.(Minor)
- Carry out an investigation to compare the properties of soil from different places relating their capacity to retain water, provide nutrients, and support the growth of certain plants.(Minor)
- Use a model to illustrate the relationship between the needs of different plants and animals (including humans) and the places they live. (Revisions)
- Engage in argument from evidence to explain ways that humans can protect natural resources in the environment.(Revisions)

Second Grade:

- Engage in argument from evidence to summarize ways in which animals closely resemble their parents and ways they are different. (Minor)
- Analyze and interpret data to illustrate variations among individual organisms that are related. (Minor)

- Obtain, evaluate, and communicate information to generalize how energy from the sun serves as a source of light that warms the land, air, and water.(Minor)

DRC Recommendations:

SUPPORT DOCUMENTS:

- Stakeholders have asked that Information in the support documents include detailed examples of the SEPs.
- Stakeholders have asked for the inclusion of critical vocabulary and description of proficiency for measurable outcomes in the support documents.
- Stakeholders have asked for boundary statements in the support documents.
- Create a support document for parents explaining the SEPs

PROFESSIONAL LEARNING:

- There is a need for high quality professional learning on the Scientific & Engineering Practices in order to support teachers with instructional practices including sample of formative assessment.
- District leaders need professional development and informational sessions to ensure proper vertical curriculum alignment and verbiage used during teacher training.

3rd-5th Grade

The major concerns expressed in the stakeholder feedback survey regarding Draft 2 of the proposed 3-5 science standards are as follows: (1) Stakeholders need more direction and guidance to support their understanding of the standards, specifically the SEPs (2) Stakeholders expressed the need for resources including support documents and classroom resources and materials (3) Stakeholders expressed a need for guidance when implementing the standards.

Changes to the wording of some objectives and the Science and Engineering Practices are needed. Two fifth grade standards require minor content revisions.

Fifth Grade:

- Use mathematics and computational thinking to explain the relationship between speed, distance and time.(Content)
- Construct an argument with evidence to **infer** the effects that may result from the interconnected relationships of plants and animals to their ecosystem. (SEP)
- Engage in an argument from evidence to explain the ocean's influences on weather (temperature, wind, and precipitation) and climate. (Content)

Fourth Grade:

- Carry out investigations to identify how objects with an electrostatic charge push or pull on other objects to produce motion.(Language)
- Ask questions to **identify** basic forms of energy (light, sound, heat, electrical, and magnetic) as an ability to cause motion or create change. (Language)
- Construct an argument to **explain** that plants and animals have internal and external structures that function to support survival, growth, repair, reproduction, and behavior.(SEP)
- Construct an argument to **explain** how differences among animals of the same population sometimes gives individuals an advantage in surviving and reproducing in changing habitats. (SEP)
- Construct an argument to **explain** how differences among animals of the same population sometimes gives individuals an advantage in surviving and reproducing in changing habitats. (SEP)
- Use models to **explain** changes in Earth's surface over time (to include slow changes of erosion and weathering, and fast changes of earthquakes, landslides, and volcanic activity).(Language)
- Use a model based on observations to **explain** the repeating pattern of the phases of the moon (new, crescent, quarter, gibbous, and full).(Language)
- Construct an argument to **explain** how humans can adapt their behavior to live in changing environments (e.g. recycling wastes, establishing rain gardens, planting native species to prevent flooding and erosion).(SEP).

Third Grade

- Obtain, evaluate, and communicate information to **explain** how energy can be transferred from a warmer object to a cooler one by contact or at a distance and the cooler object gets warmer.(Language)
- Analyze and interpret data from maps to **compare** Earth's saltwater and freshwater features (including oceans, seas, rivers, lakes, ponds, streams, and glaciers).(SEP)

Minor changes include ensuring that the SEP language is similar throughout (e.g. all singular or plural).

DRC Recommendations:

SUPPORT DOCUMENTS:

- Stakeholders have asked that Information in the support documents include detailed examples of the SEPs
- Stakeholders have asked for the inclusion of critical vocabulary in the support documents.
- Stakeholders have asked for boundary statements in the support documents.

PROFESSIONAL LEARNING:

- There is a need for high quality professional learning on the Scientific & Engineering Practices in order to support teachers with instructional practices including assessment.

6th-8th Grade

Based on the positive stakeholder feedback and limited changes that are recommended for the proposed 2023 Grades 6-8 Standards, the Data Review Committee (DRC) would like to thank the Grades 6-8 Science Writing Team (SWT) for their diligent and thoughtful work in taking all recommendations into account as they drafted the standards.

Overall, stakeholder feedback was very supportive of the proposed standards changes and supported the move to more rigor and inclusion of science process skills. However, a few concerns were voiced by many stakeholders. These major concerns expressed in the stakeholder feedback survey regarding Draft 2 of the proposed Grades 6-8 standards include the following: (1) many standards are very wordy and difficult for all stakeholders to clearly comprehend what mastery of the standard will demonstrated or assessed, (2) standards show increase in rigor but the breadth of the content raises concerns over lack of time to fully meet the intent of the standard, and (3) there is much ambiguity over what resources will be needed to comply with the new standards and how these resources will be acquired, (4) many concerns over the need for high quality support documents and professional development to make the pedagogical shift.

Other Concerns of Note

- Conflict between SEP and objective verbs
- Vertical alignment
 - A lot of overlap between 5th and 6th grades and between 8th grade and Earth Science
 - Include specific vocabulary words for each level
- Specifics on the type of model for each objective (i.e. mathematical, graphical, physical, etc)
- Use of “develop an argument” when the goal is for a specific conclusion to be reached. Suggestions include modifying this to “citing observation and evidence”
- How to measure or assess mastery (example: providing a common rubric for evaluating an argument)
- Concern that objectives may be interpreted differently in different districts or schools
- The amount of content may be challenging for schools on semester or other nontraditional scheduling options

SUPPORT DOCUMENTS

Unpacking documents for the new units should include parameters for each objective (to include required vocabulary and limits on depth of content knowledge goals). Examples of applicable model types, product rubrics, and assessment examples should be included for each objective.

PROFESSIONAL LEARNING:

- Stakeholder qualitative feedback offered insight into the need for high quality professional learning around the Scientific & Engineering Practices (SEP) in order to support successful classroom instruction. A state-level developed module on implementation of the SEP would ensure equitable access to quality professional support for all teachers across the state.

Biology

Based on the positive stakeholder feedback and limited changes that are recommended for the proposed 2023 Biology Standards, the Data Review Committee (DRC) would like to thank the Biology Science Writing Team (SWT) for their diligent and thoughtful work in taking all recommendations into account as they drafted the standards.

The major concerns expressed in the stakeholder feedback survey regarding Draft 2 of the proposed Biology standards are as follows: (1) standards are not written for the average student, (2) standards show increase in rigor but there isn't enough time in a semester to address the depth and rigor, and (3) the standards are vague and stakeholders need more guidance and clarification on what is expected as well as how these new standards will be assessed through the End-of-Course (EOC) test for Biology.

Some of the above concerns will be addressed by various teams of professionals after the standards are approved by the NC State Board of Education; most notably, concerns regarding alignment of the standards and the EOC as well as depth of clarity and support provided through the supporting documents.

RIGOR:

Stakeholders raised concern with the increased rigor of the current draft. The DRC review of other state standards found that the proposed 2023 Biology Standards are equivalent in rigor. In addition, the DRC found that much of the concern for the increased rigor stems from the incorporation of Science & Engineering Practice (SEP) skills alongside content. Science & Engineering Practice skills support the critical thinking and communication needs of students who are either pursuing a post secondary education or entering the workforce. Additionally, all NC high school students are expected to meet benchmark performance on the ACT Science exam, an exam which includes those same skills of: (1) Interpretation of Data, (2) Scientific Investigation, and (3) Evaluation of Models, Inferences, and Experimental Results.

In an effort to improve alignment with the ACT Science expectations as well as represent a balance of the Science & Engineering Practices within the proposed Biology standards, the DRC recommends revisiting the following objectives:

- Analyze and interpret data to explain how enzymes act as catalysts for biochemical reactions and how environmental factors affect enzyme activity.
- Construct an explanation to summarize how cells and organisms maintain homeostasis.
- Ask questions to identify prokaryotic and eukaryotic cells in terms of structures and degree of complexity.
- Construct explanations to summarize how biological evolution and common ancestry are supported by comparative anatomy, molecular biology, and antibiotic resistance.

The DRC recommends that most proposed objectives are to be left unchanged, or 'keep as is,' based on stakeholder feedback. The survey data showed for 9 of 10 questions asked, there was at least 70% or higher agreement (including neutral responses) for support of the objectives as written. The only question with lower statistics referenced 'ambiguity and confusion of the standard'. This concern can be addressed in supporting documents outside of the standard nomenclature in Draft 3.

The qualitative feedback offered through the survey showed stakeholder concern with only a few standards. The DRC has addressed those concerns below with evidence to support the recommendations for Draft 3.

EVOLUTION

Stakeholders recommended that the language of the following objective be modified: *Construct explanations to summarize how biological evolution and common ancestry are supported by comparative anatomy, molecular biology, and antibiotic resistance.* In this current draft, the objective is written in a misleading way, indicating that both biological evolution and common ancestry can be supported by the concept of antibiotic resistance.

The DRC recommends that a separate objective is included to capture agents that drive natural selection. This will allow for greater specificity and depth, as requested in the stakeholder survey. The DRC has provided a sample objective to the SWT to guide this work based on stakeholder feedback.

ECOLOGY & OVERLAP WITH EARTH & ENVIRONMENTAL SCIENCE

Stakeholders expressed some concern with possible redundancies between Biology and Earth & Environmental Science as it pertains to human impact on the environment. There will be a natural overlap between Earth and Environmental Science and Biology standards due to the ecosystem focus in both courses. The DRC has made efforts to resolve any redundancies around specific examples referenced in the standards as it pertains to human impact.

HUMAN BODY & DISEASE

Stakeholders have asked for inclusion of concepts related to human health, virus transmission, immunity, and human disease. We do not recommend updating the language of the drafted standards and/or objectives to include these concepts because there are organic

opportunities to incorporate human health, disease transmission, and inheritance of disease in the following standards:

- Construct explanations to summarize how traits result from interactions of genetic factors (multiple genes and/or alleles) and environmental factors.
- Construct explanations to illustrate that proteins regulate gene expression resulting in cellular differentiation, specialized cells with specific functions, and uncontrolled cell growth.
- Obtain and communicate information that summarizes the impact of biotechnology applications on the individual, society, and the environment, including agriculture and medicine.

A Framework for K-12 Science Education does not reference disease or immune response for high school science coursework, instead, these concepts are recommended to be taught in middle grades. The drafted standards for middle school currently contain objectives around microbiology, human body systems (including immune system), and human health.

OTHER CONSIDERATIONS:

ACCOUNTABILITY:

- There was concern from stakeholders regarding the integration of the SEP with the Disciplinary Core Idea (DCI) on future assessments. EOC style questions will need to reflect these objectives to include the SEP and Disciplinary Core Ideas. The DRC recommends that DPI Accountability confer with the NCDPI Science Consultants and the Standards Writing Team to determine the best measures that align with the SEPs.

SUPPORT DOCUMENTS:

- In order to respond to stakeholder concern regarding ambiguity and confusion, the DRC recommends that the SEPs are well defined in the support documents. Additionally, examples of each of the SEPs as it pertains to the DCI need to be explicit and plentiful to provide greater clarity of the boundary of the objective.
- Stakeholders have asked for the inclusion of critical vocabulary in the support documents.
- Stakeholders have asked for boundary statements in the support documents.

PROFESSIONAL LEARNING:

- Stakeholder qualitative feedback offered insight into the need for high quality professional learning around the Scientific & Engineering Practices in order to support successful classroom instruction.

Chemistry:

Based on the positive stakeholder feedback and limited changes that are recommended for the proposed 2023 Chemistry Standards, the Data Review Committee (DRC) would like to thank the Chemistry Science Writing Team (SWT) for their diligent and thoughtful work as they drafted the standards.

The major concerns expressed in the stakeholder feedback survey regarding Draft 2 of the proposed Chemistry standards are as follows: (1) standards should be more rigorous; in some cases the standards were review of middle school material and needed to be revised to be at a high school level, (2) some SEPs (use models and constructing arguments) might make the content difficult for student learners, and (3) the standards are vague and stakeholders need more guidance and clarification on what is expected as well as how these new standards will be assessed; the third being the biggest concern among stakeholders.

Most of the recommendations are minor because we are seeking a clarification of the language in the objectives, as this was requested by the stakeholder survey data; or, a more “assess-able” version of the objective. In most cases, making an objective more “assess-able” meant changing the SEP (e.g., “Use a model” instead of “develop and use models”).

There was **one removal** that should be addressed:

- Line 18 in the PS1 tab: This objective is almost an exact duplicate of the 8th grade standard and can be removed. Additionally, survey comments from draft 2 survey asked for a reduction in content to go deeper with some other objectives. We found this objective to be the most appropriate for removal.

There were **two major revisions** that should be addressed:

- Line 12 in the PS1 tab: If the objective is to address nomenclature specifically then this needs to be clearly articulated in the standard.
- Line 28 in the PS1 tab: This standard needs much more clarification (some may be handled through support documents).

SUPPORT DOCUMENTS:

- In order to respond to stakeholder concern regarding ambiguity and confusion, the DRC recommends that the SEPs are well defined in the support documents. Additionally, examples of each of the SEPs as it pertains to the DCI need to be explicit and plentiful to provide greater clarity of the boundary of the objective.
- Stakeholders have asked for boundary statements in the support documents. It is clear from the survey responses that many educators do not understand the difference between content for a standard-level class vs what constitutes an honor extension or is beyond the scope of a high school Chemistry course.

- SEP were chosen based on what could feasibly be assessed (assuming the same/similar testing method that is currently used [i.e., multiple-choice rather than performance-based]). This means “use models” is shown in the objective but ideally students should be DEVELOPING models in addition to using them as this is in alignment with National Standards. Thus, support documents need to ensure that this is clear to teachers as they plan and carry out teaching science content through SEP.

PROFESSIONAL LEARNING:

- Stakeholder qualitative feedback offered insight into the need for high quality professional learning around the Scientific & Engineering Practices in order to support successful classroom instruction. Survey data indicated that many teachers are concerned about how to support students to appropriately “use models” and “construct explanations.”
- We recommend that DPI help facilitate cross-county curricular development to assist classroom teachers in smaller PSUs in implementing these new standards in their classrooms.

Earth/Environmental Science

Based on the positive stakeholder feedback and limited changes that are recommended for the proposed 2023 Earth/Environmental Science Standards, the Data Review Committee (DRC) would like to thank the Earth/Environmental Science Writing Team (SWT) for their diligent and thoughtful work in taking all recommendations into account as they drafted the standards.

Approximately 75% (including neutral responses) of the qualitative stakeholder data was favorable for the proposed 2023 Earth/Environmental Standards. Therefore, the DRC recommends keeping the standards and objectives “as is”.

The major concerns expressed in the stakeholder feedback survey regarding Draft 2 of the proposed Earth/Environmental Science standards are as follows: (1) more guidance is needed regarding the Scientific and Engineering Practices, particularly, modeling, and unpacking documents (2) the standards need more content added, mainly climate change, to covers a wide breadth of topics, and (3) most of the content repeats from middle school.

Some of the above concerns will be addressed by various teams of professionals after the standards are approved by the NC State Board of Education; most notably, concerns regarding the additional guidance for the unpacking documents and modeling will be provided through future professional development and through supporting documents.

SCIENTIFIC AND ENGINEERING PRACTICES (SEP) AND UNPACKING DOCUMENTS

Stakeholders raised concern with the need to add more guidance for modeling, since this is a pedagogy shift from the current standards. The DRC found that much of the concern for the increased rigor stems from the incorporation of Science & Engineering Practice (SEP) skills alongside content. Science & Engineering Practice skills support the critical thinking and communication needs of students who are either pursuing a post secondary education or entering the workforce.

Additionally, guidance is needed to add supporting documents, specifically unpacking documents. For example, stakeholders stated the unpacking documents are needed to provide clarity and regarding the content and pedagogy needed for all teachers to successfully implement the standards.

CLIMATE CHANGE

Stakeholders recommended adding content, mainly climate change, to cover a wide breadth of topics. There are several proposed standards where climate change can be addressed and integrated, specifically, the Earth System strand and Human Activity strand. This stakeholder feedback is supported by research contained in *A Framework for K-12 Science Education*.

The DRC recommends the unpacking documents to give more guidance to address climate change. This will allow for greater specificity to address a wide breadth of topics.

MIDDLE SCHOOL CONTENT

Stakeholders expressed some concern with possible redundancies between middle school and Earth & Environmental Science.

The DRC recommends creating a document that illustrates the vertical alignment of K-12 Science Standards. This would help to show the alignment of learning progression between the middle school and high school Earth/Environmental Science standards. Additionally, the DRC recommends creating support documents that include boundary statements to delineate the depth of Earth/Environmental Science topics taught in middle and high school.

OTHER CONSIDERATIONS:

SUPPORT DOCUMENTS:

- In order to respond to stakeholder concern regarding clarification and examples, the DRC recommends that the SEPs are well-defined in the support documents. Additionally, examples of each of the SEPs as it pertains to the DCI need to be explicit and plentiful to provide greater clarity of the boundary of the objective.
- Stakeholders have asked for the inclusion of critical vocabulary in the support documents.
- Stakeholders have asked for boundary statements in the support documents.

PROFESSIONAL LEARNING:

- Stakeholder qualitative feedback offered insight into the need for high quality professional learning around the Scientific & Engineering Practices in order to support successful classroom instruction.

RESOURCES:

- Stakeholder qualitative feedback stated additional funds would be needed to implement the SEP along with learning new standards. Additional funding and resources would provide more opportunities for student learning and success.

Physical Science

Based on the positive stakeholder feedback and limited changes that are recommended for the proposed 2023 Physical Science Standards, the Data Review Committee (DRC) would like to express our gratitude to the Physical Science Writing Team (SWT) for their careful, meticulous, and thoughtful work as they drafted the standards.

In reviewing the data for the stakeholder survey on Draft 2, the question that received the most disagreement is “The standards are free from ambiguity and confusion.” A number of specific comments were also made by educators taking the survey around this topic as well. Since the language of the standards cannot be all encompassing, one major recommendation is when introducing the standards to the general public, always include messaging about the upcoming support documents that will be created to help educators understand the standards, unpack the language into more specific topics and tasks, and crosswalks between these new standards and the last iteration. Such messaging will reinforce that the standards themselves are not the only support for teaching science that educators will receive.

Matter and Its Interactions

- There are **five major** recommendations:
 - Lines 34, 35, and 36 should be combined. After reviewing data from Survey 1 and 2, it is best to combine these 3 objectives. Phase changes are a part of physical changes. There is a similar objective in 8th grade (Line 56). There needs to be clarification in how the two objectives are different from each other along with the expectation of what students should know and do for each objective.
 - Lines 37 and 38 should be combined. It was a recommendation in the DRC Draft 2 feedback along with feedback from the surveys. Line 37 should be a subset of Line 38. Expand the elements from 1-18 to 1-20.
 - Lines 39 and 41 should be combined and moved under the strand “Understanding types, properties, and structure of matter”. There is a similar

objective in Chemistry and it could be used for reference to be able to combine the objectives.

- Line 43 has a wording change recommendation. With feedback from survey 1 and 2, the DRC recommends to remove IUPAC wording and move towards just using “nomenclature models or conventions”. It is supported that using IUPAC is above the scope and sequence of physical science and should remain in Chemistry.
- Line 51 has a recommendation for possible combining with Line 49 and 50. Since Line 51 discusses the applications of nuclear reactions, it is recommended to consider this objective in conjunction with Line 49 and 50.

Motion and Stability - Forces and Interactions:

Here is a summary of any major recommendations for these objectives.

- Lines 10 and 11 cover two objectives whose concepts covered should be rearranged between them for making better connections and to improve the flow. The notes column of the Draft 3 spreadsheet has suggested language for this change. Re-organizing these two objectives is supported by *A Framework for K-12 Science Education*.
- Line 15 is an objective related specifically to classifying frictional forces. In reviewing the Florida and Georgia science standards and the NC middle school science objectives, this stood out as a concept too specific for its own objective, especially in light of the fact that nowhere are the general types of forces addressed in these objectives. The DRC’s recommendation is to broaden this objective to include friction, weight, applied, and normal forces.
- The DRC is also recommending some minor language changes for a few of the other standards that are noted in the Draft 3 spreadsheet.

Energy

Overall, there was a consensus that the current four objectives were revised adequately for the final round of revisions. These objectives aligned with the standards in GA, FL and in other national documentation.

Since this is a math and calculation heavy content area, it is essential that the unpacking and other support documents contain and provide support for the various calculations and content expected in this area. Many of the main formulas have been provided in the notes section. One suggestion to consider is that three of these objectives require the students to “explain” areas that necessitate mathematical computation. While the Revised Bloom's Taxonomy expands the verb “explain” to include cause and effect, it is important to remind teachers of this in the unpacking documents.

Waves and Their Applications in Technologies for Information Transfer

- There have been some considerable revisions in the objectives in the current draft of objectives. Two have been removed and a new one has been added.
- Three of the current objectives have not been revised as they were strongly supported from the feedback from the stakeholders. These objectives are also well aligned with the standards in GA, FL and in other national documentation.

- The one new objective that was recommended from the last revision, was adopted with small wording changes and we support this new objective with one suggestion. It might be worth revising the objective “Obtain, evaluate, and communicate information to explain how instruments that transmit and detect waves are used to extend human senses” to “used in everyday life” instead of “used to extend human senses.” This would allow this objective to be consistent with language used in other science objectives.
- We supported the deletion of two objectives as the removal was supported by the stakeholder.
- It is important to provide teachers with appropriate unpacking documents to support the concepts taught in this area. Many of the key elements have been provided in the notes section.

SUPPORT DOCUMENTS:

- Since several objectives overlap with other content areas, such as 8th grade, boundary statements for any grade levels/courses need to be established.
- Any mathematical formulas students need to use should be included in the support documents.
- In order to ensure stakeholders understand SEP language integrated into these standards, having a list of all of the SEP protocols defined and with clear and specific examples of what they would look like in the classroom would be helpful.
- Since this is a math and calculation heavy content area, it is essential that the unpacking and other support documents contain and provide support for the various calculations and content expected in this area. Many of the main formulas have been provided in the notes section.

PROFESSIONAL DEVELOPMENT:

- The Science House is willing to help weave in the Modeling Institute work and create modules, train the trainer workshops, and develop pd to support teachers in better understanding the how of teaching these new standards with the SEPs.
- Ongoing pd for teachers on the SEPs will be critical for teachers to feel successful in this work and to help new teachers into the field.

Physics

Based on the positive stakeholder feedback and limited changes that are recommended for the proposed 2023 Physics Standards, the Data Review Committee (DRC) would like to thank the Physics Science Writing Team (SWT) for their diligent and thoughtful work as they drafted the standards.

The major concerns expressed in the stakeholder feedback survey regarding Draft 2 of the proposed Physics standards are as follows: (1) the standards are ambiguous and depth and complexity are unclear and (2) are the standards written for a variety of audiences, including but not limited to students, parents, teachers, and community members. Both of these concerns were expressed by 20% of the respondents. It is essential that the supporting documents provide clear examples of the material and depth of the material that students are expected to demonstrate as mastery of physics.

There were **three minor revisions** that should be addressed:

- Line 30 in the PS2 tab: Change wording from "conduct" to "carry out." Unpacking will include stationary objects and objects in motion as well as inertia as a topic.
- Line 33 in the PS2 tab: Rewrite as "Analyze and interpret data to explain the effect of elastic force on objects. (Hooke's Law)"
- Line 18 in the PS4 tab: Rewrite changing "analyze" to "summarize"

SUPPORT DOCUMENTS:

- In order to respond to stakeholder concern regarding ambiguity and confusion, the DRC recommends that the SEPs are well defined in the support documents. Additionally, examples of each of the SEPs as it pertains to the DCI need to be explicit and plentiful to provide greater clarity of the boundary of the objectives.
- Stakeholders have asked for boundary statements in the support documents. It is clear from the survey responses that many educators are not clear on how the standards documents should be used and how to create pacing guides and syllabi using the standards documents. The DRC made the purposeful decision to not reorder the standards in the order for which we recommend teaching the standards to preserve teacher and district autonomy.
- SEPs were chosen based on what could feasibly be assessed (assuming the same/similar testing method that is currently used [i.e., multiple-choice rather than performance-based]). This means "use models" is shown in the objective but ideally students should be DEVELOPING models in addition to using them as this is in alignment with National Standards. Thus, support documents need to ensure that this is clear to teachers as they plan and carry out teaching science content through SEP.

PROFESSIONAL LEARNING:

We recommend that DPI assist all LEAs in developing cross-LEA professional learning communities to support physics teachers in implementation of these standards in their classrooms. Resources for developing the Science and Engineering practices would support these physics standards by offering ways for teachers to provide models and inquiry for exploration of physics concepts in real world scenarios. The DRC suggests providing professional learning on using this standards document as a resource for the creation of pacing guides.

Data Review Committee Conclusions

Based on the trends, themes, data, and research provided, members of the Data Review Committee (DRC) completed a standards-by-standards set of recommendations for possible revisions to the K-12 Science Standard Course of Study. The spreadsheets linked below provide details of their findings organized by each of the proposed 2023 K-12 Science Standards strands. Within each spreadsheet, the standards and objectives for that strand are listed for each grade level/course.

For each standard that applies to a grade/course, DRC members provided a conclusion of either “Keep as is”, “Needs minor revisions”, “Needs revisions” or “No longer relevant”. The objective was then also color coded based on the conclusion with “Keep as is” indicated in green, “Needs minor revisions” as a light blue, “Needs revisions” as a darker blue, and “No longer relevant” indicated in red.

In the following columns, DRC members provided information related to the data source(s) that led them to that conclusion, related trends within the data and supporting research from the Science Standards Research spreadsheet.

- [Earth Science: Earth’s Place in the Universe](#)
- [Earth Science: Earth Systems](#)
- [Earth Science: Earth and Human Activity](#)

- [Life Science: From Molecules to Organisms - Structures and Processes](#)
- [Life Science: Ecosystems - Interactions, Energy and Dynamics](#)
- [Life Science: Heredity: Inheritance and Variation of Traits](#)
- [Life Science: Biological Evolution: Unity and Diversity](#)

- [Physical Science: Motion and Stability- Forces and Interactions](#)
- [Physical Science: Matter and Its Interactions](#)
- [Physical Science: Energy Conservation and Transfer](#)
- [Physical Science: Waves and Their Application](#)

Appendices

Appendix A: Copy of Survey Questions with Raw Data

1. [All Stakeholder Standard-by-Standard Survey Questions](#)
2. [All Stakeholder Standard-by-Standard Survey Raw Data](#)
 - Item numbers listed in Column B are aligned to the question numbers shown in the survey.

Appendix B: Draft 2 Qualitative Review

1. [Draft 2 Qualitative Review](#)