

California Department of Education

Executive Office

SBE-003 (REV. 11/2017)

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# California State Board of Education January 2020 Agenda Item #05

## Subject

The California Assessment of Student Performance and Progress System and English Language Proficiency Assessments for California: Approval of Revisions to the California Science Test Blueprint, Student Score Reports for the Initial English Language Proficiency Assessments for California, and an Update on Assessment Program Activities.

## Type of Action

Action, Information.

## Summary of the Issue(s)

This item seeks approval of the proposed changes to the California Science Test (CAST) blueprint and proposed revisions to the Initial English Language Proficiency Assessments for California (ELPAC) Student Score Reports (SSRs). This item also provides a summary of developments and updates related to the CAASPP and ELPAC, including the release of the 2018−19 CAST and California Spanish Assessment (CSA) results; the CSA constructed response (CR) full-write items; the California Alternate Assessment (CAA) for Science; the Alternate ELPAC pilot/cognitive lab study; the California Educator Reporting System (CERS); and the soft launch of Tools for Teachers. Attachment 1 provides CAASPP and ELPAC outreach and professional development activities from November through December 2019.

## Recommendations

The California Department of Education (CDE) recommends that the California State Board of Education (SBE) approve the following:

1. Proposed changes to the CAST design and blueprint

* Delay the implementation of the multistage adaptive test (MST) until the item pool is of sufficient size to measure the range of students’ abilities.
* Eliminate the use of a screener.
* Revise the CAST blueprint, as described in Attachment 2.
  + Reduce the number of stand-alone items in Segment A and Segment C.
  + Add a third performance task to Segment B to assess all three science domains.
  + Eliminate matrix sampling in Segment C.

1. Proposed SSRs for the Initial ELPAC, as described in Attachment 3

The CDE further recommends that the SBE authorize CDE staff to make technical edits, as necessary, in the documents associated with the recommendations above.

## Brief History of Key Issues

The following sections of this item detail the CDE’s proposed recommendations to the SBE and provide a summary of developments and updates related to the CAASPP and ELPAC programs.

### Overview and Proposed Revisions to the California Science Test Design and Blueprint

In November 2017, the SBE approved the CAST blueprint. A test blueprint details the number of items and points by Performance Expectations. In accordance with the approved blueprint, the CAST measures all of the challenging and rigorous California Next Generation Science Standards (CA NGSS) Performance Expectations for grades three through twelve over a three-year cycle. The SBE approved the CAST high level test design (HLTD) to measure the full range of the CA NGSS in March 2016.

Table 1 presents a summary of the SBE-approved CAST HLTD that displays the three segments: Segment A, Segment B, and Segment C. For a comprehensive overview of the CAST design, refer to the August 2018 Information Memorandum, which is located at <https://www.cde.ca.gov/be/pn/im/documents/memo-pptb-adad-aug18item01.docx>.

Table 1. CAST Design Summary

| Characteristics | Segment A | Segment B | Segment C |
| --- | --- | --- | --- |
| Reporting level | Contributes to student and group reports | Contributes to student and group reports | Contributes to group reports |
| Scope and depth of measurement | Wide breadth—measures a broad sample of performance expectations (PEs) | Deep measurement of targeted sample of a few PEs provided in item sets | Broad and deep—full range of measurement of PEs for each grade span |
| Number and type of items | 32–34 stand-alone items that include selected-response, technology enhanced, machine-scorable items | Two performance tasks (with 4–6 item sets) | 12 or 14 stand-alone items that include selected-response, technology enhanced items (like Segment A) *or* one performance task (like Segment B, with 4–7 item sets) |
| Grade by PEs measured | Grade 5 assesses PEs\* from grades 3–5  Grade 8 assesses PEs from grades 6–8  High school assesses PEs from grades 9–12 | Grade 5 assesses PEs\* from grades 3–5  Grade 8 assesses PEs from grades 6–8  High school assesses PEs from grades 9–12 | Grade 5 assesses PEs\* from grades 3–5  Grade 8 assesses PEs from grades 6–8  High school assesses PEs from grades 9–12 |

\*Grade five also includes the foundational concepts introduced in kindergarten through grade two.

Throughout the development of the CAST, the CDE and testing contractor Educational Testing Service (ETS) have intended to provide periodic updates to the SBE on the progress of the test development to include possible refinements of the approved blueprint plan in recognition of the innovative approach and complexities of the standards.

Using the CAST results from the first operational year, ETS conducted two studies to investigate the practicality of the MST and screener and the amount of time it takes students to complete the CAST. In its December 2019 Information Memorandum, the CDE provided the SBE with a summary of the CAST development and the findings from *Informing California Science Test Blueprint Improvements: Results from the Psychometric Studies*. That Memorandum is located at <https://www.cde.ca.gov/be/pn/im/documents/dec19memoadad01.docx>, and the report is located at <https://www.cde.ca.gov/be/pn/im/documents/dec19memoadad01a01.docx>.

The CDE used the results from these studies and analyses to inform the recommendation to revise the CAST design and blueprint. The studies and analyses are described in the following sections. A summary of ETS’s findings can be found in the report *Proposed Data-Driven Improvements to the California Science Test Blueprint* in Attachment 4. If the SBE approves this recommendation, ETS and the CDE will implement the change beginning with the 2020–21 administration of the CAST.

#### Multistage-Adaptive Test and Screener Studies

The MST study evaluated the feasibility of structuring the assessment in a multistage-adaptive format and whether using an adaptive component would offer improved measurement precision over that of a linear test. However, implementation of an MST requires a sufficient number and range of items to be available in order to build the necessary second-stage block of items. Results of the study revealed that, at this time, the number of CAST items across the range, while sufficient for score reporting, is insufficient to support the building of the second-stage block of items to fully realize the benefit of the MST design.

In the screener study, ETS explored the potential utility of implementing a screener algorithm to eliminate the selection of a specific content domain in the performance task section of the CAST. The impetus for the screener was to increase the precision by assessing students in the science domains in which they exhibited relative strengths, thereby collecting in-depth information about the students’ knowledge, skills, and abilities in the assessed standard(s). However, the results of the study indicate that the precision of measurement was not improved by the use of a screener.

#### Matrix Sampling and CAST Administration Time Analyses

The CAST design for Segment C consists of either a block of stand-alone items or another performance task, both of which could be used for matrix sampling and field testing. The CDE recommends Segment C be used solely for field testing, until the item pool is built to a sufficient volume; therefore, such a change to the CAST blueprint would be required. If further analyses around target reports prove fruitful, the CDE may recommend a further change in the blueprint to support it.

In addition, the CAST design states that the expected completion time for students to take the CAST is two hours. However, in its analysis of how long students actually were taking to complete the assessment, ETS found that approximately half of the students in grades five and eight took longer than two hours. ETS also conducted further analysis that revealed students who were assigned the field test block, consisting of stand-alone items, took longer to complete the test. The data on student testing times suggests that an adjustment to the blueprint, in the number of stand-alone items in Segment A and Segment C, might be necessary to reduce the total testing time; or, an adjustment to the testing time expectation needs to be made.

#### Rationale to Revise the California Science Test Blueprint

In response to ETS’s findings, the following section provides the rationale for revising the CAST blueprint.

ETS analyzed the impact of decreasing the overall number of items on the CAST in Segment A and in Segment C and found that if there were a reduction in the total number of CAST items, students would be more likely to complete the assessment within two hours. In the section titled “Summary of Psychometric Analyses” of the *Proposed Data-Driven Improvements to the California Science Test Blueprint* in Attachment 4, ETS provides a breakdown of student response-time data that explains the expected percent increase of students completing the assessment within two hours.

The SBE-approved CAST design has stand-alone items in Segment A, which cover all three science domains. Segment B has two operational performance tasks that assess the three science domains. ETS’s findings indicate that revising the blueprint to add a third performance task will allow for all three science domains to be represented in both operational Segment A and Segment B and, furthermore, will contribute to accurate domain-specific reporting, increasing the reliability of the three science domains.

In alignment with the CAST goals, adding a third performance task also will incentivize science instruction in all three science domains and ensure that all three science domains have equal representation on the assessment. Performance tasks are intended to measure a few CA NGSS Performance Expectations at a deeper level of understanding than stand-alone items, which are designed to measure the same Performance Expectations. Therefore, incorporating three performance tasks in each grade level assessment will send a signal to the field that instruction in each of the domains of Earth and Space Sciences, Life Sciences, and Physical Sciences is of equal importance and should be prioritized in all grade levels.

The CDE has identified three possible options to make changes to the CAST design or blueprint:

1. Keep test blueprint the same but increase the testing time for students to complete the assessment.
2. Reduce the number of items in Segment A and Segment C, thereby reducing the reliability in the three science domains.
3. Reduce the number of items in Segment A and Segment C and add a third performance task in Segment B, thereby maintaining reliability in the three science domains.

#### Proposed Revisions to the California Science Test Design and Blueprint

ETS’s recommended changes to the CAST blueprint are based on extensive feedback from educators, national science experts, various stakeholders, the CAASPP Technical Advisory Group (TAG), and CDE leadership. The CDE’s proposed revisions to the CAST blueprint will maintain its fidelity to the CA NGSS and continue to encourage science instruction.

On the basis of results from these studies and analyses, the CDE proposes the following:

* Delay the implementation of the MST until the item pool is of sufficient size and range to measure the range of students’ abilities.
* Eliminate the use of a screener.
* Revise the CAST blueprint.
  + Reduce the number of stand-alone items in Segment A and Segment C.
  + Add a third performance task to Segment B to assess all three science domains.
  + Eliminate matrix sampling in Segment C.

The recommended changes do not necessitate a new standard setting and do not impact the ability to compare scale scores from previous administrations. The CDE and ETS will continue to monitor the item pool and update the SBE periodically on results of analyses and studies as well as developments for the CAST.

The proposed time line in table 2 includes the dates for past activities related to the development of the CAST and projected dates for the implementation of the blueprint change if approved by the SBE.

Table 2. Proposed Time Line for the Development of the CA NGSS Assessments

| Date | Activity |
| --- | --- |
| September 2013 | CA NGSS adopted by the SBE |
| March 2016 | CAST HLTD design approved by the SBE |
| November 2017 | CAST general achievement level descriptors and blueprint approved by the SBE |
| March–July 2017 | Pilot test |
| April–July 2018 | Field test |
| January–July 2019 | First operational CAST administered |
| November 2019 | CAST proposed threshold scores approved by the SBE |
| January 2020 | Proposed revision of CAST blueprint |
| 2020−21 | Implementation of revised CAST blueprint, if approved |

### Proposed Initial English Language Proficiency Assessments for California Student Score Reports

In September 2019, the SBE approved the redesign of 2019–20 SSRs for the CAASPP and Summative ELPAC. Today, the CDE recommends that the SBE approve the redesign of the 2020–21 Initial ELPAC SSR in Attachment 3. The proposed Initial ELPAC SSR has been redesigned for visual consistency with the SSRs of all the other California assessments to meet federal accessibility requirements and for greater usability for parents. The Initial ELPAC SSR may be sent to parents and guardians along with the required Initial Parent Notification Letter (Federal Title I or Title III and State Requirements). This letter informs parents of their child’s identification as an English Learner or initially fluent-English proficient student, upon entering a California school for the first time. The Initial Parent Notification Letter templates are available on the Language Policy and Leadership Office website located at <https://www.cde.ca.gov/sp/el/t3/lepparent.asp>.

After it is approved, the SSR will be made available to LEAs starting July 1, 2020. The following sections describe the process the CDE used to collect stakeholder feedback and implement changes related to the design and usability of the Initial ELPAC SSRs.

#### Stakeholder Input on the Design of the Initial ELPAC SSR

In October 2019, the CDE and ETS conducted stakeholder meetings with several groups that included parents and representatives from the California State Parent Teacher Association, Californians Together, and the California Association for Bilingual Education to collect input on proposed revisions to the Initial ELPAC SSR. Stakeholders were given an opportunity to provide feedback on design elements of the new Initial SSR to clearly communicate the assessment results to parents and guardians.

Stakeholder recommendations included the following:

* Use of updated color schemes
* Vertical representation of the graphics that allows for quick and easy understanding of results
* Additional color and dimension that make the SSR seem more modern
* Links to test questions and additional resources that are available to parents and guardians

#### ELPAC SSR Design

Parent and stakeholder feedback have informed the redesign of the proposed SSR with an aim to increase its readability and usability for families. The recommended Initial ELPAC SSR design prominently features an overall score level and a description of what the student can do at each level. The SSR displays Oral Language and Written Language composite scores that are easy to read and understand and provides easy access to additional information through active links to Starting Smarter, a parent resource website. The result is a parent-friendly SSR that is consistent with the design of SSRs for all other California assessments.

The modified electronic SSR format addresses universal accessibility and provides greater access to the SSR for persons with visual impairments through text-to-speech applications, which was not possible with the paper version. The SSRs will be translated into Spanish, Chinese (traditional), Vietnamese, and Filipino for 2020–21. These languages represent the four most frequently spoken languages by California students other than English. Another important improvement is the option for LEAs to provide the reports to parents and guardians in multiple ways, such as through their online parent portals, leveraging existing information systems for family engagement all year long. Although LEAs are able to send the SSRs to parents and guardians electronically, they still have the option to print SSRs and send them to parents in the mail.

### Release of Results for the 2018–19 California Science Test and California Spanish Assessment

In January 2020, the CDE will release the first operational 2018–19 CAST and CSA SSRs. The CAST SSRs will include the students’ Overall scale score, an achievement level, and information about how they performed in each science area (i.e., Life Sciences, Physical Sciences, and Earth and Space Sciences). The CSA SSRs will include the students’ score reporting ranges and information about how they performed. The CAST and CSA SSRs will be available electronically to LEAs through the Test Operations Management System. LEAs will then distribute the electronic SSRs to parents and guardians through their local student information systems. For parents and guardians who do not have access to technology, LEAs will have the ability to print individual student reports or order printed copies through ETS.

The Starting Smarter website at <https://ca.startingsmarter.org/> also will launch for the CAST and CSA in January 2020. This parent-friendly site will offer parents and guardians sample CAST and CSA questions and resources.

Tentatively scheduled for January/February 2020, the CAST and CSA summary results will be available on the CDE Public Reporting website, which is located at [https://caaspp-elpac.cde.ca.gov/caaspp/.](https://caaspp-elpac.cde.ca.gov/caaspp/.%20) The summary results will be reported at the state, county, district, and school levels by student groups. The CDE will provide more information on the public release of the CAST and CSA in a February 2020 Information Memorandum to the SBE.

### California Spanish Assessment Constructed Response Full-Write Items

ETS convened a group of 18 educators on October 16–18, 2019, for a Writing Range Finding Meeting in Sacramento. The purpose of this meeting was to review Spanish CR full-write item prompts and scored responses for the 2018–19 field-tested CSA items. These items were reviewed for score agreement and clarity of annotations for optional local administration and scoring. As part of the process, educators recommended seven of the fourteen CR full-write items (one per grades three through eight and one for high school) to be made available to LEAs. Because the CSA currently does not include CR items, providing LEAs with CR items offers them the option to administer and score CRs locally for the purpose of gathering additional information regarding students’ Spanish writing skills. The educators’ recommendations were reconciled with the CDE on November 13, 2019, at which time ETS began developing training materials in preparation for a January 2020 release of the CSA CR full-write items.

### Update on the California Alternate Assessment for Science

The 2019–20 first operational CAA for Science was made available to LEAs in September 2019. The CAA for Science is administered online to students with the most significant cognitive disabilities whose individualized education program indicates the use of an alternate assessment. Eligible students take the CAA for Science in grades five and eight and one time in high school (i.e., grade ten, eleven, or twelve). Students take four embedded performance tasks from the three science domains of the CA NGSS (i.e., Physical Sciences, Life Sciences, and Earth and Space Sciences) and must attempt all four performance tasks to complete the assessment. As of December 16, 2019, 356 students have started at least one embedded performance task for this assessment.

Tentatively scheduled for a January/February 2020 release, the CDE will again report preliminary indicators for the 2018−19 CAA for Science field test. Preliminary indicators include a percent of items answered correctly by indicator category. Preliminary indicators offer LEAs a general indication of a student’s content knowledge and provide them with a broad and early indication about an LEA’s implementation of the CA NGSS. Preliminary indicators are not precise enough to stand on their own and should be used in conjunction with other information. The results should *not* be used to compare students, schools, and LEAs. The CDE has provided resources to LEAs to assist them in understanding the limitations of preliminary indicators and to communicate the results to parents/guardians and students. These resources are available on the Preliminary Indicator Toolkit web page, which can be found at <https://www.cde.ca.gov/ta/tg/ca/prelimindicatortoolkit.asp>.

ETS and the CDE will conduct a CAA for Science standard setting workshop in August 2020 with special education and science educators to develop the educator panel-recommended threshold scores. The CDE will bring the proposed CAA for Science proposed threshold scores to the SBE for approval in November 2020.

### Update on the Alternate English Language Proficiency Assessments for California Pilot and Cognitive Lab Study

The Alternate ELPAC pilot test and cognitive lab study, is scheduled to take place January 14 through 31, 2020. Six LEAs are expected to participate. Between January 8 and January 15, ETS and SCOE will conduct in-person training for test examiners from the participating LEAs, which will include an overview of the Alternate ELPAC assessments, the purpose of the pilot test and cognitive lab study, and the procedures for administering the pilot test. ETS also will produce a video of the training sessions and post it on the ELPAC website for use by LEAs.

The overall purpose of the study is to determine whether the task types are suitable for the intended population— English learner (EL) students, or potential EL students, with significant cognitive disabilities.

The study will examine student response and test examiner interactions during the pilot administration of the Alternate ELPAC. The results of this study will inform field test development. The specific goals of the Alternate ELPAC cognitive lab study are as follows:

* Examine test examiner and student interaction with proposed task types to determine whether the task types elicit the intended knowledge and skills without construct-irrelevant interference.
* Collect evidence of the use of accessibility resources used for test administration and determine whether the test design supports access.
* Examine test administration practices to determine whether the assessment is administered with fidelity. This will inform future refinement and recommendations for the field test.

The study findings will provide recommendations for future development of the Alternate ELPAC and may include refinement of task types, accessibility considerations, and improvement of test administration materials. Study findings may be used as evidence for technical requirements under peer review (US Department of Education Standards Assessment, and Accountability web page at <https://www2.ed.gov/admins/lead/account/saa.html> [accessed October 25, 2018]).

### Update on the Incorporation of Summative Assessment Results in the California Educator Reporting System

Over the next two years, CERS will become the “one stop shop” for LEA staff to access individual and aggregate student results from all CAASPP and ELPAC assessments, with the exception of the Initial ELPAC. CERS already contains all historical results from the Smarter Balanced Interim Assessments and has a live feed of results. For each summative assessment within the CAASPP and ELPAC, historical test results are being added to CERS first, followed by a daily feed of test results.

ELPAC summative assessments were the first summative assessment results to be made available in CERS. Historical test results were made available through CERS in November 2019, and the daily feed of results is scheduled to begin in May 2020. The ELPAC results in CERS include overall score, composite scores, and domain results at both the individual and aggregate student levels. Through CERS, LEA staff can create customized student groups to view student results that can be filtered by race/ethnicity, language acquisition status, migrant status, and primary language.

The next results to be made available through CERS will be the Smarter Balanced Summative Assessments for English language arts/literacy (ELA) and mathematics and the CAAs for ELA and mathematics. For those assessments, historical data will be made available in January 2020, followed by the daily feed of results in spring 2021. In the coming months, the CDE will provide updates to the SBE on the progress of incorporating results from additional summative assessments into CERS.

In addition to the availability of ELPAC student results in CERS, mock student data for the summative ELPAC was loaded into the CERS Sandbox—a training tool for LEA staff to learn about the features and functions of CERS in a nonsecure environment. Because the Sandbox does not contain any secure information, logon credentials are not needed to access it. The Sandbox can be accessed at <http://cerssandbox.smarterreporting.org/>. In addition, a CERS user guide is available at <http://www.caaspp.org/rsc/pdfs/CAASPP--CERS-User-Guide.2019-20.pdf>, and a CERS promotional flyer is available at <http://www.caaspp.org/rsc/pdfs/CAASPP--California-Educator-Reporting-System-Assessment-Results-Flyer.2019-20.pdf>.

### Forthcoming Launch of the New Digital Library—Tools for Teachers

Over the past year, Smarter Balanced, in collaboration with its member states, has been working on the development of a new, enhanced Digital Library portal with a new name—Tools for Teachers. In January 2020, Smarter Balanced will conduct user acceptance testing for the new Tools for Teachers portal with members of the Consortium. In February 2020, Smarter Balanced will conduct a pilot test of the new portal with members of the State Network of Educators (SNE) and State Leadership Team (SLT) who attend the February workshop. The SNE consists of educators—primarily teachers—from Consortium member states who are trained to develop formative assessment resources for Tools for Teachers. The SLT, which consists of state education agency staff members, provides guidance to SNE members in creating the instructional resources for inclusion in Tools for Teachers. California has 45 representatives in the SNE and 3 representatives on the SLT.

Smarter Balanced is hosting a series of workshops for members of the SNE and SLT to develop and update resources for Tools for Teachers, as well as improve the overall format and function of the portal’s interface. During the last workshop, which was held in November 2019, California educators made up approximately 15 percent of the workshop participants, with 18 teachers and curriculum coaches from districts across California participating. Three staff members from the CDE also participated as members of the SLT to provide guidance and support to SNE members. The next workshop will take place in February 2020 where SNE and SLT members will provide feedback on the new Tools for Teachers portal and continue to review and update instructional resources for the portal.

The original Digital Library portal will be decommissioned in May 2020 and the launch of Tools for Teachers will follow in June 2020, in conjunction with the 10-year anniversary of Smarter Balanced.

## Summary of Previous State Board of Education Discussion and Action

In a December 2019 Information Memorandum, the CDE provided the SBE with updates on the results of ETS’s CAST studies and analyses on the MST, the screener, the use of matrix sampling for group reporting, and the amount of time it takes students to complete the CAST (<https://www.cde.ca.gov/be/pn/im/documents/dec19memoadad01.docx>)

(<https://www.cde.ca.gov/be/pn/im/documents/dec19memoadad01a01.docx>).

In a December 2019 Information Memorandum, the CDE provided the SBE with an update on the public release of the 2018–19 ELPAC student results (<https://www.cde.ca.gov/be/pn/im/documents/dec19memoadad02.docx>).

In a December 2019 Information Memorandum, the CDE provided the SBE with a summary of the 2019 CAASPP independent evaluation report and notified the SBE of the posting of the full report on the CDE website (<https://www.cde.ca.gov/be/pn/im/documents/dec19memoadad03.docx>).

In October 2019, the CDE provided the SBE with updates on the CAST Standard Setting Plan and a summary of related activities conducted before and after the convening of the CAST July/August 2019 Standard Setting Workshop (<https://www.cde.ca.gov/be/pn/im/documents/oct19memoadad01.docx>).

In October 2019, the CDE provided the SBE with updates on the new resources added to the Digital Library and on the efforts made to support educators, including CERS (<https://www.cde.ca.gov/be/pn/im/documents/oct19memoadad02.docx>).

In October 2019, the CDE provided the SBE with information on the public release of the 2018–19 CAASPP student results (<https://www.cde.ca.gov/be/pn/im/documents/oct19memoadad03.docx>).

In October 2019, the CDE provided the SBE with information on the Site Administrator Survey and the *Site Administrator Feedback Sessions Report* (<https://www.cde.ca.gov/be/pn/im/documents/oct19memoadad04.docx>).

In September 2019, the CDE provided the SBE with updates on the CAASPP System and ELPAC activities. The SBE approved the CAASPP and computer-based ELPAC summative SSRs and the CSA preliminary reporting scale score ranges (<https://www.cde.ca.gov/be/ag/ag/yr19/documents/sep19item03.docx>)

(<https://www.cde.ca.gov/be/ag/ag/yr19/documents/sep19item03a2.pdf>)

(<https://www.cde.ca.gov/be/ag/ag/yr19/documents/sep19item03a3rev.docx>)

(<https://www.cde.ca.gov/be/ag/ag/yr19/documents/sep19item03a3rev2.docx>).

In August 2019, the CDE provided the SBE with updates on the development of the first operational administration of the CAA for Science and the upcoming development activities and test format for the 2019–20 CAST administration (<https://www.cde.ca.gov/be/pn/im/documents/memo-pptb-adad-aug19item01.docx>).

In July 2019, the CDE provided the SBE with a summary of events and developments related to the CAASPP System and ELPAC activities and displayed the enhancements to the CAASPP and ELPAC public reporting website (<https://www.cde.ca.gov/be/ag/ag/yr19/documents/jul19item01.docx>).

In June 2019, the CDE provided the SBE with an Information Memorandum that included the draft accessibility resources for operational testing for the Initial and Summative ELPAC and the Alternate ELPAC based on the transition to an online test delivery system (<https://www.cde.ca.gov/be/pn/im/documents/memo-pptb-adad-jun19item03.docx>).

In May 2019, the CDE provided the SBE with updates on the CAASPP System and ELPAC activities. The SBE approved the proposed HLTD for the transition of the Initial and Summative ELPAC to computer-based tests, the proposed HLTD for the development of the computer-based Initial and Summative Alternate ELPAC, and proposed revisions to the computer-based Summative ELPAC blueprints (<https://www.cde.ca.gov/be/ag/ag/yr19/documents/may19item01.docx>).

In April 2019, the CDE provided the SBE with an Information Memorandum that gave an update on the Smarter Balanced Summative Assessment blueprints for ELA and mathematics (<https://www.cde.ca.gov/be/pn/im/documents/memo-pptb-adad-apr19item01.docx>).

In March 2019, the CDE provided the SBE with updates on the CAASPP System and ELPAC activities. The SBE approved the HLTD for the Initial and Summative ELPAC computer-based delivery and the Alternate ELPAC (<https://www.cde.ca.gov/be/ag/ag/yr19/documents/mar19item03.docx>).

In February 2019, the CDE provided the SBE with an Information Memorandum that gave an update on the ELPAC threshold score review study (<https://www.cde.ca.gov/be/pn/im/documents/memo-pptb-adad-feb19item01.docx>).

In January 2019, the CDE provided the SBE with updates on the CAASPP System and ELPAC activities. The SBE approved the 2019 LEA apportionment rates for CAASPP (<https://www.cde.ca.gov/be/ag/ag/yr19/documents/jan19item08.docx>).

In December 2018, the CDE provided the SBE with an Information Memorandum that gave an update on the 2017–18 public releases for the Initial California English Language Development Test, the Physical Fitness Test, and the preliminary indicators for the CAST field test and the CAA for Science, year two pilot (<https://www.cde.ca.gov/be/pn/im/documents/memo-pptb-adad-dec18item01.docx>).

In November 2018, the CDE provided the SBE with updates on CAASPP System activities. The SBE approved the proposed contract amendment for the CAASPP contract with ETS to include the integration of the ELPAC and requested approval of the proposed contract amendment to the University of California, Santa Cruz (UCSC) interagency agreement to provide an educator reporting system (<https://www.cde.ca.gov/be/ag/ag/yr18/documents/nov18item08.docx>)

(<https://www.cde.ca.gov/be/ag/ag/yr18/documents/nov18item08a1.pdf>)

(<https://www.cde.ca.gov/be/ag/ag/yr18/documents/nov18item08a2.pdf>)

(<https://www.cde.ca.gov/be/ag/ag/yr18/documents/nov18item08a3.pdf>)

(<https://www.cde.ca.gov/be/ag/ag/yr18/documents/nov18item08a4.xlsx>)

(<https://www.cde.ca.gov/be/ag/ag/yr18/documents/nov18item08a5.pdf>)

(<https://www.cde.ca.gov/be/ag/ag/yr18/documents/nov18item08a6.xlsx>).

In October 2018, the CDE provided the SBE with an Information Memorandum that gave an update on the SSR for 2018–19 and beyond (<https://www.cde.ca.gov/be/pn/im/documents/memo-pptb-adad-oct18item01.docx>).

In September 2018, the CDE provided the SBE with updates on the CAASPP System, including a presentation on the electronic reporting pilot (<https://www.cde.ca.gov/be/ag/ag/yr18/documents/sep18item03.docx>).

In August 2018, the CDE provided the SBE with an Information Memorandum that gave an update on the development of both new science assessments, the CAST and the CAA for Science

(<https://www.cde.ca.gov/be/pn/im/documents/memo-pptb-adad-aug18item01.docx>).

In July 2018, the SBE approved a request for authority to enter into negotiations to amend ETS’s CAASPP contract to include the integration of the ELPAC assessments into the amended contract and enter into negotiations with the UCSC for an interagency agreement to provide an educator reporting system for non-Smarter Balanced assessments (<https://www.cde.ca.gov/be/ag/ag/yr18/documents/jul18item03.docx>).

In June 2018, the CDE provided the SBE with an Information Memorandum that included an update on the ELPAC and a review of the preliminary results of the Enhanced Assessment Grant for the Smarter Balanced Summative Assessments (<https://www.cde.ca.gov/be/pn/im/documents/memo-pptb-adad-jun18item02.docx>) (<https://www.cde.ca.gov/be/pn/im/documents/memo-pptb-adad-jun18item02a01.pdf>).

In May 2018, the CDE provided the SBE with updates on the CAASPP System (<https://www.cde.ca.gov/be/ag/ag/yr18/documents/may18item03.docx>).

In March 2018, the CDE provided the SBE with updates on the CAASPP System (<https://www.cde.ca.gov/be/ag/ag/yr18/documents/mar18item08.docx>).

In January 2018, the SBE approved the CAA for Science test blueprint, general achievement level descriptors, and score reporting structure (<https://www.cde.ca.gov/be/ag/ag/yr18/documents/jan18item06.docx>).

In January 2018, the SBE approved LEA apportionment rates for the 2017–18 CAASPP administration and CDE-approved grade two diagnostic assessments

(<https://www.cde.ca.gov/be/ag/ag/yr18/documents/jan18item06.docx>).

## Fiscal Analysis

The 2019–20 Budget Acts includes $87,537,000 for CAASPP contract activities and $21,696,000 for ELPAC contract activities. The anticipated 2020–21 Budget Act includes $87,108,469 for the CAASPP contract activities and $23,496,396 for ELPAC contract activities. Funding for 2021–22 and beyond will be contingent on an annual appropriation being made available from the Legislature in future fiscal years.

## Attachment(s)

* Attachment 1: Outreach and Professional Development Activities (6 Pages)
* Attachment 2: Revised CAST Blueprint (31 Pages)
* Attachment 3: Initial ELPAC Student Score Report (2 Pages)
* Attachment 4: *Proposed Data-Driven Improvements to the California Science Test Blueprint* (30 Pages)

# Outreach and Professional Development Activities

The California Department of Education (CDE), in coordination with California Assessment of Student Performance and Progress (CAASPP) and English Language Proficiency Assessments for California (ELPAC) contractors, has provided a variety of outreach activities, including in-person workshops, focus group meetings, and presentations, throughout the state to prepare local educational agencies (LEAs) for the administration of the CAASPP System and the ELPAC. In addition, the CDE continues to release information regarding assessment program updates, including weekly updates, on its website and through listserv email. The following tables provide descriptions of outreach and professional development activities during November and December 2019.

## Table 1. Trainings

| **Date(s)** | **Location** | **Estimated Number of Attendees** | **Description** |
| --- | --- | --- | --- |
| 11/5 | Redding | 53 | 2019–20 ELPAC: The Results Are In Workshop  Training for LEAs on how to access and use ELPAC results to ensure success for English learners. |
| 11/5 | Visalia | 180 | Computer-Based Summative ELPAC Administration and Scoring Training for Non-Field Test LEAs  Administration and scoring training to prepare non-field-testing LEAs for the computer-based Summative ELPAC administration. |
| 11/6 | Montebello | 180 | Computer-Based Summative ELPAC Administration and Scoring Training for Non-Field Test LEAs  Administration and scoring training to prepare non-field-testing LEAs for the computer-based Summative ELPAC administration. |
| 11/8 | San Diego | 120 | Computer-Based Summative ELPAC Administration and Scoring Training for Non-Field Test LEAs  Administration and scoring training to prepare non-field-testing LEAs for the computer-based Summative ELPAC administration. |
| 11/12 | Pomona | 150 | Computer-Based Summative ELPAC Administration and Scoring Training for Non-Field Test LEAs  Administration and scoring training to prepare non-field-testing LEAs for the computer-based Summative ELPAC administration. |
| 11/13 | Burbank | 180 | Computer-Based Summative ELPAC Administration and Scoring Training for Non-Field Test LEAs  Administration and scoring training to prepare non-field-testing LEAs for the computer-based Summative ELPAC administration. |
| 11/14 | Santa Barbara | 100 | Computer-Based Summative ELPAC Administration and Scoring Training for Non-Field Test LEAs  Administration and scoring training to prepare non-field-testing LEAs for the computer-based Summative ELPAC administration. |
| 12/2 | Sacramento | 175 | New Coordinator Training  Training for new CAASPP and new ELPAC coordinators focusing on preparing for summative testing, the Test Operation Management System (TOMS), and coordinator checklist activities. |
| 12/2 | Los Angeles | 175 | New Coordinator Training  Training for new CAASPP and new ELPAC coordinators focusing on preparing for summative testing, TOMS, and coordinator checklist activities. |
| 12/2 | Modesto | 175 | New Coordinator Training  Training for new CAASPP and new ELPAC coordinators with focus on preparing for summative testing, TOMS, and coordinator checklist activities. |
| 12/3 | Sonoma | 175 | New Coordinator Training  Training for new CAASPP and new ELPAC coordinators focusing on preparing for summative testing, TOMS, and coordinator checklist activities. |
| 12/10 | San Bernardino | 175 | New Coordinator Training  Training for new CAASPP and new ELPAC coordinators focusing on preparing for summative testing, TOMS, and coordinator checklist activities. |
| 12/11 | Webcast | 150 | ELPAC Pretest Webcast  Webcast to provide LEA ELPAC coordinators with information they need to train their ELPAC site coordinators and test examiners. |
| 12/11 | Orange County | 175 | New Coordinator Training  Training for new CAASPP and new ELPAC coordinators focusing on preparing for summative testing, TOMS, and coordinator checklist activities. |
| 12/11 | Santa Clara | 175 | New Coordinator Training  Training for new CAASPP and new ELPAC coordinators focusing on preparing for summative testing, TOMS, and coordinator checklist activities. |
| 12/17 | Shasta | 175 | New Coordinator Training  Training for new CAASPP and new ELPAC coordinators focusing on preparing for summative testing, TOMS, and coordinator checklist activities. |

## Table 2. Advisory Panel/Review Committee Meetings

| **Date(s)** | **Location** | **Estimated Number of Attendees** | **Description** |
| --- | --- | --- | --- |
| 11/4 or 11/5 | Sacramento | 8 | Alternate ELPAC Blueprint Review Meeting  Participating educators reviewed preliminary test blueprints for usability issues. |
| 11/5–6 | Sacramento | 16 | California Alternate Assessment (CAA) for Science Alignment Workshop  California educators participated in a Human Resources Research Organization alignment study to evaluate the CAA for Science test items and their alignment with the alternate science standards that were derived from the California Next Generation Science Standards Performance Expectations. |
| 11/22 | Sacramento | 4 | Alternate ELPAC Test Design Advisory Team  Team members provided input on the preliminary test blueprints. |
| 12/19 | (WebEx) | 14 | Statewide Assessment Stakeholders Meeting  Participants received information on the latest assessment developments and provided feedback. |

## Table 3. Presentations by CDE Staff

| **Date(s)** | **Location** | **Estimated Number of Attendees** | **Description** |
| --- | --- | --- | --- |
| 11/7 | San Francisco | 100 | Association of California School Administrators Leadership Summit  Participants were provided with an overview of communicating results for the CAASPP and ELPAC. |
| 11/8 | Sacramento | 85 | Bilingual Coordinators Meeting  Participants were provided with updates on the computer-based ELPAC. |
| 11/13 | Sacramento | 25 | Regional Assessment Network Meeting  Assessment Development and Administration Division provided updates on activities and test developments. |
| 11/18–20 | Sacramento | 100 | California Educational Research Association (CERA) Conference  A presentation was provided on the assessment and accountability topic of Data-Based Decision-Making for the Computer-Based ELPAC: A Pilot Study |
| 11/18–20 | Sacramento | 50 | CERA Conference—CDE Chats  Presentations were provided on the following topics:   * ELPAC Question and Answer (Q&A) Session * State Assessment Resources to Support Families * Science Assessments Q&A Session |
| 12/9–10 | Anaheim | 50 | California Science Technology Engineering Art Math (STEAM) Symposium:  “Deconstructing the Design and Expectations of the California Science Test (CAST)”  Participants deconstructed California Next Generation Science Standards Performance Expectations by employing item specifications used in the development of the CAST questions. |



**Proposed Revisions to the California Science Test Blueprint**

Prepared by:



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## Introduction

The California Science Test (CAST), administered pursuant to California Education Code (EC) Section 60640(b)(2)(B), is part of the California Assessment of Student Performance and Progress System. The CAST measures the full range of the California Next Generation Science Standards (CA NGSS) over a three-year period and is administered to students in grades five and eight and once in high school (i.e., grade ten, eleven, or twelve).

The CAST blueprint documents how test forms for the CAST will be assembled, including rules for the assessment of the CA NGSS Performance Expectations (PEs) and the integration of the Disciplinary Core Ideas (DCIs), Science and Engineering Practices (SEPs), and Crosscutting Concepts (CCCs). The CA NGSS are referred to as “three dimensional” (3D) because of the interrelationships of the DCIs, SEPs, and CCCs. The CAST is designed to reflect a commitment to the 3D approach in both the writing of test items, each of which is aligned to at least two of the three dimensions, and in the assembly of test forms as detailed in this blueprint.

The test includes three science domains (Physical Sciences, Life Sciences, and Earth and Space Sciences) and one engineering domain (Engineering, Technology, and Application of Science). For scoring and reporting purposes, each of the three science domains will constitute one-third of the test (items written to assess PEs associated with Engineering, Technology, and Application of Science will be assigned to one of the three science domains, depending upon the context of their stimulus). California’s Environmental Principles and Concepts will also be used as context for items, as appropriate to the three science domains.

The CAST is an untimed test (meaning that students should be allowed as much time as they need to complete it), and it is expected to take approximately two hours to administer all three segments:

* Segment A contributes to individual student scores, contains discrete items, and is designed to measure a broad sample of PEs.
* Segment B contributes to individual student scores, contains performance tasks (PTs), and is designed to provide deep measurement of a targeted sample of a few PEs in item sets.
* Segment C may contain either a block of discrete field test items or a single field test PT.

CAST test forms will sample PEs as follows:

* For the segments contributing to individual student scores (Segment A and Segment B), it is not possible to assess all PEs in a single testing year. As a result, PEs assessed in Segment A and Segment B will be rotated from year to year so that all PEs can be assessed in the segments contributing to individual scores over the course of a three-year period.

For Segment C, administer a number of different versions across the state to allow for all PEs to appear on the CAST annually at a statewide level.

Although the CAST blueprint is not intended to guide instruction, it is a goal of the CAST to sample PEs broadly each year, as explained, so that instruction in a broad range of PEs across the grade spans will both be true to the intentions of the CA NGSS and will also provide solid preparation for the CAST.

## CAST Claims

The CAST has four claims—one overall claim for the entire assessment and three separate science domain claims. [Table 1](#_bookmark2) shows the claim statements for the CAST.

### Table 1. CAST Claims

| **Domains** | **Description** |
| --- | --- |
| 3D Overall | Students can demonstrate performances associated with the expectations of the California Next Generation Science Standards, through the integration of Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts across the domains of Physical Sciences, Life Sciences, Earth and Space Sciences, and Engineering, Technology, and Application of Science. |
| 3D Physical Sciences | Students can demonstrate performances associated with the expectations in the disciplinary area of Physical Sciences within the California Next Generation Science Standards, through the integration of Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts. |
| 3D Life Sciences | Students can demonstrate performances associated with the expectations in the disciplinary area of Life Sciences within the California Next Generation Science Standards, through the integration of Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts. |
| 3D Earth and Space Sciences | Students can demonstrate performances associated with the expectations in the disciplinary area of Earth and Space Sciences within the California Next Generation Science Standards, through the integration of Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts. |

## CAST Segments Contributing to Individual Scores

[Table 2](#_bookmark4) shows the distribution of points by science domain and by DCI for the two sections of the CAST used to generate student scores (Segment A and Segment B). An individual student will receive items with sufficient points in each domain to support the reporting of both an overall score and science domain levels. More detailed tables illustrating the integration of the DCIs, SEPs, and CCCs appear later in this document (see [Table 4](#_bookmark8), [Table 5](#_bookmark10), and [Table 6](#_bookmark12)). Note that each assessment draws on PEs from several grades. The grade five assessment draws on PEs from grades three through five (3–5) and includes the foundational concepts that are addressed in kindergarten through grade two (K–2). The grade eight assessment draws on PEs from grades six through eight (6–8), and the high school assessment draws on PEs from grades nine through twelve (9–12).

### Table 2. Segments Contributing to Individual Scores—Assessed in Grades Five and Eight and in High School

| **Science Domain and DCI Strand\*\*** | **Items by DCI in Segment A—Grade 5** | **Items by DCI in Segment A—Grade 8** | **Items by DCI in Segment A—High School** | **Performance Tasks (PTs) in Segment B—All Grade Levels** |
| --- | --- | --- | --- | --- |
| **Physical Sciences 1:** *Matter and Its Interactions* | 1–3 | 1–5 | 2–7 | 0–1 |
| **Physical Sciences 2:** *Motion and Stability: Forces and Interactions* | 1–4 | 1–4 | 1–5 | 0–1 |
| **Physical Sciences 3:** *Energy* | 1–4 | 1–4 | 1–4 | 0–1 |
| **Physical Sciences 4:** *Waves and Their Applications in Technologies for Information Transfer* | 1–2 | 1–2 | 1–4 | 0–1 |
| **Engineering, Technology, and Applications of Science:** *Engineering Design* | 0–1 | 0–1 | 0–1 | 0–1 |
| **Total Physical Sciences Items or Performance Tasks** | **8–9** | **8–10** | **9–12** | **1** |
| **Life Sciences 1:** *From Molecules to Organisms: Structures and Processes* | 1–2 | 1–6 | 1–6 | 0–1 |
| **Life Sciences 2:** *Ecosystems: Interactions, Energy, and Dynamics* | 1–2 | 1–4 | 1–7 | 0–1 |
| **Life Sciences 3:** *Heredity: Inheritance and Variation of Traits* | 1–2 | 1–2 | 1–2 | 0–1 |
| **Life Sciences 4:** *Biological Evolution: Unity and Diversity* | 1–4 | 1–5 | 1–5 | 0–1 |
| **Engineering, Technology, and Applications of Science:** *Engineering Design* | 0–1 | 0–1 | 0–1 | 0–1 |
| **Total Life Sciences Items or Performance Tasks** | **8–9** | **8–10** | **9–12** | **1** |
| **Earth and Space Sciences 1:** *Earth’s Place in the Universe* | 1–2 | 1–3 | 1–5 | 0–1 |
| **Earth and Space Sciences 2:** *Earth’s Systems* | 1–5 | 1–5 | 1–6 | 0–1 |
| **Earth and Space Sciences 3:** *Earth and Human Activity* | 1–3 | 1–4 | 1–5 | 0–1 |
| **Engineering, Technology, and Applications of Science:** *Engineering Design* | 0–1 | 0–1 | 0–1 | 0–1 |
| **Total Earth and Space Sciences Items or Performance Tasks** | **8–9** | **8–10** | **9–12** | **1** |
| **Operational Items (and Points) per Form per Grade Level (Segments A and B)** | 26 Discrete Items (28–32 Points) | 28 Discrete Items (30–34 Points) | 32 Discrete Items (34–38 Points) | 3 PTs, 12–18 Items (18–21 Points) |

\*\*The CAST Item Specifications provide greater detail on the assessment targets by Performance Expectation.

## CAST Segment C

[Table 3](#_bookmark6) shows the additional items by science domain and DCI strand that will be assessed in Segment C. In Segment C, each student will complete either a block of discrete field test items or one field test PT.

Note that each assessment draws on PEs from several grades. The grade five assessment draws on PEs from grades three through five (3–5) and includes the foundational concepts that are addressed in kindergarten through grade two (K–2). The grade eight assessment draws on PEs from grades six through eight (6–8), and the high school assessment draws on PEs from grades nine through twelve (9–12).

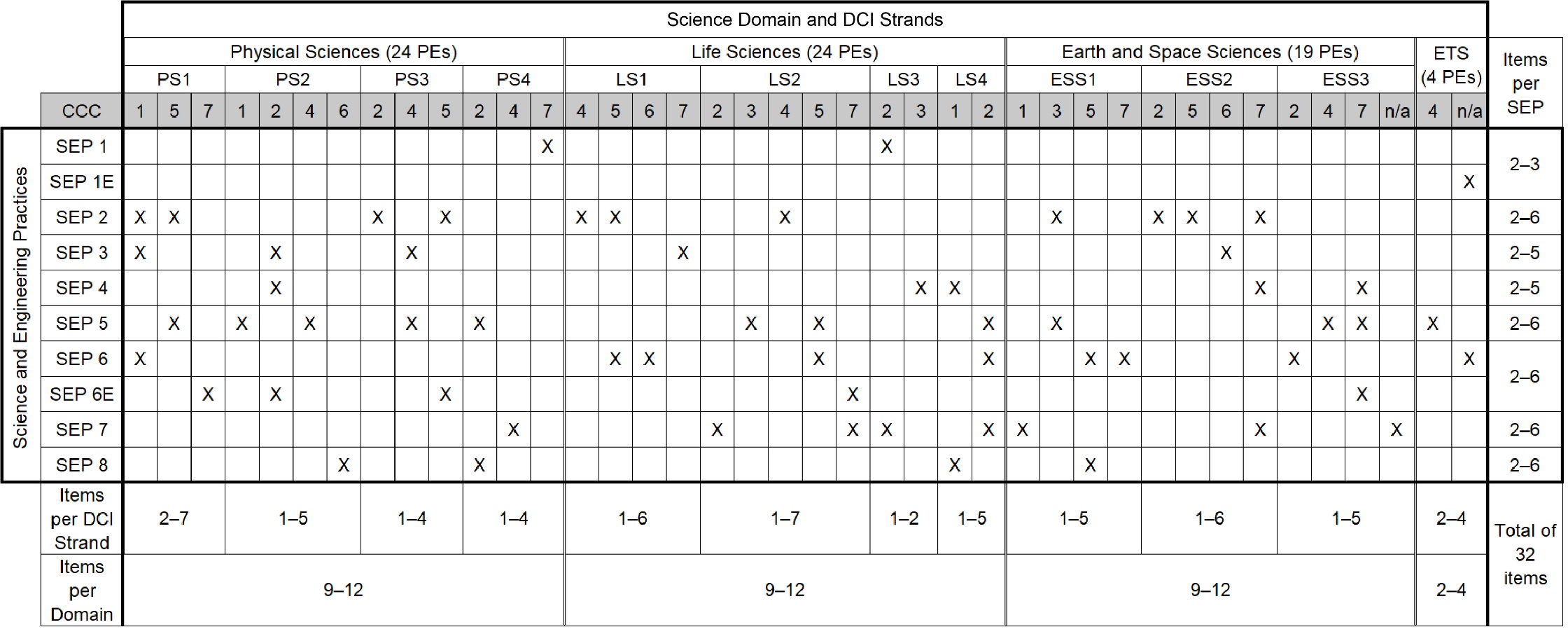
### Table 3. Segment C—Assessed in Grades Five and Eight and in High School

| **Science Domain and DCI Strand** | **Discrete Items** | **Performance Task Items (PT)** |
| --- | --- | --- |
| **Physical Sciences 1:** *Matter and Its Interactions* | 0–1 | 0–6 |
| **Physical Sciences 2:** *Motion and Stability: Forces and Interactions* | 0–1 | 0–6 |
| **Physical Sciences 3:** *Energy* | 0–1 | 0–6 |
| **Physical Sciences 4:** *Waves and Their Applications in Technologies for Information Transfer* | 0–1 | 0–6 |
| **Engineering, Technology, and Applications of Science:** *Engineering Design* | 0–1 | 0–4 |
| **Total Physical Sciences Items** | **2** | **6** |
| **Life Sciences 1:** *From Molecules to Organisms: Structures and Processes* | 0–1 | 0–6 |
| **Life Sciences 2:** *Ecosystems: Interactions, Energy, and Dynamics* | 0–1 | 0–6 |
| **Life Sciences 3:** *Heredity: Inheritance and Variation of Traits* | 0–1 | 0–6 |
| **Life Sciences 4:** *Biological Evolution: Unity and Diversity* | 0–1 | 0–6 |
| **Engineering, Technology, and Applications of Science:** *Engineering Design* | 0–1 | 0–4 |
| **Total Life Sciences Items** | **2** | **6** |
| **Earth and Space Sciences 1:** *Earth’s Place in the Universe* | 0–1 | 0–6 |
| **Earth and Space Sciences 2:** *Earth’s Systems* | 0–1 | 0–6 |
| **Earth and Space Sciences 3:** *Earth and Human Activity* | 0–1 | 0–6 |
| **Engineering, Technology, and Applications of Science:** *Engineering Design* | 0–1 | 0–4 |
| **Total Earth and Space Sciences Items** | **2** | **6** |
| **Field Test Items per Form (Segment C)** | 6 Field Test Discrete Items | 6 Field Test Performance Task Items |

## Segment A—Details of PE Distribution for High School Assessment

Segment A is designed to assess a student’s mastery of a breadth of PEs of the CA NGSS in high school (9–12). [Table 4](#_bookmark8) displays an "X" for the intersections of SEPs, DCIs, and CCCs articulated in the PEs. These intersections represent opportunities to develop items that can be used to assemble Segment A. While each individual item reflects the intersection of a SEP, DCI, and CCC, the table that follows indicates the proposed distribution of Segment A items by DCI, SEP, and CCC.

### Table 4. PE Distribution for Segment A of the CAST High School Assessment

\* For scoring and reporting purposes, items written to assess PEs associated with Engineering, Technology, and Application of Science will be assigned to one of the three science domains, depending upon the context of their stimulus.

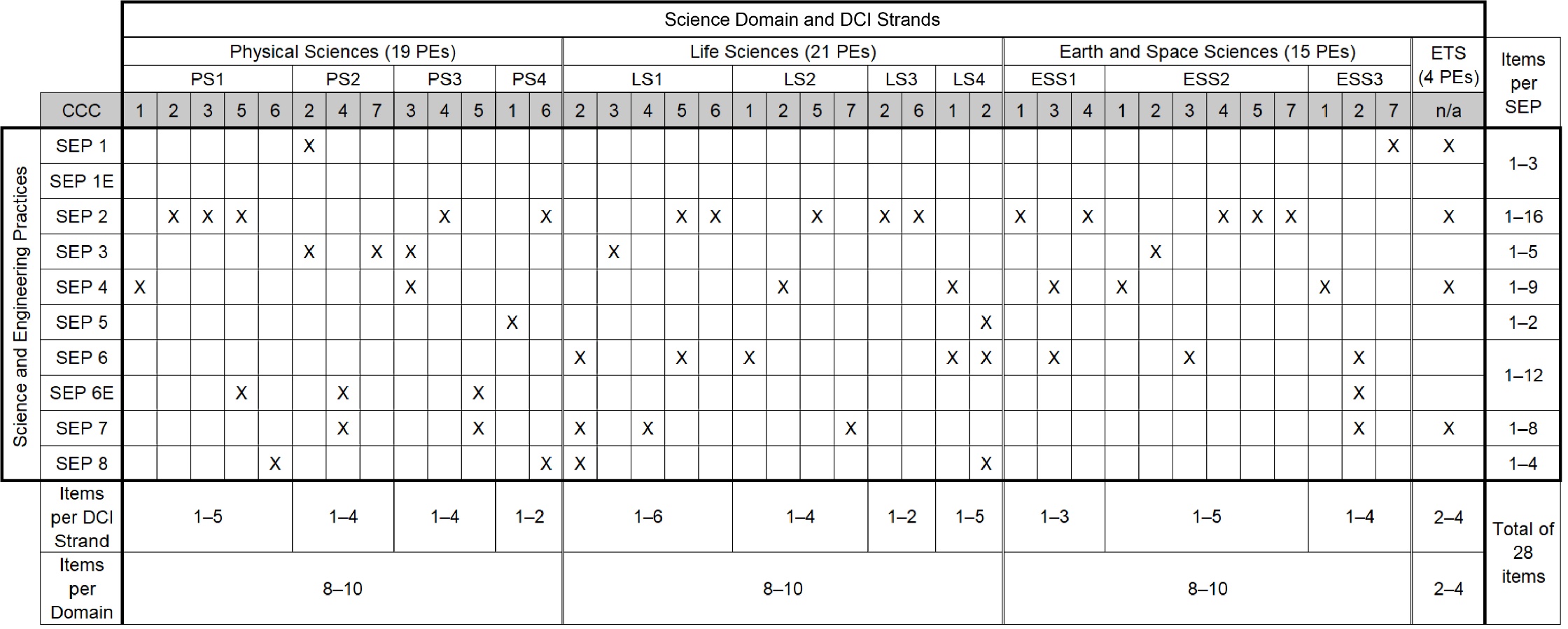
### Notes on [Table 4](#_bookmark8):

* X indicates that there is at least one PE at the given intersection of the three dimensions that can be sampled on a test form for Segment A.
* N/A indicates there is no CCC for at least some of the PEs in the column.
* SEPs 1 and 6 have separate components for science and engineering (SEP 1E and SEP 6E). All other SEPs incorporate the same components for both science and engineering.
  + CA NGSS calls out the distinctive purposes of practices primarily in two specific SEPs: SEP 1 and SEP 6. For SEP 1 in science (SEP 1), the practice focuses on identifying questions about phenomena. For SEP 1 in engineering (SEP 1E), the practice focuses on defining a problem to be solved. For SEP 6 in science (SEP 6), the goal of the practice is to construct logically coherent explanations of phenomena to incorporate students’ current understanding of science. For SEP 6 in engineering (SEP 6E), the goal is to propose design solutions to balance competing criteria of desired functions.
* Details on the naming conventions and full names of SEPs, DCIs, and CCCs are provided in Appendix B: Full Titles for SEPs, DCIs, and CCCs.

## Segment A—Details of PE Distribution for Grade Eight Assessment

Segment A is designed to assess a student’s mastery of a breadth of PEs of the CA NGSS in grades six through eight (6–8). Table 5 displays an "X" for the intersections of SEPs, DCIs, and CCCs articulated in the PEs. These intersections represent opportunities to develop items that can be used to assemble Segment A. While each individual item reflects the intersection of a SEP, DCI, and CCC, the table that follows indicates the proposed distribution of Segment A items by DCI, SEP, and CCC.

### Table 5. PE Distribution for Segment A of the CAST Grade Eight Assessment

\* For scoring and reporting purposes, items written to assess PEs associated with Engineering, Technology, and Application of Science will be assigned to one of the three science domains, depending upon the context of their stimulus.

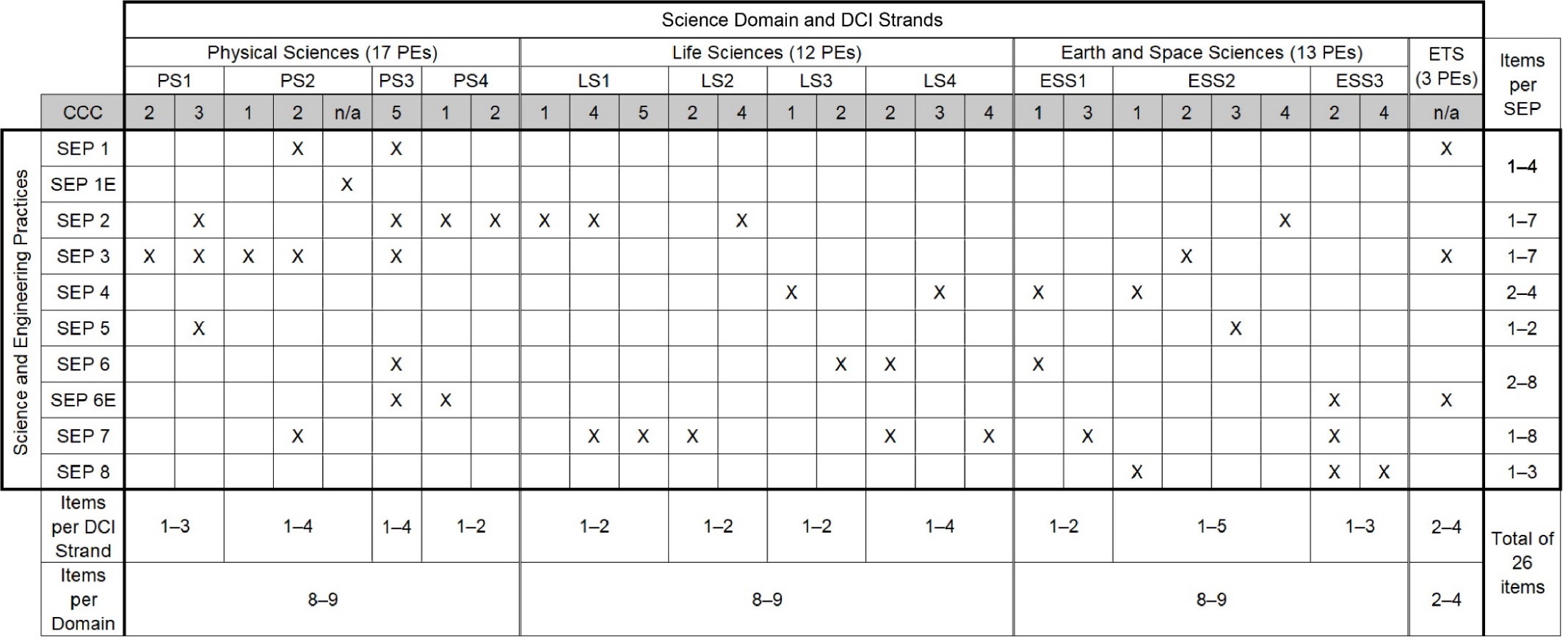
### Notes on Table 5:

* X indicates that there is at least one PE at the given intersection of the three dimensions that can be sampled on a test form for Segment A.
* N/A indicates there is no CCC for at least some of the PEs in the column.
* SEPs 1 and 6 have separate components for science and engineering (SEP 1E and SEP 6E). All other SEPs incorporate the same components for both science and engineering.
  + CA NGSS calls out the distinctive purposes of practices primarily in two specific SEPs: SEP 1 and SEP 6. For SEP 1 in science (SEP 1), the practice focuses on identifying questions about phenomena. For SEP 1 in engineering (SEP 1E), the practice focuses on defining a problem to be solved. For SEP 6 in science (SEP 6), the goal of the practice is to construct logically coherent explanations of phenomena to incorporate students’ current understanding of science. For SEP 6 in engineering (SEP 6E), the goal is to propose design solutions to balance competing criteria of desired functions.
* Details on the naming conventions and full names of SEPs, DCIs, and CCCs are provided in Appendix B: Full Titles for SEPs, DCIs, and CCCs.

## Segment A—Details of PE Distribution for Grade Five Assessment

Segment A is designed to assess a student’s mastery of a breadth of PEs of the CA NGSS in grades three through five (3–‍5) and includes the foundational concepts that are introduced in kindergarten through grade two (K–2). Table 6 displays an "X" for the intersections of SEPs, DCIs, and CCCs articulated in the PEs. These intersections represent opportunities to develop items that can be used to assemble Segment A. While each individual item reflects the intersection of a SEP, DCI, and CCC, the tables that follow indicate the proposed distribution of Segment A items by DCI, SEP, and CCC.

### Table 6. PE Distribution for Segment A of the CAST Grade 5 Assessment



\* For scoring and reporting purposes, items written to assess PEs associated with Engineering, Technology, and Application of Science will be assigned to one of the three science domains, depending upon the context of their stimulus.

### Notes on Table 6:

* X indicates that there is at least one PE at the given intersection of the three dimensions that can be sampled on a test form for Segment A.
* N/A indicates there is no CCC for at least some of the PEs in the column.
* SEPs 1 and 6 have separate components for science and engineering (SEP 1E and SEP 6E). All other SEPs incorporate the same components for both science and engineering.
  + CA NGSS calls out the distinctive purposes of practices primarily in two specific SEPs: SEP 1 and SEP 6. For SEP 1 in science (SEP 1), the practice focuses on identifying questions about phenomena. For SEP 1 in engineering (SEP 1E), the practice focuses on defining a problem to be solved. For SEP 6 in science (SEP 6), the goal of the practice is to construct logically coherent explanations of phenomena to incorporate students’ current understanding of science. For SEP 6 in engineering (SEP 6E), the goal is to propose design solutions to balance competing criteria of desired functions.
* Details on the naming conventions and full names of SEPs, DCIs, and CCCs are provided in Appendix B: Full Titles for SEPs, DCIs, and CCCs.

## Appendix A: Guidance on Interpreting [Table 4](#_bookmark8), [Table 5](#_bookmark10), and [Table 6](#_bookmark12)

| **Excerpt** | **Description** |
| --- | --- |
| Image of the excerpt (from Table 4), in which the “X” corresponds to a PE that has DCI(s) in the PS1 strand and is coded to SEP 2 (Developing and Using Models) and CCC 5 (Energy and Matter). | In the excerpt shown (from [Table 4](#_bookmark8)), the “X” corresponds to a PE that has DCI(s) in the PS1 strand and is coded to SEP 2 (Developing and Using Models) and CCC 5 (Energy and Matter).  The corresponding PE, HS-PS1-4, is excerpted from the CA NGSS Item Specifications on the CDE website here:  <https://www.cde.ca.gov/ta/tg/ca/documents/itemspecs-hs-ps1-4.docx> |

## Appendix B: Full Titles for SEPs, DCIs, and CCCs

### Science and Engineering Practices (SEPs)

SEP 1—Asking Questions (Science)

SEP 1E—Defining Problems (Engineering)

SEP 2—Developing and Using Models

SEP 3—Planning and Carrying Out Investigations

SEP 4—Analyzing and Interpreting Data

SEP 5—Using Mathematics and Computational Thinking

SEP 6—Constructing Explanations (Science)

SEP 6E—Designing Solutions (Engineering)

SEP 7—Engaging in Argument from Evidence

SEP 8—Obtaining, Evaluating, and Communicating Information

### Disciplinary Core Ideas (DCIs)

PS1—Matter and Its Interactions

PS2—Motion and Stability: Forces and Interactions

PS3—Energy

PS4—Waves and Their Applications in Technologies for Information Transfer

LS1—From Molecules to Organisms: Structures and Processes

LS2—Ecosystems: Interactions, Energy, and Dynamics

LS3—Heredity: Inheritance and Variation of Traits

LS4—Biological Evolution: Unity and Diversity

ESS1—Earth’s Place in the Universe

ESS2—Earth’s Systems

ESS3—Earth and Human Activity

ETS1—Engineering, Technology, and Application of Science

### Crosscutting Concepts (CCCs)

1—Patterns

2—Cause and effect

3—Scale, proportion, and quantity

4—Systems and system models

5—Energy and matter

6—Structure and function

7—Stability and change

## Appendix C: Details from Table 4

In the table, an X indicates that there is at least one Performance Expectation (PE) at the given intersection of the three dimensions that can be sampled on a test form for Segment A. The table has an X only in the locations described in the bulleted text that follows for each science domain and the Engineering, Technology, and Applications of Science (ETS) sub-domain.

In the Physical Sciences (PS) domain for high school, there are twenty-four PEs, organized into four Disciplinary Core Idea (DCI) strands, that are distributed among the eight Science and Engineering Practices (SEPs) and six of the seven Crosscutting Concepts (CCCs).

* For the science component of SEP 1, there is at least one PE in DCI strand PS4, with CCC 7.
* For SEP 2, there are at least four PEs.
  + There are at least two PEs in DCI strand PS1, with CCC 1 and CCC 5.
  + There are at least two PEs in DCI strand PS3, with CCC 2 and CCC 5.
* For SEP 3, there are at least three PEs.
  + There is at least one PE in DCI strand PS1, with CCC 1.
  + There is at least one PE in DCI strand PS2, with CCC 2.
  + There is at least one PE in DCI strand PS3, with CCC 4.
* For SEP 4, there is at least one PE in DCI strand PS2, with CCC 2.
* For SEP 5, there are at least five PEs.
  + There is at least one PE in DCI strand PS1, with CCC 5.
  + There are at least two PEs in DCI strand PS2, with CCC 1 and CCC 4.
  + There is at least one PE in DCI strand PS3, with CCC 4.
  + There is at least one PE in DCI strand PS4, with CCC 2.
* For the science component of SEP 6, there is at least one PE in DCI strand PS1, with CCC 1.
* For the engineering component of SEP 6 (SEP 6E), there are at least three PEs.
  + There is at least one PE in DCI strand PS1, with CCC 7.
  + There is at least one PE in DCI strand PS2, with CCC 2.
  + There is at least one PE in DCI strand PS3, with CCC 5.
* For SEP 7, there is at least one PE in DCI strand PS4, with CCC 4.
* For SEP 8, there are at least two PEs.
  + There is at least one PE in DCI strand PS2, with CCC 6.
  + There is at least one PE in DCI strand PS4, with CCC 2.

The range of items per DCI strand is described as follows:

* Between two and seven items aligned to PEs from DCI strand PS1 will be assessed on Segment A of the CAST.
* Between one and five items aligned to PEs from DCI strand PS2 will be assessed on Segment A of the CAST.
* Between one and four items aligned to PEs from DCI strand PS3 will be assessed on Segment A of the CAST.
* Between one and four items aligned to PEs from DCI strand PS4 will be assessed on Segment A of the CAST.

For the entire PS domain, between nine and twelve items will be assessed on Segment A of the CAST.

In the Life Sciences (LS) domain for high school, there are twenty-four PEs, organized into four DCI strands, that are distributed among eight SEPs and seven CCCs.

* For the science component of SEP 1, there is at least one PE in DCI strand LS3, with CCC 2.
* For SEP 2, there are at least three PEs.
  + There are at least two PEs in DCI strand LS1, with CCC 4 and CCC 5.
  + There is at least one PE in DCI strand LS2, with CCC 4.
* For SEP 3, there is at least one PE in DCI strand LS1, with CCC 7.
* For SEP 4, there are at least two PEs.
  + There is at least one PE in DCI strand LS3, with CCC 3.
  + There is at least one PE in DCI strand LS4, with CCC 1.
* For SEP 5, there are at least three PEs.
  + There are at least two PEs in DCI strand LS2, with CCC 3 and CCC 5.
  + There is at least one PE in DCI strand LS4, with CCC 2.
* For the science component of SEP 6, there are at least four PEs.
  + There are at least two PEs in DCI strand LS1, with CCC 5 and CCC 6.
  + There is at least one PE in DCI strand LS2, with CCC 5.
  + There is at least one PE in DCI strand LS4, with CCC 2.
* For the engineering component of SEP 6 (SEP 6E), there is at least one PE in DCI strand LS2, with CCC 7.
* For SEP 7, there are at least four PEs.
  + There are at least two PEs in DCI strand LS2, with CCC 2 and CCC 7.
  + There is at least one PE in DCI strand LS3, with CCC 2.
  + There is at least one PE in DCI strand LS4, with CCC 2.
* For SEP 8, there is at least one PE in DCI strand LS4, with CCC 1.

The range of items per DCI strand is described as follows:

* Between one and six items aligned to PEs from DCI strand LS1 will be assessed on Segment A of the CAST.
* Between one and seven items aligned to PEs from DCI strand LS2 will be assessed on Segment A of the CAST.
* Between one and two items aligned to PEs from DCI strand LS3 will be assessed on Segment A of the CAST.
* Between one and five items aligned to PEs from DCI strand LS4 will be assessed on Segment A of the CAST.

For the entire LS domain, between nine and twelve items will be assessed on Segment A of the CAST.

In the Earth and Space Sciences (ESS) domain for high school, there are nineteen PEs, organized into three DCI strands, that are distributed among seven of the eight SEPs and seven CCCs.

* For SEP 2, there are at least four PEs.
  + There is at least one PE in DCI strand ESS1, with CCC 3.
  + There are at least three PEs in DCI strand ESS2, with CCC 2, CCC 5, and CCC 7.
* For SEP 3, there is at least one PE in DCI strand ESS2, with CCC 6.
* For SEP 4, there are at least two PEs.
  + There is at least one PE in DCI strand ESS2, with CCC 7.
  + There is at least one PE in DCI strand ESS3, with CCC 7.
* For SEP 5, there are at least three PEs.
  + There is at least one PE in DCI strand ESS1, with CCC 3.
  + There are at least two PEs in DCI strand ESS3, with CCC 4 and CCC 7.
* For the science component of SEP 6, there are at least three PEs.
  + There are at least two PEs in DCI strand ESS1, with CCC 5 and CCC 7.
  + There is at least one PE in DCI strand ESS3, with CCC 2.
* For the engineering component of SEP 6 (SEP 6E), there is at least one PE in DCI strand ESS3, with CCC 7.
* For SEP 7, there are at least three PEs.
  + There is at least one PE in DCI strand ESS1, with CCC 1.
  + There is at least one PE in DCI strand ESS2, with CCC 7.
  + There is at least one PE in DCI strand ESS3, with no CCC.
* For SEP 8, there is at least one PE in DCI strand ESS1, with CCC 5.

The range of items per DCI strand is described as follows:

* Between one and five items aligned to PEs from DCI strand ESS1 will be assessed on Segment A of the CAST.
* Between one and six items aligned to PEs from DCI strand ESS2 will be assessed on Segment A of the CAST.
* Between one and five items aligned to PEs from DCI strand ESS3 will be assessed on Segment A of the CAST.

For the entire ESS domain, between nine and twelve items will be assessed on Segment A of the CAST.

In the ETS sub-domain for high school, there are four PEs, organized into one DCI strand, that are distributed among three of the eight SEPs and one of the seven CCCs.

* For the engineering component of SEP 1 (SEP 1E), there is at least one PE in the DCI strand ETS1, with no CCC.
* For SEP 5, there is at least one PE in the DCI strand ETS1, with CCC 4.
* For the science component of SEP 6, there is at least one PE in the DCI strand ETS1, with no CCC.

The range of items per DCI strand is described as follows:

* Between two and four items aligned to PEs from DCI strand ETS1 will be assessed on Segment A of the CAST.

For the entire ETS sub-domain, between two and four items will be assessed on Segment A of the CAST.

The range of items per SEP across all domains is described as follows:

* Between two and three items representing both the science and engineering components of SEP 1 will be assessed on Segment A of the CAST.
* Between two and six items representing SEP 2 will be assessed on Segment A of the CAST.
* Between two and five items representing SEP 3 will be assessed on Segment A of the CAST.
* Between two and five items representing SEP 4 will be assessed on Segment A of the CAST.
* Between two and six items representing SEP 5 will be assessed on Segment A of the CAST.
* Between two and six items representing both the science and engineering components of SEP 6 will be assessed on Segment A of the CAST.
* Between two and six items representing SEP 7 will be assessed on Segment A of the CAST.
* Between two and six items representing SEP 8 will be assessed on Segment A of the CAST.

For high school, a total of thirty-two items representing a selection of PEs across all three science domains and the ETS sub‑domain will be assessed on Segment A of the CAST.

## Appendix D: Details from Table 5

In the table, an X indicates that there is at least one performance expectation (PE) at the given intersection of the three dimensions that can be sampled on a test form for Segment A. The table has an X only in the locations described in the bulleted text that follows for each science domain and the Engineering, Technology, and Applications of Science (ETS) sub-domain.

In the Physical Sciences (PS) domain for grade eight, there are nineteen PEs, organized into four Disciplinary Core Idea (DCI) strands, that are distributed among eight Science and Engineering Practices (SEPs) and seven Crosscutting Concepts (CCCs).

* For the science component of SEP 1, there is at least one PE in DCI strand PS2, with CCC 2.
* For SEP 2, there are at least five PEs.
  + There are at least three PEs in DCI strand PS1, with CCC 2, CCC 3, and CCC 5.
  + There is at least one PE in DCI strand PS3, with CCC 4.
  + There is at least one PE in DCI strand PS4, with CCC 6.
* For SEP 3, there are at least three PEs.
  + There are at least two PEs in DCI strand PS2, with CCC 2 and CCC 7.
  + There is at least one PE in DCI strand PS3, with CCC 3.
* For SEP 4, there are at least two PEs.
  + There is at least one PE in DCI strand PS1, with CCC 1.
  + There is at least one PE in DCI strand PS3, with CCC 3.
* For SEP 5, there is at least one PE in DCI strand PS4, with CCC 1.
* For the engineering component of SEP 6 (SEP 6E), there are at least three PEs.
  + There is at least one PE in DCI strand PS1, with CCC 5.
  + There is at least one PE in DCI strand PS2, with CCC 4.
  + There is at least one PE in DCI strand PS3, with CCC 5.
* For SEP 7, there are at least two PEs.
  + There is at least one PE in DCI strand PS2, with CCC 4.
  + There is at least one PE in DCI strand PS3, with CCC 5.
* For SEP 8, there are at least two PEs.
  + There is at least one PE in DCI strand PS1, with CCC 6.
  + There is at least one PE in DCI strand PS4, with CCC 6.

The range of items per DCI strand is described as follows:

* Between one and five items aligned to PEs from DCI strand PS1 will be assessed on Segment A of the CAST.
* Between one and four items aligned to PEs from DCI strand PS2 will be assessed on Segment A of the CAST.
* Between one and four items aligned to PEs from DCI strand PS3 will be assessed on Segment A of the CAST.
* Between one and two items aligned to PEs from DCI strand PS4 will be assessed on Segment A of the CAST.

For the entire PS domain, between eight and ten items will be assessed on Segment A of the CAST.

In the Life Sciences (LS) domain for grade eight, there are twenty-one PEs, organized into four DCI strands, that are distributed among seven of the eight SEPs and seven CCCs.

* For SEP 2, there are at least five PEs.
  + There are at least two PEs in DCI strand LS1, with CCC 5 and CCC 6.
  + There is at least one PE in DCI strand LS2, with CCC 5.
  + There are at least two PEs in DCI strand LS3, with CCC 2 and CCC 6.
* For SEP 3, there is at least one PE in DCI strand LS1, with CCC 3.
* For SEP 4, there are at least two PEs.
  + There is at least one PE in DCI strand LS2, with CCC 2.
  + There is at least one PE in DCI strand LS4, with CCC 1.
* For SEP 5, there is at least one PE in DCI strand LS4, with CCC 2.
* For the science component of SEP 6 (SEP 6), there are at least five PEs.
  + There are at least two PEs in DCI strand LS1, with CCC 2 and CCC 5.
  + There is at least one PE in DCI strand LS2, with CCC 1.
  + There are at least two PEs in DCI strand LS4, with CCC 1 and CCC 2.
* For SEP 7, there are at least three PEs.
  + There are at least two PEs in DCI strand LS1, with CCC 2 and CCC 4.
  + There is at least one PE in DCI strand LS2, with CCC 7.
* For SEP 8, there are at least two PEs.
  + There is at least one PE in DCI strand LS1, with CCC 2.
  + There is at least one PE in DCI strand LS4, with CCC 2.

The range of items per DCI strand is described as follows:

* Between one and six items aligned to PEs from DCI strand LS1 will be assessed on Segment A of the CAST.
* Between one and four items aligned to PEs from DCI strand LS2 will be assessed on Segment A of the CAST.
* Between one and two items aligned to PEs from DCI strand LS3 will be assessed on Segment A of the CAST.
* Between one and five items aligned to PEs from DCI strand LS4 will be assessed on Segment A of the CAST.

For the entire LS domain, between eight and ten items will be assessed on Segment A of the CAST.

In the Earth and Space Sciences (ESS) domain for grade eight, there are fifteen PEs, organized into three DCI strands, that are distributed among six of the eight SEPs and six of the seven CCCs.

* For the science component of SEP 1, there is at least one PE in DCI strand ESS3, with CCC 7.
* For SEP 2, there are at least five PEs.
  + There are at least two PEs in DCI strand ESS1, with CCC 1 and CCC 4.
  + There are at least three PEs in DCI strand ESS2, with CCC 4, CCC 5, and CCC 7.
* For SEP 3, there is at least one PE in DCI strand ESS2, with CCC 2.
* For SEP 4, there are at least three PEs.
  + There is at least one PE in DCI strand ESS1, with CCC 3.
  + There is at least one PE in DCI strand ESS2, with CCC 1.
  + There is at least one PE in DCI strand ESS3, with CCC 1.
* For the science component of SEP 6, there are at least three PEs.
  + There is at least one PE in DCI strand ESS1, with CCC 3.
  + There is at least one PE in DCI strand ESS2, with CCC 3.
  + There is at least one PE in DCI strand ESS3, with CCC 2.
* For the engineering component of SEP 6 (SEP 6E), there is at least one PE in DCI strand ESS3, with CCC 2.
* For SEP 7, there is at least one PE in DCI strand ESS3, with CCC 2.

The range of items per DCI strand is described as follows:

* Between one and three items aligned to PEs from DCI strand ESS1 will be assessed on Segment A of the CAST.
* Between one and five items aligned to PEs from DCI strand ESS2 will be assessed on Segment A of the CAST.
* Between one and four items aligned to PEs from DCI strand ESS3 will be assessed on Segment A of the CAST.

For the entire ESS domain, between eight and ten items will be assessed on Segment A of the CAST.

In the ETS sub-domain for grade eight, there are four PEs, organized into one DCI strand, that are distributed among four of the eight SEPs and no CCCs.

* For the science component of SEP 1, there is at least one PE aligned to DCI strand ETS1.
* For SEP 2, there is at least one PE aligned to DCI strand ETS1.
* For SEP 4, there is at least one PE aligned to DCI strand ETS1.
* For SEP 7, there is at least one PE aligned to DCI strand ETS1.

The range of items per DCI strand is described as follows:

* Between two and four items aligned to PEs from DCI strand ETS1 will be assessed on Segment A of the CAST.

For the entire ETS sub-domain, between two and four items will be assessed on Segment A of the CAST.

The range of items per SEP across all domains is described as follows:

* Between one and three items representing both the science and engineering components of SEP 1 will be assessed on Segment A of the CAST.
* Between one and sixteen items representing SEP 2 will be assessed on Segment A of the CAST.
* Between one and five items representing SEP 3 will be assessed on Segment A of the CAST.
* Between one and nine items representing SEP 4 will be assessed on Segment A of the CAST.
* Between one and two items representing SEP 5 will be assessed on Segment A of the CAST.
* Between one and twelve items representing both the science and engineering components of SEP 6 will be assessed on Segment A of the CAST.
* Between one and eight items representing SEP 7 will be assessed on Segment A of the CAST.
* Between one and four items representing SEP 8 will be assessed on Segment A of the CAST.

For grade eight, a total of twenty-eight items representing a selection of PEs across all three science domains and the ETS sub‑domain will be assessed on Segment A of the CAST.

## Appendix E: Details from Table 6

In the table, an X indicates that there is at least one Performance Expectation (PE) at the given intersection of the three dimensions that can be sampled on a test form for Segment A. The table has an X only in the locations described in the bulleted text that follows for each science domain and the Engineering, Technology, and Applications of Science (ETS) sub-domain.

In the Physical Sciences (PS) domain for grade five, there are seventeen PEs, organized into four Disciplinary Core Idea (DCI) strands, that are distributed among six of the eight Science and Engineering Practices (SEPs) and four of the seven Crosscutting Concepts (CCCs).

* For the science component of SEP 1, there are at least two PEs.
  + There is at least one PE in DCI strand PS2, with CCC 2.
  + There is at least one PE in DCI strand PS3, with CCC 5.
* For the engineering component of SEP 1 (SEP 1E), there is at least one PE in DCI strand PS2, with no CCC.
* For SEP 2, there are at least four PEs.
  + There is at least one PE in DCI strand PS1, with CCC 3.
  + There is at least one PE in DCI strand PS3, with CCC 5.
  + There are at least two PEs in DCI strand PS4, with CCC 1 and CCC 2.
* For SEP 3, there are at least five PEs.
  + There are at least two PEs in DCI strand PS1, with CCC 2 and CCC 3.
  + There are at least two PEs in DCI strand PS2, with CCC 1 and CCC 2.
  + There is at least one PE in DCI strand PS4, with CCC 5.
* For SEP 5, there is at least one PE in DCI strand PS1, with CCC 3.
* For the science component of SEP 6, there is at least one PE in DCI strand PS3, with CCC 5.
* For the engineering component of SEP 6 (SEP 6E), there are at least two PEs.
  + There is at least one PE in DCI strand PS3, with CCC 5.
  + There is at least one PE in DCI strand PS4, with CCC 1.
* For SEP 7, there is at least one PE in DCI strand PS2, with CCC 2.

The range of items per DCI strand is described as follows:

* Between one and three items aligned to PEs from DCI strand PS1 will be assessed on Segment A of the CAST.
* Between one and four items aligned to PEs from DCI strand PS2 will be assessed on Segment A of the CAST.
* Between one and four items aligned to PEs from DCI strand PS3 will be assessed on Segment A of the CAST.
* Between one and two items aligned to PEs from DCI strand PS4 will be assessed on Segment A of the CAST.

For the entire PS domain, between eight and nine items will be assessed on Segment A of the CAST.

In the Life Sciences (LS) domain for grade five, there are twelve PEs, organized into four DCI strands, that are distributed among four of the eight SEPs and five of the seven CCCs.

* For SEP 2, there are at least three PEs.
  + There are at least two PEs in DCI strand LS1, with CCC 1 and CCC 4.
  + There is at least one PE in DCI strand LS2, with CCC 4.
* For SEP 4, there are at least two PEs.
  + There is at least one PE in DCI strand LS3, with CCC 1.
  + There is at least one PE in DCI strand LS4, with CCC 3.
* For the science component of SEP 6 (SEP 6), there are at least two PEs.
  + There is at least one PE in DCI strand LS3, with CCC 2.
  + There is at least one PE in DCI strand LS4, with CCC 2.
* For SEP 7, there are at least five PEs.
  + There are at least two PEs in DCI strand LS1, with CCC 4 and CCC 5.
  + There is at least one PE in DCI strand LS2, with CCC 2.
  + There are at least two PEs in DCI strand LS4, with CCC 2 and CCC 4.

The range of items per DCI strand is described as follows:

* Between one and two items aligned to PEs from DCI strand LS1 will be assessed on Segment A of the CAST.
* Between one and two items aligned to PEs from DCI strand LS2 will be assessed on Segment A of the CAST.
* Between one and two items aligned to PEs from DCI strand LS3 will be assessed on Segment A of the CAST.
* Between one and four items aligned to PEs from DCI strand LS4 will be assessed on Segment A of the CAST.

For the entire LS domain, between eight and nine items will be assessed on Segment A of the CAST.

In the Earth and Space Sciences (ESS) domain for grade five, there are thirteen PEs, organized into three DCI strands, that are distributed among seven of the eight SEPs and four of the seven CCCs.

* For SEP 2, there is at least one PE in DCI strand ESS2, with CCC 4.
* For SEP 3, there is at least one PE in DCI strand ESS2, with CCC 2.
* For SEP 4, there are at least two PEs.
  + There is at least one PE in DCI strand ESS1, with CCC 1.
  + There is at least one PE in DCI strand ESS2, with CCC 1.
* For SEP 5, there is at least one PE in DCI strand ESS2, with CCC 3.
* For the science component of SEP 6, there is at least one PE in DCI strand ESS1, with CCC 1.
* For the engineering component of SEP 6 (SEP 6E), there is at least one PE in DCI strand ESS3, with CCC 2.
* For SEP 7, there are at least two PEs.
  + There is at least one PE in DCI strand ESS1, with CCC 3.
  + There is at least one PE in DCI strand ESS3, with CCC 2.
* For SEP 8, there are at least three PEs.
  + There is at least one PE in DCI strand ESS2, with CCC 1.
  + There are at least two PEs in DCI strand ESS3, with CCC 2 and CCC 4.

The range of items per DCI strand is described as follows:

* Between one and two items aligned to PEs from DCI strand ESS1 will be assessed on Segment A of the CAST.
* Between one and five items aligned to PEs from DCI strand ESS2 will be assessed on Segment A of the CAST.
* Between one and three items aligned to PEs from DCI strand ESS3 will be assessed on Segment A of the CAST.

For the entire ESS domain, between eight and nine items will be assessed on Segment A of the CAST.

In the ETS sub-domain for grade five, there are three PEs, organized into one DCI strand, that are distributed among three of the eight SEPs and no CCCs.

* For the science component of SEP 1, there is at least one PE.
* For SEP 3, there is at least one PE.
* For the engineering component of SEP 6 (SEP 6E), there is at least one PE.

The range of items per DCI strand is described as follows:

* Between two and four items aligned to PEs from DCI strand ETS1 will be assessed on Segment A of the CAST.

For the entire ETS sub-domain, between two and four items will be assessed on Segment A of the CAST.

The range of items per SEP across all domains in grade five is described as follows:

* Between one and four items representing both the science and engineering components of SEP 1 will be assessed on Segment A of the CAST.
* Between one and seven items representing SEP 2 will be assessed on Segment A of the CAST.
* Between one and seven items representing SEP 3 will be assessed on Segment A of the CAST.
* Between two and four items representing SEP 4 will be assessed on Segment A of the CAST.
* Between one and two items representing SEP 5 will be assessed on Segment A of the CAST.
* Between two and eight items representing both the science and engineering components of SEP 6 will be assessed on Segment A of the CAST.
* Between one and eight items representing SEP 7 will be assessed on Segment A of the CAST.
* Between one and three items representing SEP 8 will be assessed on Segment A of the CAST.

In grade five, a total of thirty-two items representing a selection of PEs across all three science domains and the ETS sub-domain will be assessed on Segment A of the CAST.



# Proposed Data-Driven Improvements to the California Science Test Blueprint

**Contract #CN150012**

**Prepared for the California Department of Education by Educational Testing Service**

**Presented November 26, 2019**

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## Introduction

In March 2016, the California State Board of Education (SBE) approved the original, high-level test design for a general summative assessment developed to the California Next Generation Science Standards (CA NGSS). In November 2017, the SBE approved the California Science Test (CAST) Blueprint. Since the 2016 and 2017 test design and blueprint approvals, Educational Testing Service (ETS) has developed and administered a census pilot (2016–17), a census field test (2017–18), and the first operational administration of the CAST in 2018–19.

Based on results and analyses from three administrations and feedback from California educators and the California Department of Education (CDE), ETS recommends several changes to the test blueprint that will better meet the needs of the program. This document presents ETS’ proposed blueprint changes. ETS understands that the CDE will consider the recommendations with the goal of presenting recommendations for approval to the SBE in January 2020. If the SBE approves these blueprint recommendations by February 2020, ETS will implement the revised blueprint beginning with the 2020–21 administration of the CAST.

## Analysis of Data

ETS analyzed results from the 2017–18 field test and the 2018–19 first operational administration. ETS’ Psychometric Analysis and Research team conducted several psychometric studies focusing on the following:

* Response-time analysis
* Test dimensionality
* Transitioning to a multistage adaptive test (MST) design
* Utility of a content screener

Summaries of key findings from these studies are included in this memorandum. A final comprehensive report titled “Informing the California Science Test (CAST) Blueprint Improvements: Results from the Psychometric Studies” has been referenced throughout this document to provide additional information.

Over the last three years, ETS engaged with educators, science experts, and the CDE’s technical advisory group to share key information on the CAST (e.g., test designs, blueprints, field test data results, and operational test data as available) and to obtain input and guidance on aspects of the CAST blueprint.

ETS’ proposed changes to the CAST blueprint are based on extensive feedback from key stakeholders, guidance from the CDE’s leadership, and psychometric analyses.

## Summary of Recommended CAST Blueprint Improvements

Table summarizes the recommended improvements to the CAST blueprint based on data and input received to date. ETS recommends that this be implemented as a complete set of changes. Details of these recommendations and rationales begin in the section [Summary of Psychometric Analyses](#_Summary_of_Psychometric).

**Table 1. Summary of Recommendations to Support CAST Blueprint Improvements**

|  |  |  |
| --- | --- | --- |
| **SBE-Approved Design** | **Recommended Improvement** | **Rationale** |
| This design has a two‑stage adaptive session for Segment A that presents items that are substantively equivalent in content but may differ in difficulty to match each student’s level of performance. | Administer Segment A as a linear, nonadaptive test and reevaluate when the bank is more robust. | Based on the MST study, the number of items in the pool at higher difficulty ranges is insufficient to support building second‑stage blocks. |
| Use a screener to select two performance tasks (PTs) from three science domains based on student’s performance in Segment A. | Eliminate the use of a screener. | Results from the screener study show no clear evidence that a screener would result in improved performance on the CAST by eliminating content where student performance was conspicuously poor in relation to a student being randomly assigned content from any science domain. (A summary of findings can be found in this memorandum in the section titled “[Summary of Psychometric Analyses](#_Summary_of_Psychometric).”) |

Table 1 *(continuation 1)*

|  |  |  |
| --- | --- | --- |
| **SBE-Approved Design** | **Recommended Improvement** | **Rationale** |
| The existing test blueprint (in appendix B) shows the same number of discrete operational items in Segment A across the three grade bands:   * 32–‍34 operational discrete items worth 42–44 points in Segment A   Based on response-time analyses, 42 percent of grade five students, 58 percent of grade eight students, and 92 percent of high school students completed the test in two hours. | Revise the test blueprint (in appendix C) to establish a fixed number of discrete items in Segment A that will vary across grades based on the number of performance expectations (PEs) to be covered in a three-year cycle. The recommended numbers of items for Segment A are as follows:   * Grade five—26 items worth 28–32 points * Grade eight—28 items worth 30–34 points * High school—32 items worth 34–38 points | Based on response-time analyses, a high percentage of students in grades five and eight did not complete the test within two hours. The expected improvement under the recommended design would yield a 12 percent increase in students completing the test within two hours in grade five, a 14 percent increase in grade eight, and a slight increase in high school.  A breakdown of response‑time data for each grade can be found in this memorandum in the section titled “[Summary of Psychometric Analyses](#_Summary_of_Psychometric).” The high school design was modified to have a fixed number of discrete items to maintain consistency with the other grades. |
| The existing test blueprint has two operational PTs in Segment B. | Revise the test blueprint to have three PTs, one PT for each science domain (Physical Sciences, Life Sciences, and Earth and Space Sciences), in Segment B. | Three PTs will allow all three science domains to be represented in both operational segments A and B. |

Table 1 *(continuation 2)*

|  |  |  |
| --- | --- | --- |
| **SBE-Approved Design** | **Recommended Improvement** | **Rationale** |
| The existing test blueprint for Segment C has students receiving one of the following:   * 12 to 14 discrete items (operational and field test) * One operational PT (4 to 6 items) * One field test PT (4 to 7 items) | Revise the test blueprint for Segment C so students receive one of the following:   * 6 discrete field test items * One field test PT (6 items) | To accommodate the additional PT in Segment B and remain within the two‑hour testing window, the maximum number of items will need to be reduced.  The number of items recommended for Segment C is supported by the response-time analyses located in the section titled “[Summary of Psychometric Analyses](#_Summary_of_Psychometric).” |
| Using the operational items in segments A, B, and C, provide additional, unique information at the group level. This is in addition to the aggregation of the students’ individual scores. | Investigate new types of information that can be reported at the group level utilizing items from segments A, B, and C. For example, reports may provide information about students’ relative strengths and areas of weakness. | It is important to provide more information to improve instruction. This has been supported by both national experts and California educators. |
| The test is administered as a single test session and can be paused as needed based on class period or student needs. The test is estimated to take approximately two hours. | Based on timing data across grades and advice from the technical advisory group, investigate current test administration practices, such as class period time constraints. | Feedback from the field suggests there may be a need to recognize class period constraints in the test administration, which may differ by grade. |

Table 2 presents a summary of the test as it will be administered to an individual student if the recommendations in Table 1 are implemented.

**Table 2. Recommended Blueprint for an Individual Student**

|  |  |  |
| --- | --- | --- |
| **Segment** | **SBE-Approved Number of Items** | **Recommended Number of Items** |
| Segment A—operational only | Grades five, eight, and high school  – 32–34 discrete items per student  – Two blocks of 16–17 items each | • Grade five  – 26 discrete items per student  – Two blocks of 13 items each  • Grade eight  – 28 discrete items per student  – Two blocks of 14 items each  • High school  – 32 discrete items per student  – Two blocks of 16 items each |
| Segment B—operational only | Two PTs from different science domains, selected from a pool of PTs representing three science domains, with four to six items per PT | Three PTs per student, one from each science domain, with four to six items per PT (one constructed response item per newly developed PT) |

Table 2 *(continuation)*

|  |  |  |
| --- | --- | --- |
| **Segment** | **SBE-Approved Number of Items** | **Recommended Number of Items** |
| Segment C—operational and field test | Twelve to fourteen discrete items or one PT with four to seven items per student | Six discrete items or one PT with six items (all field test) per student   * Sufficient number of discrete field test items to support coverage of all PEs over a three-year period and to support building Segment A blocks * Sufficient number of PTs per grade to support the refresh rate of one PT per grade, per domain, each year beginning with the 2021–22 administration |
| Total testing time | Median testing time between 65 to 132 minutes | Median testing time between 60 to 114 minutes (based on the 50th Percentile data located in Table 6 response time data) |

To detail this test blueprint further, a student would receive two blocks of items in Segment A. Beginning after the 2018–19 administration, there will be an annual refresh of segments A and B to allow coverage of all grade-band PEs within a three‑year cycle and to meet necessary refresh rates. The number of items to replace or refresh will vary by grade based on the number of PEs per grade. The total number of PEs to assess varies by grade, as follows:

* Grade five—45
* Grade eight—59
* High school—71

A student would receive three PTs in Segment B, one from each of the science domains of Life Sciences, Physical Sciences, and Earth and Space Sciences. Beginning with the 2021–22 administration, there would be a pool of six operational PTs, two per domain, from which PTs would be randomly delivered. The refresh rate of PTs will begin with a minimum of one PT per grade and increase to one PT per domain per grade annually, beginning with the 2021–22 administration.

Segment C field test items would be randomly delivered as a block of six discrete items or a PT of six items. A student would receive either a discrete item block or a PT block but not both. Items in Segment C will support annual requirements for item refresh rates and resting rules in segments A and B. Items being replaced for refresh would rest for at least one year before being used again.

## Summary of Psychometric Analyses

The recommendations are made based on several psychometric studies on test dimensionality; practicality of implementing a multistage, adaptive design; and utility of a screener. The psychometric analyses addressed the following questions:

1. Is the current test length appropriate?
2. If there is a need to change the blueprint based on the analyses, does the test dimensionality change under the proposed blueprint and will score reporting be affected?
3. Is there enough evidence to support the implementation of an MST design and the use of a screener to screen out a PT based on a student’s performance on Segment A items?

The first question was addressed through a response-time analysis. The response-time analysis summarizes the time students spent on the total test by test segment and by item type.

The second question is addressed through the evaluation of test dimensionality. The test dimensionality study evaluated the underlying structure of the test. The test dimensionality study has implications on how scores are reported. If the test measures predominantly a single latent variable, the test is unidimensional and a unidimensional item response theory (IRT) model can be used to calibrate the items and score students. If the test measures multiple latent variables, the test is multidimensional, and a multidimensional IRT model should be used.

The third question is addressed through the MST design study and the content screener study. The following section provides a brief summary of the key findings from these analyses, which support the recommended changes to the CAST test blueprint. The full detail on the methodology and complete sets of results are provided in a final report titled “Informing the California Science Test (CAST) Blueprint Improvements: Results from the Psychometric Studies.”

### Test Length and Response Time

In the original test blueprint, the expected completion time was 60 minutes for Segment A, 40 minutes for Segment B, and 20 minutes for Segment C, for a total test time of 120 minutes. Response-time analyses were conducted using the data from the first operational administration in 2018–19 to evaluate if the test length is appropriate. Table provides the amount of time grade five students spent on the total test as administered. Some students received a single field test block containing discrete items, and others received a single field test block containing one performance task with associated items. Table 4 and Table 5 provide the same information for grade eight and high school, respectively. Across all grades, the tables show that when administered the total test with one performance task, students are spending less time than when administered the total test with discrete items. For additional detail on timing by segment, see December memo.

**Table 3. Time Spent (in Minutes) on the CAST for Grade Five**

|  |  |  |  |
| --- | --- | --- | --- |
| **Test Administered** | **25th Percentile** | **50th Percentile** | **75th Percentile** |
| Total Test with Discrete Field Test Block | 100 | 134 | 181 |
| Total Test with Performance Task Field Test Block | 97 | 130 | 177 |

**Table 4. Time Spent (in Minutes) on the CAST for Grade Eight**

|  |  |  |  |
| --- | --- | --- | --- |
| **Test Administered** | **25th Percentile** | **50th Percentile** | **75th Percentile** |
| Total Test with Discrete Field Test Block | 86 | 114 | 150 |
| Total Test with Performance Task Field Test Block | 81 | 107 | 140 |

**Table 5. Time Spent (in Minutes) on the CAST for High School**

|  |  |  |  |
| --- | --- | --- | --- |
| **Test Administered** | **25th Percentile** | **50th Percentile** | **75th Percentile** |
| Total Test with Discrete Field Test Block | 47 | 67 | 89 |
| Total Test with Performance Task Field Test Block | 44 | 63 | 85 |

Table 6 provides the percent of students completing the test within two hours from the 2019–20 administration and the estimated percent of students who can complete the test with the recommended test length within two hours. With a similar number of items on the test, it took longer for students in grades five and eight to complete the total test than it took students from high school. Fewer than half of grade five students and slightly more than half of grade eight students completed the test in two hours; over 90 percent of high school students completed the test in two hours.

**Table 6. Response Time Comparison for the Current and Proposed Blueprints**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Grade and Blueprint** | **50th Percentile (in Minutes)** | **60th Percentile (in Minutes)** | **75th Percentile (in Minutes)** | **Estimated Percentage of Students to Complete Test in Two Hours** |
| Grade Five Current | 132 | 148 | 179 | 42 |
| Grade Five Proposed | 114 | 128 | 154 | 54 |
| Grade Eight Current | 111 | 122 | 145 | 58 |
| Grade Eight Proposed | 94 | 105 | 124 | 72 |
| High School Current | 65 | 73 | 87 | 92 |
| High School Proposed | 60 | 68 | 82 | 94 |

These results suggest that the current test length is likely too long for grade five and grade eight. ETS recommends reducing the number of items for grades five and eight to the extent possible while still providing reliable scores and appropriate content coverage to meet a revised test blueprint. Given that the number of PEs assessed in grade five and grade eight is lower than high school (45 for grade five, 59 for grade eight, and 71 for high school), shortening the test for grades five and eight will still provide PE coverage within a three-year period. ETS recommends reducing the number of items for high school to be consistent with grades five and eight while still maintaining PE coverage within a three-year period.

The SBE-approved original test blueprint was based on an estimate of 20 minutes to complete a PT in Segment B. Therefore, a student could only receive a maximum of two PTs from two of the three science domains in Segment B, which results in a variance in the number of items reported for each domain. Given that students did not take as long as the expected 40 minutes on two PTs, it is reasonable to add a third PT to Segment B, which will provide students balance across each of the three science domains.

The discrete items in segments A and C can be reduced while still preserving the test reliability and content coverage. The reduction of discrete items in Segment C can also help balance the response time for students who receive the discrete Segment C block and those who receive the PT Segment C block.

As shown in Table 6, the percentage of students who can finish the test within two hours has increased for grades five and eight (12% increase for grade five, 14% increase for grade eight, and no change in high school). By adding a PT in Segment B and reducing the number of discrete items in segments A and C, three key benefits are realized:

* The number of students in grades five and eight who can complete the test within two hours increases.
* Each student will now receive three PTs in Segment B representing each of three science domains.
* The time needed to complete Segment C discrete items is reduced and more in line with the time needed to complete a Segment C PT.

## Reliability

Table 7 provides reliabilities for the 2018–19 operational forms and the estimated reliability of forms developed with the number of discrete items and PTs proposed in the test blueprint recommendations in Table 2. As shown in Table 7, the change in the number of discrete items and PTs results in either negligible or no reduction of test reliability for each grade.

**Table 7. A Comparison on the Reliability of the Current and Proposed Blueprints**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Grade** | **Average Number of OP Items—Current Blueprint** | **Average Number of OP Items—Proposed Blueprint** | **Reliability—Current Blueprint** | **Reliability—Proposed Blueprint** |
| Five | 46 | 41 | 0.91 | 0.90 |
| Eight | 44 | 43 | 0.89 | 0.89 |
| High School | 46 | 47 | 0.88 | 0.88 |

## Dimensionality

A test dimensionality study was conducted to provide evidence of whether the CAST measures a single integrated science construct or several distinctive science content domains. These results would inform calibration, equating, and score reporting. The study was run with the field test data from the 2017–18 administration. This study was replicated again with the 2018–19 first operational administration with an added condition to evaluate the test dimensionality under the proposed blueprint with three PTs in Segment B, one from each science domain.

Evaluation of the dimensional structure was based on comparing the strength of the general factor (e.g., overall science factor) in relation to other subfactors (e.g., Life Sciences domain, Earth and Space Sciences domain, and Physical Sciences domain). Following the guidelines in Rodriguez, Reise, and Haviland (2016), four measures were part of the evaluation:

* **Omega hierarchical (OmegaH) and Omega hierarchical subscale (OmegaHS):** OmegaH estimates the proportion of variance in total scores that can be attributed to a single general factor. OmegaHS reflects the reliability of a subscale score after controlling for the variance due to the general factor. High values of OmegaHS indicate that, after controlling for the variance due to the general factor, there is still a large amount of the variance that can be explained by the group-specific variance, which could be an indicator of multidimensionality.
* **Explained common variance (ECV) (Sijtsma, 2009; Ten Berge and Socan, 2004):** ECV is the ratio of the variance explained by the general factor divided by the variance explained by the general and the group-specific factor. A high ECV value is evidence of an essentially unidimensional model.
* **Relative parameter bias:** Summarizes the amount of item parameter bias present when a test with multidimensional structure is forced to conform to a unidimensional model.

Table 8 provides a summary of the evaluation indices for one selected form for grade five by content domain. Results for grade eight and high school are similar to those of grade five and are available in the full report “Informing the California Science Test (CAST) Blueprint Improvements: Results from the Psychometric Studies.” The 2-PT blueprint is the current blueprint where there are only two PTs in Segment B. The 3-PT blueprint used the third PT from the field test block to simulate the condition under the proposed blueprint where each student will receive three PTs, one from each science domain, in their operational block.

**Table 8. The Evaluation Indices for Test Dimensionality for One Selected Form from Grade Five**

|  |  |  |
| --- | --- | --- |
| **Index** | **2-PT** | **3-PT** |
| OmegaH | 0.94 | 0.95 |
| OmegaHS: Earth and Space Sciences | 0.00 | 0.00 |
| OmegaHS: Life Sciences | 0.00 | 0.00 |
| OmegaHS: Physical Sciences | 0.01 | 0.01 |
| ECV | 94% | 93% |
| Relative Parameter Bias | 0.01 | -0.002 |

The OmegaH index suggests that the general factor can explain 94 percent (or 95% for the 3-PT blueprint) of the variance of the total score. The ECV index indicates the general factor explained 94 percent (or 93% for the 3-PT blueprint) of the common variance from the general factor and the domain-specific factors. The results suggest there is no impact on the test dimensionality under the current blueprint (i.e., 2-PT blueprint) and the proposed blueprint (i.e., the 3-PT blueprint). These indices suggest that the unidimensional model can be effectively used to calibrate, equate, and score students for the proposed blueprint.

## Multistage Adaptive Study

The original high-level test design proposed an MST design where Segment A consisted of a two-stage adaptive session that would present items in two blocks. Performance on the first block would act as a router to a second block of items that are substantively equivalent in content but may differ in difficulty to most appropriately match each student’s level of performance. The multistage adaptive study evaluated whether an adaptive Segment A offered improved measurement precision over a linear test. The study was conducted with the 2017–18 field test data and replicated with the 2018–19 operational-year data.

Figure 1 through Figure 3 show a comparison of the conditional standard errors of measurement (CSEM) for the MST panel and the linear form for three grades, respectively.

Figure 1, for grade five, uses the data from Table D.1.

**Figure 1. Comparison of the Conditional Standard Error for the MST and the Linear Form for Grade Five**

Figure 2, for grade eight, uses the data from Table D.2.

**Figure 2. Comparison of the Conditional Standard Error for the MST and the Linear Form for Grade Eight**

Figure 3, for high school, uses the data from Table D.3.

**Figure 3. Comparison of the Conditional Standard Error for the MST and the Linear Form for High School**

As shown in Figure 1 and Figure 3, for grade five and high school, the MST panel has improved measurement precision over the linear form on the lower end of the ability distribution. However, there is not much improvement in CSEM for students at the upper end of the ability continuum. For students at the extreme end of the ability distribution, the linear form outperformed the MST form.

For grade eight, the MST panel has improved measurement precision over the linear form on both the lower and upper end of the ability distribution.

A further evaluation of the item pool suggests the relative strengths and weaknesses of the assembly pools are largely reflected in the degree and location of the measurement improvement. Figure 4 shows the block information for the blocks in the MST panel for grade five. Ideally, information provided by the router will be centered near the middle, or proficiency value of 0, and the easy and hard blocks would be centered to the left and right, relative to the router. As shown in the figure, the easy block is peaked to the left of center, however the hard block overlaps with information provided by the router. This indicates that there are not enough difficult items in the grade five item pool. The item pools for grade eight and high school are slightly more balanced than grade five; however, additional easy and difficult items are desirable. Further details can be found in the December memo. Therefore, ETS recommends postponing the implementation of an MST design until the item pool at each grade is expanded and can be reevaluated.

Figure 4, for block information functions, uses the data from Table D.4.

Figure 4. The Block Information Functions for a Two-Stage MST Design for Grade Five

## Screener Study

Under the current test design, students received two PTs in Segment B of CAST, where each PT has a primary domain—Life Sciences, Earth and Space Sciences, or Physical Sciences. For the 2018–19 operational administration, students were randomly assigned to the two PTs with the restriction that each assigned PT was from two different content domains. The random assignment of students to PTs might result in advantaging or disadvantaging certain students if students are found to perform better in contexts with which they are interested and experienced and if they happen to be assigned PTs in the domains in which they are most or least familiar. A screener was proposed to use a student’s performance on Segment A, which consists of 32–34 items evenly spread across each of the content domains, to “screen out” PTs in the domains that the student is less likely to be successful on. Specifically, if a student performs conspicuously poorly in one science content domain (e.g., Physical Sciences) based on Segment A, there will be little additional information to be learned about this student’s science knowledge if they are assigned a performance task in that same content domain. A study was conducted with both the 2017–18 field test and the 2018–19 operational-year data to evaluate the utility of using the content screener.

Operational implementation of a screener mechanism is advisable if students show very different scores across domains in Segment A so that the Segment A domain scores add significantly to the prediction of the Segment B scores, and if using the content screener significantly improves the prediction of Segment B scores.

Three Linear models were constructed to assess the extent to which

1. Segment A performance predicts Segment B performance;

Segment A performance and Segment A domain performance improves the prediction of Segment B performance; and

Segment A performance, Segment A domain performance, and being assigned a Segment B PT that aligns with a student’s Segment A performance (alignment index) improves prediction of Segment B performance. (The alignment index measures the extent to which the assigned PTs align with the student’s strengths in Segment A. The formula can be found in the full report “Informing the CAST Blueprint Improvements: Results from the Psychometric Studies.”)

Each of these models was evaluated by computing the proportion of variation in Segment B scores that could be explained by the model after accounting for the number of independent variables appearing in the model. This measure is referred to as adjusted R2. An increase in the adjusted R2 for the two adjacent linear models indicates the additional predictor adds to predicting the Segment B scores.

Table 9 shows the adjusted R2 for the three linear models. Results suggest that the increase in the adjusted R2 is negligible with the additional independent variables. This suggests that the Segment A domain scores and the alignment index did not help improve the prediction of PT scores (i.e., there is no strong evidence to favor the implementation of a screener.)

Additional follow-up analyses also compared students’ performance on Segment B based on their performance on Segment A. The analysis used the students who performed poorly in one science domain and compared those who were assigned the PT domain and those who were not. The results were inconclusive in that students who were assigned PTs in their poorest performing domain did not consistently perform less well than students who were randomly assigned PTs in other domains. Therefore, it is inconclusive that a screener would be useful for the CAST.

Also, the proposed blueprint adds a third PT to Segment B where all students will receive a PT from each of the science domains, which eliminates the utility of a screener.

**Table 9. Adjusted R2 for the Linear Models**

|  |  |  |  |
| --- | --- | --- | --- |
| **Model** | **Grade Five** | **Grade Eight** | **High School** |
| 1: Segment A only | 0.4097 | 0.4199 | 0.3835 |
| 2: Segment A + Segment A domain scores | 0.4100 | 0.4204 | 0.3844 |
| 3: Segment A + Segment A domain + alignment index | 0.4100 | 0.4204 | 0.3845 |

## Conclusion

Based on the results of the response-time analysis; test dimensionality; a multistage, adaptive design; and the screener study, ETS recommends the following changes to the CAST blueprint:

* Reduce the number of discrete items in segments A and C
* Add a third PT to Segment B
* Eliminate the screener
* Postpone the implementation of the MST design until the pool can be expanded to fully realize the potential of the adaptive design

## Glossary of Terms

**Discrete Item—**An item that is standalone and not part of a set.

**Performance Task (PT)—**A group of items developed around a single science concept or phenomena. The PT may contain multiple stimuli and items written to more than one PE.

**Linear—**A test in which items are in a fixed order within a segment or block. The order of segments is delivered differently across the testing population for position effects.

**Multistage Adaptive Test (MST)—**A test in which some portions of the test (e.g., a segment) are constructed in stages. Each stage can include multiple groups of items, and the route from one stage to the next is adaptive depending on students’ performance in the prior stage. The order of segments is delivered differently across the testing population for position effects.

**Matrix Sampling—**A method which allows for assessment of more PEs at a statewide level by administering different blocks of stand-alone items or PTs to different groups of students.

**Group-Level Score Reporting—**Group-level score reporting provides feedback needed to support teaching and promote curriculum improvement, while at the same time ensuring that each student is measured fairly and comparably. Furthermore, it does so while keeping the testing time required of each student within reasonable limits.

**Test Dimensionality—**The dimensionality of a test refers to the latent (underlying) structure of the test. A test can be unidimensional or multidimensional. A unidimensional test measures predominantly one latent variable and a multidimensional test measures more than one latent variable.

**Segment A—**A block of the test that presents stand-alone items that are substantively equivalent in content but which may differ in difficulty. The segment includes mostly machine-scorable selected-response items and some machine or human-scored constructed-response items that cover a very broad range of the CA NGSS PEs.

**Segment B—**A block of the test that includes item sets (i.e., PTs) which require students to solve a series of complex problems set in discipline-specific contexts which deeply measure a student’s command of selected CA NGSS PEs. This segment includes mostly machine-scorable selected-response items and may include some machine or human-scored constructed-response items.

**Segment C—**A block of the test that presents students with a range of item types similar to those presented in Segment A and Segment B. Students are randomly assigned a set of stand-alone items or one PT.

**Screener—**A method used to select two PTs from three science domains based on students’ performance in Segment A.

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## Appendix A: Data for Graphs

**Table D.1.** **Data for Figure 1 CSEMs—Grade Five**

|  |  |  |  |
| --- | --- | --- | --- |
| Proficiency | MST 1–2 | MST 1–3 | Linear |
| -3.0 | 0.66 | 0.66 | 0.58 |
| -2.9 | 0.67 | 0.67 | 0.59 |
| -2.8 | 0.67 | 0.67 | 0.60 |
| -2.7 | 0.67 | 0.67 | 0.61 |
| -2.6 | 0.66 | 0.66 | 0.61 |
| -2.5 | 0.64 | 0.64 | 0.61 |
| -2.4 | 0.62 | 0.62 | 0.61 |
| -2.3 | 0.60 | 0.60 | 0.60 |
| -2.2 | 0.57 | 0.57 | 0.59 |
| -2.1 | 0.54 | 0.54 | 0.57 |
| -2.0 | 0.51 | 0.51 | 0.55 |
| -1.9 | 0.48 | 0.48 | 0.53 |
| -1.8 | 0.45 | 0.45 | 0.51 |
| -1.7 | 0.42 | 0.42 | 0.48 |
| -1.6 | 0.39 | 0.39 | 0.46 |
| -1.5 | 0.37 | 0.37 | 0.43 |
| -1.4 | 0.35 | 0.35 | 0.41 |
| -1.3 | 0.33 | 0.33 | 0.38 |
| -1.2 | 0.32 | 0.32 | 0.36 |
| -1.1 | 0.31 | 0.31 | 0.34 |
| -1.0 | 0.30 | 0.30 | 0.33 |
| -0.9 | 0.29 | 0.29 | 0.31 |
| -0.8 | 0.28 | 0.28 | 0.30 |
| -0.7 | 0.27 | 0.27 | 0.29 |
| -0.6 | 0.27 | 0.27 | 0.28 |
| -0.5 | 0.26 | 0.26 | 0.28 |
| -0.4 | 0.26 | 0.26 | 0.27 |
| -0.3 | 0.26 | 0.26 | 0.27 |
| -0.2 | 0.26 | 0.26 | 0.27 |
| -0.1 | 0.26 | 0.26 | 0.27 |
| 0.0 | 0.26 | 0.26 | 0.27 |
| 0.1 | 0.26 | 0.26 | 0.27 |
| 0.2 | 0.26 | 0.26 | 0.28 |
| 0.3 | 0.27 | 0.27 | 0.28 |
| 0.4 | 0.28 | 0.28 | 0.29 |

Table D.1 *(continuation)*

|  |  |  |  |
| --- | --- | --- | --- |
| Proficiency | MST 1–2 | MST 1–3 | Linear |
| 0.5 | 0.28 | 0.28 | 0.30 |
| 0.6 | 0.29 | 0.29 | 0.31 |
| 0.7 | 0.31 | 0.31 | 0.32 |
| 0.8 | 0.32 | 0.32 | 0.34 |
| 0.9 | 0.33 | 0.33 | 0.36 |
| 1.0 | 0.35 | 0.35 | 0.37 |
| 1.1 | 0.37 | 0.37 | 0.40 |
| 1.2 | 0.40 | 0.40 | 0.42 |
| 1.3 | 0.42 | 0.42 | 0.45 |
| 1.4 | 0.45 | 0.45 | 0.48 |
| 1.5 | 0.48 | 0.48 | 0.51 |
| 1.6 | 0.51 | 0.51 | 0.55 |
| 1.7 | 0.55 | 0.55 | 0.58 |
| 1.8 | 0.59 | 0.59 | 0.62 |
| 1.9 | 0.63 | 0.63 | 0.66 |
| 2.0 | 0.66 | 0.66 | 0.70 |
| 2.1 | 0.70 | 0.70 | 0.73 |
| 2.2 | 0.73 | 0.73 | 0.77 |
| 2.3 | 0.76 | 0.76 | 0.80 |
| 2.4 | 0.79 | 0.79 | 0.83 |
| 2.5 | 0.82 | 0.82 | 0.86 |
| 2.6 | 0.84 | 0.84 | 0.88 |
| 2.7 | 0.86 | 0.86 | 0.90 |
| 2.8 | 0.87 | 0.87 | 0.91 |
| 2.9 | 0.89 | 0.89 | 0.92 |
| 3.0 | 0.89 | 0.89 | 0.93 |

**Table D.2.** **Data for Figure 2 CSEM—Grade Eight**

|  |  |  |  |
| --- | --- | --- | --- |
| Proficiency | MST 1–2 | MST 1–3 | Linear |
| -3.0 | 0.63 | 0.63 | 0.67 |
| -2.9 | 0.64 | 0.64 | 0.68 |
| -2.8 | 0.65 | 0.65 | 0.69 |
| -2.7 | 0.65 | 0.65 | 0.69 |
| -2.6 | 0.64 | 0.64 | 0.69 |
| -2.5 | 0.63 | 0.63 | 0.69 |
| -2.4 | 0.62 | 0.62 | 0.68 |
| -2.3 | 0.60 | 0.60 | 0.67 |
| -2.2 | 0.58 | 0.58 | 0.65 |
| -2.1 | 0.55 | 0.55 | 0.62 |
| -2.0 | 0.52 | 0.52 | 0.60 |
| -1.9 | 0.50 | 0.50 | 0.57 |
| -1.8 | 0.47 | 0.47 | 0.54 |
| -1.7 | 0.44 | 0.44 | 0.51 |
| -1.6 | 0.41 | 0.41 | 0.47 |
| -1.5 | 0.39 | 0.39 | 0.44 |
| -1.4 | 0.36 | 0.36 | 0.42 |
| -1.3 | 0.34 | 0.34 | 0.39 |
| -1.2 | 0.33 | 0.33 | 0.37 |
| -1.1 | 0.31 | 0.31 | 0.35 |
| -1.0 | 0.30 | 0.30 | 0.33 |
| -0.9 | 0.29 | 0.29 | 0.32 |
| -0.8 | 0.28 | 0.28 | 0.30 |
| -0.7 | 0.27 | 0.27 | 0.29 |
| -0.6 | 0.27 | 0.27 | 0.28 |
| -0.5 | 0.26 | 0.26 | 0.28 |
| -0.4 | 0.26 | 0.26 | 0.27 |
| -0.3 | 0.25 | 0.25 | 0.26 |
| -0.2 | 0.25 | 0.25 | 0.26 |
| -0.1 | 0.25 | 0.25 | 0.26 |
| 0.0 | 0.25 | 0.25 | 0.26 |
| 0.1 | 0.25 | 0.25 | 0.26 |
| 0.2 | 0.25 | 0.25 | 0.26 |
| 0.3 | 0.25 | 0.25 | 0.26 |
| 0.4 | 0.26 | 0.26 | 0.27 |
| 0.5 | 0.26 | 0.26 | 0.27 |
| 0.6 | 0.27 | 0.27 | 0.28 |

Table D.2 *(continuation)*

|  |  |  |  |
| --- | --- | --- | --- |
| Proficiency | MST 1–2 | MST 1–3 | Linear |
| 0.7 | 0.27 | 0.27 | 0.29 |
| 0.8 | 0.28 | 0.28 | 0.30 |
| 0.9 | 0.29 | 0.29 | 0.32 |
| 1.0 | 0.30 | 0.30 | 0.33 |
| 1.1 | 0.31 | 0.31 | 0.35 |
| 1.2 | 0.33 | 0.33 | 0.37 |
| 1.3 | 0.34 | 0.34 | 0.40 |
| 1.4 | 0.36 | 0.36 | 0.42 |
| 1.5 | 0.39 | 0.39 | 0.45 |
| 1.6 | 0.41 | 0.41 | 0.48 |
| 1.7 | 0.44 | 0.44 | 0.52 |
| 1.8 | 0.47 | 0.47 | 0.55 |
| 1.9 | 0.50 | 0.50 | 0.59 |
| 2.0 | 0.53 | 0.53 | 0.62 |
| 2.1 | 0.56 | 0.56 | 0.65 |
| 2.2 | 0.59 | 0.59 | 0.68 |
| 2.3 | 0.61 | 0.61 | 0.70 |
| 2.4 | 0.63 | 0.63 | 0.72 |
| 2.5 | 0.65 | 0.65 | 0.74 |
| 2.6 | 0.67 | 0.67 | 0.76 |
| 2.7 | 0.67 | 0.67 | 0.76 |
| 2.8 | 0.68 | 0.68 | 0.77 |
| 2.9 | 0.68 | 0.68 | 0.77 |
| 3.0 | 0.67 | 0.67 | 0.77 |

**Table D.3.** **Data for Figure 3 CSEMs—High School**

|  |  |  |  |
| --- | --- | --- | --- |
| Proficiency | MST 1–2 | MST 1–3 | Linear |
| -3.0 | 0.63 | 0.63 | 0.71 |
| -2.9 | 0.64 | 0.64 | 0.72 |
| -2.8 | 0.65 | 0.65 | 0.73 |
| -2.7 | 0.65 | 0.65 | 0.74 |
| -2.6 | 0.65 | 0.65 | 0.74 |
| -2.5 | 0.64 | 0.64 | 0.73 |
| -2.4 | 0.63 | 0.63 | 0.73 |
| -2.3 | 0.61 | 0.61 | 0.71 |
| -2.2 | 0.59 | 0.59 | 0.70 |
| -2.1 | 0.57 | 0.57 | 0.67 |
| -2.0 | 0.54 | 0.54 | 0.65 |
| -1.9 | 0.51 | 0.51 | 0.62 |
| -1.8 | 0.48 | 0.48 | 0.59 |
| -1.7 | 0.45 | 0.45 | 0.55 |
| -1.6 | 0.42 | 0.42 | 0.52 |
| -1.5 | 0.39 | 0.39 | 0.48 |
| -1.4 | 0.37 | 0.37 | 0.45 |
| -1.3 | 0.35 | 0.35 | 0.42 |
| -1.2 | 0.33 | 0.33 | 0.39 |
| -1.1 | 0.32 | 0.32 | 0.37 |
| -1.0 | 0.30 | 0.30 | 0.35 |
| -0.9 | 0.29 | 0.29 | 0.33 |
| -0.8 | 0.28 | 0.28 | 0.31 |
| -0.7 | 0.28 | 0.28 | 0.30 |
| -0.6 | 0.27 | 0.27 | 0.29 |
| -0.5 | 0.27 | 0.27 | 0.28 |
| -0.4 | 0.26 | 0.26 | 0.27 |
| -0.3 | 0.26 | 0.26 | 0.27 |
| -0.2 | 0.26 | 0.26 | 0.27 |
| -0.1 | 0.26 | 0.26 | 0.26 |
| 0.0 | 0.26 | 0.26 | 0.26 |
| 0.1 | 0.26 | 0.26 | 0.26 |
| 0.2 | 0.26 | 0.26 | 0.26 |
| 0.3 | 0.26 | 0.26 | 0.27 |
| 0.4 | 0.27 | 0.27 | 0.27 |
| 0.5 | 0.27 | 0.27 | 0.27 |
| 0.6 | 0.28 | 0.27 | 0.28 |

Table D.3 *(continuation)*

|  |  |  |  |
| --- | --- | --- | --- |
| Proficiency | MST 1–2 | MST 1–3 | Linear |
| 0.7 | 0.28 | 0.28 | 0.28 |
| 0.8 | 0.29 | 0.28 | 0.29 |
| 0.9 | 0.29 | 0.29 | 0.30 |
| 1.0 | 0.30 | 0.30 | 0.31 |
| 1.1 | 0.30 | 0.30 | 0.32 |
| 1.2 | 0.31 | 0.31 | 0.33 |
| 1.3 | 0.32 | 0.32 | 0.34 |
| 1.4 | 0.33 | 0.33 | 0.36 |
| 1.5 | 0.35 | 0.35 | 0.37 |
| 1.6 | 0.36 | 0.36 | 0.39 |
| 1.7 | 0.37 | 0.37 | 0.41 |
| 1.8 | 0.39 | 0.39 | 0.43 |
| 1.9 | 0.41 | 0.41 | 0.45 |
| 2.0 | 0.43 | 0.43 | 0.47 |
| 2.1 | 0.45 | 0.45 | 0.50 |
| 2.2 | 0.48 | 0.48 | 0.53 |
| 2.3 | 0.50 | 0.50 | 0.55 |
| 2.4 | 0.53 | 0.53 | 0.58 |
| 2.5 | 0.56 | 0.56 | 0.61 |
| 2.6 | 0.59 | 0.59 | 0.63 |
| 2.7 | 0.61 | 0.61 | 0.66 |
| 2.8 | 0.64 | 0.64 | 0.68 |
| 2.9 | 0.66 | 0.66 | 0.69 |
| 3.0 | 0.68 | 0.68 | 0.71 |

**Table D.4.** **Data for Figure 4 Information Curves of the Assembled MST 1–2 Design Panel—Grade Five**

|  |  |  |  |
| --- | --- | --- | --- |
| Proficiency | Router | Easy | Hard |
| -3.0 | 0.71 | 1.37 | 0.82 |
| -2.9 | 0.79 | 1.53 | 0.91 |
| -2.8 | 0.89 | 1.71 | 1.00 |
| -2.7 | 0.99 | 1.91 | 1.10 |
| -2.6 | 1.11 | 2.13 | 1.22 |
| -2.5 | 1.25 | 2.38 | 1.35 |
| -2.4 | 1.39 | 2.65 | 1.49 |
| -2.3 | 1.56 | 2.95 | 1.65 |
| -2.2 | 1.75 | 3.28 | 1.83 |
| -2.1 | 1.96 | 3.64 | 2.03 |
| -2.0 | 2.20 | 4.03 | 2.26 |
| -1.9 | 2.46 | 4.44 | 2.51 |
| -1.8 | 2.74 | 4.87 | 2.79 |
| -1.7 | 3.06 | 5.32 | 3.10 |
| -1.6 | 3.40 | 5.77 | 3.44 |
| -1.5 | 3.78 | 6.22 | 3.81 |
| -1.4 | 4.18 | 6.65 | 4.21 |
| -1.3 | 4.61 | 7.06 | 4.63 |
| -1.2 | 5.06 | 7.43 | 5.09 |
| -1.1 | 5.53 | 7.77 | 5.57 |
| -1.0 | 6.01 | 8.05 | 6.06 |
| -0.9 | 6.48 | 8.28 | 6.55 |
| -0.8 | 6.94 | 8.47 | 7.04 |
| -0.7 | 7.38 | 8.59 | 7.50 |
| -0.6 | 7.79 | 8.66 | 7.93 |
| -0.5 | 8.14 | 8.67 | 8.31 |
| -0.4 | 8.43 | 8.62 | 8.61 |
| -0.3 | 8.65 | 8.50 | 8.84 |
| -0.2 | 8.78 | 8.31 | 8.98 |
| -0.1 | 8.83 | 8.06 | 9.03 |
| 0.0 | 8.80 | 7.74 | 8.98 |
| 0.1 | 8.68 | 7.38 | 8.85 |
| 0.2 | 8.48 | 6.97 | 8.63 |
| 0.3 | 8.22 | 6.54 | 8.34 |
| 0.4 | 7.90 | 6.08 | 7.98 |
| 0.5 | 7.54 | 5.63 | 7.58 |

Table D.4 *(continuation)*

|  |  |  |  |
| --- | --- | --- | --- |
| Proficiency | Router | Easy | Hard |
| 0.6 | 7.14 | 5.17 | 7.13 |
| 0.7 | 6.73 | 4.73 | 6.65 |
| 0.8 | 6.31 | 4.30 | 6.16 |
| 0.9 | 5.89 | 3.90 | 5.67 |
| 1.0 | 5.47 | 3.52 | 5.19 |
| 1.1 | 5.06 | 3.17 | 4.72 |
| 1.2 | 4.67 | 2.85 | 4.28 |
| 1.3 | 4.30 | 2.56 | 3.86 |
| 1.4 | 3.95 | 2.29 | 3.47 |
| 1.5 | 3.62 | 2.05 | 3.12 |
| 1.6 | 3.31 | 1.83 | 2.80 |
| 1.7 | 3.02 | 1.64 | 2.51 |
| 1.8 | 2.75 | 1.46 | 2.25 |
| 1.9 | 2.50 | 1.31 | 2.02 |
| 2.0 | 2.28 | 1.17 | 1.81 |
| 2.1 | 2.07 | 1.05 | 1.62 |
| 2.2 | 1.87 | 0.94 | 1.46 |
| 2.3 | 1.70 | 0.84 | 1.31 |
| 2.4 | 1.54 | 0.75 | 1.18 |
| 2.5 | 1.39 | 0.67 | 1.06 |
| 2.6 | 1.26 | 0.61 | 0.95 |
| 2.7 | 1.14 | 0.55 | 0.86 |
| 2.8 | 1.03 | 0.49 | 0.77 |
| 2.9 | 0.93 | 0.44 | 0.70 |
| 3.0 | 0.84 | 0.40 | 0.63 |