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I. Background and Project Overview

In recent years, the state of California has adopted new K–12 college- and career-ready standards for English language arts, mathematics, and science. These include (respectively) the California Common Core State Standards for English Language Arts and History/Social Studies, Science, and Technical Subjects (CA CCSS for ELA/Literacy), California Common Core State Standards for Mathematics (CA CCSSM), and the Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve (CA NGSS). In accordance with California State Assembly Bill 124, in 2012 California also adopted new California English Language Development Standards (CA ELD Standards). As required by AB 124, the CA ELD Standards were designed to correspond to the CA CCSS for ELA/Literacy in order to support the language development of English learners (ELs) toward attaining English language proficiency (ELP) and accessing the core academic content for English language arts all students are expected to master. However, under the federal Elementary and Secondary Education Act, currently authorized as No Child Left Behind (NCLB, 2001), the CA ELD Standards must also adequately correspond to the language demands found within the academic content standards in math and science (NCLB s. 1111).

In October 2013, the Governor signed Assembly Bill (AB) 899 requiring that the ELD Standards be comparable in rigor and specificity to the standards for mathematics and science. AB 899 calls for the State Superintendent of Public Instruction (SSPI) to recommend to the State Board of Education any “modifications” to the ELD Standards needed to link them with the academic content standards for mathematics and science. In order to make these recommendations, the SSPI is required by AB 899 to convene a group of experts to review the mathematics and science academic content standards and ensure that the language demands inherent in these content standards are adequately addressed by the CA ELD Standards.

As a result, the California Department of Education (CDE) has contracted WestEd to: (1) conduct a study of correspondence (linkage) between the CA ELD Standards and the standards for math and science; and (2) develop materials to represent any modifications (augmentation) to the CA ELD Standards necessary based on the findings of the correspondence study.

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1 “Correspond” and “link” are used interchangeably in AB 899, and NCLB speaks of the need for ELD standards to “align” to academic content standards. The term “correspond” has been recommended by the Council of Chief State School Officers (CCSSO, 2012) to refer to standards-to-standards relationships, as the term has fewer prior technical associations than both “link” and “align”, which typically refer to the relationship of standards to assessments. In fact, as a result of the CCSSO’s English Language Proficiency Development (ELPD) Framework (CCSSO, 2012), “correspondence” was used in the CA EL Standards documents to refer to the many-to-many correspondences between the CA EL Standards and the CA CCSS for ELA/Literacy. This report therefore uses the term “correspondence”.

2 AB 899 uses the term “modifications” in referring to a possible augmentation to the CA EL Standards; WestEd and the CDE have agreed to use the term “augmentation” so as not to suggest the CA EL Standards, which were developed in a transparent and inclusive statewide process, and unanimously approved by the State Board of Education, will be altered. Rather, any unaddressed language demands from math and science will be incorporated into the EL standards through augmentation.
WestEd is completing three major tasks to assist the CDE to meet the requirements of AB 899 for determining the extent to which the CA ELD Standards correspond to the language demands in the CA CCSSM and the CA NGSS, and for making any augmentation as necessary to the CA ELD Standards. These three tasks, two for Year 1 and one for Year 2, are outlined in Table 1.

### Table 1: AB 899 Project Tasks and Timeline

<table>
<thead>
<tr>
<th>Year 1</th>
<th>October 1, 2014 – June 30, 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task 1:</strong> Conduct a correspondence study between the CA ELD Standards and the CA CCSSM and the CA NGSS</td>
<td></td>
</tr>
<tr>
<td>October 2014 – March 2015</td>
<td>WestEd conducts correspondence study and writes report.</td>
</tr>
<tr>
<td>April 2, 2015</td>
<td>Public Meeting #1 held for Expert Panel review of correspondence study and public comment.</td>
</tr>
<tr>
<td><strong>Task 2:</strong> Develop draft augmentation document that shows the correspondence between the CA ELD Standards and the CA CCSSM and the CA NGSS</td>
<td></td>
</tr>
<tr>
<td>February – May 2015</td>
<td>WestEd develops draft augmentation document based on correspondence study report, as well as Expert Panel feedback and public input from Public Meeting #1.</td>
</tr>
<tr>
<td>May 28, 2015</td>
<td>Public Meeting #2 held for Expert Panel review of draft augmentation document and public comment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 2</th>
<th>July 1, 2015 – January 31, 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task 1:</strong> Present, revise, and finalize the augmentation document that shows the correspondence between the CA ELD Standards and the CA CCSSM and the CA NGSS</td>
<td></td>
</tr>
<tr>
<td>July 8 – 9, 2015</td>
<td>State Board of Education meeting; Superintendent makes recommendation to augment the ELD Standards.</td>
</tr>
<tr>
<td>August 2015</td>
<td>Potential public review period.</td>
</tr>
<tr>
<td>September – October 2015</td>
<td>WestEd revises augmentation document, incorporating all feedback.</td>
</tr>
<tr>
<td>November 4–5, 2015</td>
<td>State Board of Education meeting to review revised augmentation document.</td>
</tr>
<tr>
<td>November – December 2015</td>
<td>WestEd finalizes augmentation document, incorporating any SBE feedback as needed.</td>
</tr>
<tr>
<td>January, 2016</td>
<td>State Board of Education meeting to review and approve final augmentation document.</td>
</tr>
</tbody>
</table>

### II. Qualifications of Staff Conducting the Correspondence Study

WestEd staff conducting the study have deep expertise and experience in the content areas of ELD, mathematics, and science, as well as in K–12 educational research, development, and service. They also collectively have deep knowledge of the CA ELD Standards (having directly assisted the CDE in their development), the CA CCSSM, and the CA NGSS. Details of staff experience by role are listed below.

**English Language Development Leads have collective expertise and experience in:**
- ELD standards development (including the CA ELD Standards)
- ELA/ELD framework development (including CA ELA/ELD Framework)
- ELD and ELA correspondence/linkage studies
- ELD standards and assessment alignment
- ELD assessment development
- Teaching K–12 and adult English learners
- Teaching math and science to English learners and non-English learners

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— Developing science and math curriculum for English learners
— Implementing the CA ELD Standards
— Theories of second language acquisition
— Approaches to teaching English as an additional language
— Professional development for educators of English learners
— State and national policy development for EL assessment and accountability including federal peer review guidance (Title III)

**Mathematics Content Lead has expertise and experience in:**
— Teaching K–12 mathematics
— Implementing the CA CCSSM
— Professional development for mathematics educators
— Leadership for mathematics education and professional development
— Mathematics standards and assessment development
— Mathematics content, curriculum, and instruction (including for ELs)

**Science Content Lead has expertise and experience in:**
— Teaching K–12 and college-level science
— Implementing the CA NGSS
— Professional development for science educators
— Leadership for science education and professional development
— Development of science standards and assessments
— Science content, curriculum, and instructional strategies
— Science educational reform

**Mathematics and Science Content Analysts have collective expertise in:**
— Teaching K–12 mathematics and science
— K–12 mathematics and science content and disciplinary literacy
— K–12 mathematics and science curriculum and instruction
— ELD content and instruction related to mathematics and science
— Mathematics and science standards development and alignment
— Mathematics and science assessment development and alignment

**III. Correspondence Study Protocols**

Due to differences in the organization and content of the CA CCSSM and the CA NGSS, separate protocols were developed for conducting the analysis of each academic content area. This section provides an overview of the study design, including reference materials consulted and level of analysis for each set of standards. It also provides a description of the protocols used for analyzing correspondence to the mathematics and science standards, including: training and calibration procedures; analysis, coding, and review procedures; and decision rules.

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A. Reference Materials
The following materials were consulted by the ELD and mathematics and science content leads as they developed the correspondence study design and protocols, and by the leads and content analysts during training and analysis to inform their coding decisions.

ELD Materials

*CA ELD Standards*
- Introduction and Proficiency Level Descriptors
- Grade-level Standards

*California English Language Arts/English Language Development Framework*

Mathematics Materials

*CA CCSS for Mathematics*
- Introduction
- Standards for Mathematical Practice
- K–8 Standards
- Higher Mathematics Standards by Conceptual Category

*Standards for Mathematical Practice: Commentary and Elaborations for K–5* (Illustrative Mathematics, 2014)

*Standards for Mathematical Practice: Commentary and Elaborations for 6–8* (Illustrative Mathematics, 2014)

*Mathematics Framework for California Public Schools: Kindergarten Through Twelfth Grade*

Science Materials

*Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve*
- NGSS Front Matter
- NGSS Structure
- Grade-level Standards by Disciplinary Core Ideas (for Middle School: CA Preferred Integrated Learning Progression Course by grade)
- Appendix F: Science and Engineering Practices in the NGSS
- Appendix M: Connections to Common Core State Standards for Literacy in Science and Technical Subjects
- Appendices A–D and J–L (as relevant)


During protocol development, the ELD leads also consulted two publications summarizing previous studies of correspondence between specific ELD standards (or discipline-specific language demands more generally) and the CA CCSSM and the CA NGSS:

*The Framework for English Language Proficiency Development Standards Corresponding to the Common Core State Standards and Next Generation Science Standards* (ELPD Framework) (CCSSO, 2012)
Both of these documents provided useful ideas and insights regarding the conceptualization of correspondence between language and content standards; the analytic framework in which to undertake a correspondence study; and practical display of correspondences between two sets of standards that, although potentially corresponding, are very different in their focus and purpose.

B. Level of Analysis of the Standards

For each set of content standards, the ELD and content leads determined the appropriate level of analysis for the correspondence study. The CA CCSSM and CA NGSS are substantially different in their organization and structure. Each set of standards was developed to represent the knowledge, skills, and abilities of the respective content area, as well as describe the particular practices and processes relevant to engaging with the content in a rigorous and comprehensive way. In addition, a study of correspondence between standards for an academic subject matter area and those for English language development necessarily requires some interpretation and professional judgment to determine the extent of connections between them. Therefore, a first step was to define the parameters of comparison. The relevant levels of analysis for each set of standards are summarized below.

CA ELD Standards

The CA ELD Standards are organized into two Parts, with strands that are consistent (yet developmentally appropriate) across grade levels (see Table 2). At each grade level, the strands are detailed in standards that have descriptors for what students know and can do at each proficiency level.

Table 2: CA ELD Standards - Parts and Strands

<table>
<thead>
<tr>
<th>Part I: Interacting in Meaningful Ways</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Collaborative (engagement in dialogue with others)</td>
</tr>
<tr>
<td>1. Exchanging information/ideas via oral communication and conversations</td>
</tr>
<tr>
<td>2. Interacting via written English (print and multimedia)</td>
</tr>
<tr>
<td>3. Offering opinions and negotiating with/persuading others</td>
</tr>
<tr>
<td>4. Adapting language choices to various contexts</td>
</tr>
<tr>
<td>B. Interpretive (comprehension and analysis of written and spoken texts)</td>
</tr>
<tr>
<td>5. Listening actively and asking/answering questions about what was heard</td>
</tr>
<tr>
<td>6. Reading closely and explaining interpretations/ideas from reading</td>
</tr>
<tr>
<td>7. Evaluating how well writers and speakers use language to present or support ideas</td>
</tr>
<tr>
<td>8. Analyzing how writers use vocabulary and other language resources</td>
</tr>
<tr>
<td>C. Productive (creation of oral presentations and written texts)</td>
</tr>
<tr>
<td>9. Expressing information and ideas in oral presentations</td>
</tr>
<tr>
<td>10. Composing/writing literary and informational texts</td>
</tr>
<tr>
<td>11. Supporting opinions or justifying arguments and evaluating others’ opinions or arguments</td>
</tr>
<tr>
<td>12. Selecting and applying varied and precise vocabulary and other language resources</td>
</tr>
</tbody>
</table>

For purposes of display, slightly different wordings between grades K-5 and 6-12, representing varying cognitive and linguistic capacities at the elementary and secondary levels, have been combined in Table 2.

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### Table 2 (continued): CA ELD Standards - Parts and Strands

<table>
<thead>
<tr>
<th>Part II: Learning About How English Works</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Structuring Cohesive Texts</strong></td>
</tr>
<tr>
<td>1. Understanding text structure and organization based on purpose, text type, and discipline</td>
</tr>
<tr>
<td>2. Understanding cohesion and how language resources across a text contribute to the way a text unfolds and flows</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>B. Expanding &amp; Enriching Ideas</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Using verbs and verb phrases to create precision and clarity in different text types</td>
</tr>
<tr>
<td>4. Using nouns and noun phrases to expand ideas and provide more detail</td>
</tr>
<tr>
<td>5. Modifying to add details to provide more information and create precision</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>C. Connecting and Condensing Ideas</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Connecting ideas within sentences by combining clauses</td>
</tr>
<tr>
<td>7. Condensing ideas within sentences using a variety of language resources</td>
</tr>
</tbody>
</table>

Each grade-level ELD standard has descriptors for each of the three proficiency levels: Emerging, Expanding, and Bridging. While analysts looked across all three proficiency levels to determine the range of language demands for the given ELD standard, the correspondence to the mathematics and science standards’ language demands was rated for the Bridging level. (The “bridge” alluded to is the transition to full engagement in grade-level academic tasks and activities in a variety of content areas without the need for specialized ELD instructional support.) At the Bridging level, EL students continue to learn and apply a range of high-level English language skills in a wide variety of contexts, including comprehension and production of highly technical texts. Confirming the ELD standards' correspondence at the Bridging level ensures that the ELD standards will adequately address the language demands of math and science content standards at grade level.

After reviewing the materials described above and engaging in deliberation, the ELD leads determined that analysis of correspondence of the ELD standards to the mathematics and science standards would be most effectively and usefully entered into via Part I of the CA ELD Standards, “Interacting in Meaningful Ways.” There are two key reasons for this. First, Part I of the CA ELD Standards addresses collaborative, interpretive, and productive language uses and purposes (explaining, presenting, arguing, etc.) for which there are direct correspondences to the mathematics and science and engineering practices; these language uses and purposes may also be explicitly described and identifiable in the content standards themselves.

Second, Part II of the CA ELD Standards, “Learning About How English Works,” is not designed or intended to be implemented in isolation of Part I. As the CA ELD Standards publication explains:

> It is critical to understand that, although Part II is presented separately in order to draw educators' attention to it, the focus in Part II on understanding how English works is integral to and inseparable from EL students' development of meaning-making and purposeful interaction as delineated in Part I, “Interacting in Meaningful Ways.” (p. 161)

Part II specifies particular elements of language structures that apply to using language in a variety of contexts and for a variety of purpose described in Part I. These standards (Understanding Cohesion, Using Verbs and Verb Phrases, etc.) do not have any explicit equivalents in the mathematics and science content standards or practices. Nevertheless, as Part II of the CA ELD Standards is intended to apply across Part I of the CA ELD Standards, any correspondence of Part I CA ELD Standards to mathematics and science standards would necessarily involve application of Part II CA ELD Standards at the same time. Thus, correspondences to Part I CA ELD Standards implicitly represent correspondences to Part II CA ELD Standards.

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It should be noted that the proposed CA ELD Standards augmentation document will be based on this correspondence analysis and, when produced, will include descriptions of applications in mathematics and science of both the Part I and the Part II CA ELD Standards. This will explicitly exemplify for teachers and students the connections that are only implicit between Part II and the mathematics and science standards.

California Common Core State Standards for Mathematics

The mathematics standards include standards at each grade level organized by domains for grades K–8 (e.g., Number and Operations in Base Ten) or by conceptual category for grades 9–12 (e.g., Algebra). The standards typically describe cognitive understanding (e.g., NF.4.4a: Understand a fraction a/b as a multiple of 1/b) or mathematical processes (e.g., N-RN.2: Rewrite expressions involving radicals and rational exponents using the properties of exponents). A smaller number of standards include descriptors that explicitly involve language uses and purposes (e.g., 7.G.3: Describe the two-dimensional figures that result from slicing three-dimensional figures . . .). Thus, in order to determine correspondences between each mathematics standard and each ELD standard, it would first be necessary to infer the various ways language would be used in teaching and learning each mathematics standard in the classroom.

Importantly, the math standards are intended to connect to a set of mathematical practices (MPs) that apply across all standards at all grade levels. As noted in the introduction to the CA CCSSM (p. 8), “Designers of curricula, assessments, and professional development should all attend to the need to connect the mathematical practices to mathematical content in mathematics instruction.” The mathematical practices focus on “processes and proficiencies” that include explicit wording specific to language uses and purposes, such as “explain” (MP1 and MP6) and “communicate” (MP3 and MP6). In fact, the two previous correspondence studies used as references for this study, the CCSSO ELPD Framework, and the ELPA 21 Consortium ELP Standards, both utilize the mathematical practices to identify the language demands inherent in the content standards and discern the level of correspondence of CA ELD Standards to the content standards.

Thus, after careful review and discussion of the options, and consultation with the CDE, the ELD and content leads agreed that the practices would constitute the best entry point for determining the relevant level for correspondence of the CA ELD Standards. In order to take into account the mathematics content at each grade level to which the practices apply, content analysts also looked across the mathematics standards for each grade level to ensure all language demands were accounted for by the CA ELD Standards, and selected at least one sample math standard that best exemplified the language demands entailed in the math standards that are explicit in the CA ELD Standards.

Mathematical Practices
(See Appendix A for a full description of each practice)
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.
Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve

The CA NGSS are designed around three interrelated dimensions: science and engineering practices (SEP), disciplinary core ideas (DCI) and crosscutting concepts (CCC). For this section of the correspondence study, the science analysts determined that the best leverage point for discerning the correspondence of the CA ELD Standards to the language demands of the CA NGSS should be the performance expectation (PE), which embodies these three dimensions. (The PEs are the equivalent level of granularity as the grade-level standards in the CA CCSSM and the grade-level standards across proficiency levels in the CA ELD Standards.) In addition, each set of PEs organized by the three dimensions includes a list of the prerequisite or connected CCSS for ELA/Literacy for the PEs. Thus, analysts could use these ELA/Literacy connections as another resource for determining correspondence between the CA ELD Standards and the PEs. (Note that, although both the CA ELD Standards and the CA NGSS provide lists of corresponding CCSS for ELA/Literacy standards, ELD and science leads/analysts agreed that a simple cross-comparison by CCSS for ELA/Literacy correspondence would not provide the comprehensive science content analysis needed for this study. The teams decided to directly examine the CA ELD Standards in relation to science PEs, using the CCSS for ELA/Literacy standards as a guide.) In addition, each PE is associated with a CA NGSS science and engineering practice (SEP). The science content lead and analysts determined that it was essential to leverage the SEPs in examining correspondence of the ELD standards to the CA NGSS since, as noted in NGSS Appendix F:

> Engagement in [science and engineering] practices is language intensive and requires students to participate in classroom science discourse. . . . When supported appropriately, these [EL] students are capable of learning science through their emerging language and comprehending and carrying out sophisticated language purposes (e.g., arguing from evidence, providing explanations, developing models) using less-than-perfect English. By engaging in such practices, moreover, they simultaneously build on their understanding of science and their language proficiency (i.e., capacity to do more with language). (p. 3)

As also noted in Appendix F of the CA NGSS, “the eight practices are not separate; they intentionally overlap and interconnect” (p. 3). After discussion among the project team, and consultation with the CDE, the team undertook examination of correspondence of the CA ELD Standards to the CA NGSS by indicating the SEP for each PE corresponding to each ELD Standard at each grade level.

**Science and Engineering Practices**
(See Appendix B for a full description of each practice)
1. Ask questions and define problems.
2. Develop and use models.
3. Plan and carry out investigations.
4. Analyze and interpret data.
5. Use mathematics and computational thinking.
6. Construct explanations and design solutions.
7. Engage in argument from evidence.
8. Obtain, evaluate, and communicate information.
C. Mathematics Protocol

As noted above, the relevant level of analysis for the CA CCSSM was determined to be best entered via the math practices (MPs). For each grade level, analysts identified correspondences between the grade-level ELD standards (with a focus on the Bridging proficiency level) and the MPs, considering specific statements within the full text of the MP (e.g., for MP3, “Students at all grades can listen [to] or read the arguments of others”). The correspondence was completed for each grade level K–8 and for grades 9–12. (Since there is only one set of CA CCSSM for the 9–12 grade span [arranged by conceptual category], correspondences are the same for the ELD 9–10 and 11–12 grade spans, whose standards descriptors differ only slightly.)

Training and Calibration of Math Analysts

The following list summarizes the steps involved in training the math analysts to engage in using the math protocol to analyze the correspondence of the CA ELD Standards to the language demands of the math standards.

1. ELD lead provided overview of project, staffing, and timeline.
2. Mathematics lead and content analysts determined grade level assignments.
3. ELD lead provided overview of the organization and content of the CA ELD Standards.
4. Mathematics lead and content analysts reviewed CA CCSSM and determined relevant levels of analysis.
5. Mathematics lead and ELD/mathematics content analysts conducted sample correspondence ratings of ELD strands to math standards at different grade levels.
7. Each content analyst continued rating initial set of standards at assigned grade level.
8. Mathematics team discussed ratings.
9. Method repeated until initial calibration was achieved.

Correspondence Rating Procedure

The following list summarizes the steps the analysts undertook in the correspondence rating procedure.

1. Read the ELD standards and identified possible corresponding MPs.
2. Identified specific statements within the MPs that correspond to the ELD standard language uses or purposes. (A document with the statements in each MP bulleted out was provided for this purpose.)
3. Read through all mathematics standards for the grade level and identified a sample standard that would best exemplify application of this ELD standard during classroom instruction.
4. Wrote comments about the ratings where relevant.

Analysis and Ongoing Calibration

The following list summarizes the steps the math content lead and analysts undertook in the analysis of the correspondence of the CA ELD Standards to the math standards, and ongoing calibration.

1. Analysts continued rating at the assigned grade level(s) as determined during training.
2. After each grade level (or at regular intervals as determined during training) the mathematics content lead reviewed the analysts’ ratings and discussed calibration with analysts as needed.
3. When all analysts had completed ratings and calibration, the content lead reviewed all grade levels for completeness, accuracy, and consistency.
4. The correspondence ratings then moved to ELD review for final analysis.

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**D. Science Protocol**

As noted above, the relevant level of analysis for the CA NGSS was determined to be the PE and the SEP. For each grade level, analysts identified correspondences between the grade-level ELD standards (with a focus on the Bridging proficiency level) and the PEs, categorized under relevant SEP. The correspondence was completed for each grade level K–8 (using the State Board of Education’s preferred Integrated Model for grades 6, 7, and 8), and for grades 9–12. (Since there is only one set of CA NGSS for the 9–12 grade span, correspondences are the same for the ELD 9–10 and 11–12 grade spans, whose standards descriptors differ only slightly.)

**Training and Calibration of Science Analysts**

The following list summarizes the steps involved in training the science analysts to engage in using the science protocol to analyze the correspondence of the CA ELD Standards to the language demands of the science standards.

1. ELD lead provides overview of project, staffing, and timeline.
2. Science lead and content analysts determine grade level assignments.
3. ELD lead provides overview of the organization and content of the ELD standards.
4. Science lead and content analysts review CA NGSS and determine relevant levels of analysis.
5. Science lead and ELD/science content analysts conduct sample correspondence ratings of ELD strands at different grade levels.
7. Each content analyst continues rating initial set of standards at assigned grade level.
8. Science team discusses ratings.
9. Repeat until initial calibration appears assured.

**Correspondence Rating Procedure**

The following list summarizes the steps the analysts undertook in the correspondence rating procedure.

1. Identify the PE that will be analyzed (e.g., 5–LSI–1: Support an argument that plants get the materials they need for growth chiefly from air and water) and the 3 dimensions (e.g., SEP–Support an argument; DCI–Plants need air and water; CCC–Energy and Matter) that are found in the PE.
2. Identify the practice descriptor bulleted in the SEP foundation box (e.g., Support an argument with evidence, data, or a model).
3. Identify the CCSS for ELA/Literacy connections with a brief description for insights into connections and possible corroborating evidence of correspondence (e.g., R1.5.1–Quote from text; R1.5.9–Integrate information from several texts to write or speak; W5.1–Write opinion pieces, supporting point of view).
4. Read ELD standards and identify correspondences (e.g., A.3–Offering opinions; A.4–Adapting word choices; B.6–Reading/viewing closely; B.7–Evaluating language choices; B.8–Analyzing language choices; C.9–Presenting; C.11a–b–Supporting opinions; 12a–Selecting language resources/academic language).
5. Write comments about the ratings where relevant.
Analysis and Ongoing Calibration
The following list summarizes the steps the science content lead and analysts undertook in the analysis of the correspondence of the CA ELD Standards to the science standards, and ongoing calibration.

1. Analysts continue rating at the assigned grade level(s) as determined during training.
2. After each grade level (or at regular intervals as determined during training) the science content lead reviews the analysts’ ratings and has a calibration discussion with analysts as needed.
3. When all analysts have completed ratings, calibration, and creation of decision rules, the content lead reviews all grade levels for completeness, accuracy, and consistency.
4. The correspondence ratings then move to ELD review for final analysis.

E. ELD Review
Once the mathematics and science analysts and leads had completed the analysis and calibration for all grade levels, the ELD leads and analysts reviewed the correspondence ratings to ensure the ratings accurately reflected the intent and linguistic focus of each ELD standard as relevant to the language demands identified in the corresponding mathematics or science practices and content standards.

Calibration of ELD Analysts
The following list summarizes the steps involved in calibrating the ELD analysts to engage in using the ELD review protocol to analyze the correspondence of the CA ELD Standards to the language demands of the mathematics and science standards.

1. ELD leads and analysts review mathematics and science correspondence ratings for two representative grade levels (4 and 9–10) for each content area and discuss accuracy of the ratings for each ELD standards given the intent and focus of each ELD standard.
2. ELD leads and analysts conduct sample correspondence ratings of ELD strands at the representative grade levels.
3. ELD team discusses ratings.
4. ELD analysts continue rating standards for representative grade levels.
5. ELD team discusses ratings.
6. Continue until initial calibration appears assured.

Analysis and Ongoing Calibration
The following summarizes the steps the ELD analysts undertook in the analysis of the correspondence of the CA ELD Standards to the mathematics and science standards, and ongoing calibration.

1. ELD leads and analysts continue rating the remaining grade level(s).
2. After each grade level (or at regular intervals as determined during calibration) the ELD leads and analysts review each other’s ratings and have a calibration discussion as needed.
3. When all leads/analysts have completed ratings and calibration, an ELD lead reviews all grade levels for completeness, accuracy, and consistency.
IV. Summary of Correspondence

This section summarized the results of correspondences of the CA ELD Standards to the CCSSM and the CA NGSS. The overall results are summarized for all grades, K–12, and the numbered strands of the CA ELD Standards. Detailed correspondences by grade or grade span for each grade-level ELD standard are provided in Appendices C and D.

A. Summary of Correspondence between CA ELD Standards and CA CCSS for Mathematics

Overall, the mathematics and ELD analysts determined that the CA ELD Standards address the full range and rigor of language demands required by the CA CCSSM across all grade levels, as represented in the standards for mathematical practice (MP). Charts detailing correspondences of the CA ELD Standards for each grade level to the CA CCSSM are in Appendix C.

Three standards for mathematical practice—MP1, MP3, and MP6—were determined to provide for explicit correspondence of the CA ELD Standards to the math standards, as shown in Table 3. The remaining five practices focus on mathematical cognitive skills and have no explicit wording related to language demands that would allow analysts to determine correspondence of a particular ELD standard to particular math standard. The language demands inherent in MP2, MP4, MP5, MP7, and MP8 would depend on the type of instruction individual teachers apply to these practices in the classroom. Thus, they were not coded as corresponding to individual ELD standards.

Table 3: Summary of Correspondence between CA ELD Standards and CA CCSS for Mathematics

<table>
<thead>
<tr>
<th>ELD Standard (Part I)</th>
<th>MP1 Make sense of problems and persevere in solving them</th>
<th>MP3 Construct viable arguments and critique the reasoning of others</th>
<th>MP6 Attend to precision</th>
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<tbody>
<tr>
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<td>Collaborative Mode</td>
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<tr>
<td></td>
<td>Interpretive Mode</td>
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<td></td>
<td>Productive Mode</td>
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<td>12</td>
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</tbody>
</table>

MP1, Make sense of problems and persevere in solving them, and MP6, Attend to precision, describe overarching habits of mind that teachers seek to instill in the mathematics classroom. The math analyst team decided that MP1 serves as an umbrella for problem solving within the other practice standards, and has aspects of language demands to which all the ELD standards correspond. The team determined correspondences of particular ELD standards to math standards represented by MP6 and based on the focus in MP6 of both computational precision and precision of mathematical language. MP3, Construct viable arguments and critique the reasoning of others, clearly describes the specific practices of arguing and critiquing—both the analytic practices and the language demands for engaging in these practice are
explicit in MP3, and particular ELD standards directly correspond to standards exemplified by this practice. An overview of each math practice and its focus on language demands or cognitive skills is provided below.

1. **Make sense of problems and persevere in solving them.**
   Language demands explicit in MP1:
   Mathematically proficient students start by
   - explaining to themselves the meaning of a problem and looking for entry points to its solution.
   They
   - make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt.
   Mathematically proficient students can
   - explain correspondences between equations, verbal descriptions, tables, and graphs.
   They can
   - understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2. **Reason abstractly and quantitatively.**
   While the teaching and learning of the abstract and quantitative reasoning practices requires use of language, language demands are not explicitly described in MP2.

3. **Construct viable arguments and critique the reasoning of others.**
   Language demands explicit in MP3:
   Mathematically proficient students
   - understand and use stated assumptions, definitions, and previously established results in constructing arguments.
   They
   - make conjectures and build a logical progression of statements to explore the truth of their conjectures.
   - justify their conclusions, communicate them to others, and respond to the arguments of others.
   Mathematically proficient students are also able to
   - compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—
     - explain what it is.
   Elementary students can
   - construct arguments using concrete referents such as objects, drawings, diagrams, and actions.
   Students at all grades can
   - listen to or read the arguments of others, decide whether they make sense, and
   - ask useful questions to clarify or improve the arguments.

4. **Model with mathematics.**
   While the teaching and learning of modeling with mathematics requires use of language, language demands are not explicitly described in MP4.
5. **Use appropriate tools strategically.**
   While the teaching and learning of the use of tools requires use of language, language demands are not explicitly described in MP5.

6. **Attend to precision.**
   Language demands explicit in MP6:
   Mathematically proficient students try to
   - communicate precisely to others.
   - use clear definitions in discussion with others and in their own reasoning.
   They
   - state the meaning of the symbols they choose, including using the equal sign consistently and appropriately.
   In the elementary grades, students
   - give carefully formulated explanations to each other.
   By the time they reach high school they have learned to
   - examine claims and
   - make explicit use of definitions.

7. **Look for and make use of structure.**
   While the teaching and learning about the use of mathematical structure requires use of language, language demands are not explicitly described in MP7.

8. **Look for and express regularity in repeated reasoning.**
   While the teaching and learning about expressing regularity in repeated reasoning requires use of language, language demands are not explicitly described in MP8.

**B. Summary of Correspondence between CA ELD Standards and CA NGSS**
Overall, the science and ELD analysts determined that the CA ELD Standards address the full range and rigor of language demands required by the CA NGSS across all grade levels, as represented in the science and engineering practices (SEP) and the performance expectations (PEs). Charts detailing correspondences of the ELD standards for each grade level to the CA NGSS PEs and SEPs are in Appendix D.

One or more ELD standards was found to correspond to each of the PEs for grades K–8. And at least one ELD standard was found to correspond to all but five PEs for high school (grades 9–12). The five PEs where the CA ELD Standards provided no correspondence address the skills of using mathematical computational representations (HS-ESS1-4, HS-ESS3-6), designing a device (HS-PS2-3, HS-PS3-3), or using a computer simulation (HS-ETS1-4). Notably, none of these PEs has a CCSS for ELA/Literacy connection, confirming that these PEs address cognitive and processing skills for which language demands would have to be inferred, rather than being apparent in the descriptors and connections for the PE.

Table 4 summarizes the correspondences by SEP for each CA ELD Standards strand across all grades, K–12.
Table 4: Summary of Correspondence between CA ELD Standards and CA NGSS

<table>
<thead>
<tr>
<th>ELD Standard (Part I)</th>
<th>Science and Engineering Practices Identified for Corresponding Performance Expectations</th>
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<tbody>
<tr>
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<td>1</td>
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<tr>
<td>Collaborative Mode</td>
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<td>4</td>
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<td>Interpretive Mode</td>
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<td>Productive Mode</td>
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<td>11</td>
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</tbody>
</table>

The science analysts concluded that ELD Part I standard 1 (exchanging information and ideas with others) has correspondence to all the PEs because of the nature of science as a social endeavor. As noted in the Framework for K–12 Science Education, “science is fundamentally a social enterprise and science knowledge advances through collaboration and in the context of a social system with well developed norms” (p. 27). Notes for ELD Part I standard 1 in the correspondence charts in Appendix D reinforce this emphasis.

The ELD reviewers noted that the language processes described in ELD Part I standards 4, 7, 8, and 12 would apply to all the PEs corresponding to the other ELD standards in the same mode. For example, students would apply standard 4 (adapting language choices to various contexts), as they engaged in the collaborative exchanges described in ELD standards 1–3, and thus, all the PEs that correspond across standards 1–3 would also correspond to standard 4. Rather than repeat the PEs from every row and column, this cross-application is represented by an ‘(X)’ in Table 4 and by explanatory notes in the correspondence charts in Appendix D.

V. Conclusion and Next Steps

The results of the correspondence analyses show that the CA ELD Standards address the full range and rigor of language demands required by the CA CCSSM and the CA NGSS across all grade levels. The only area in which augmentation of the CA ELD Standards might be called for in order to ensure the ELD standards correspond as closely as possible to the language demands of the CA CCSSM and the CA NGSS is in the application of particular ELD standards in the context of mathematics or science instruction. From analysis of the CA CCSSM and the CA NGSS it was apparent that many language demands—especially those related to specific elements of selecting language resources (such as affixes and modals), adapting language to task, purpose and audience, or analyzing the structure of texts and sentences—are implicit rather than explicit in the mathematics and science standards. In order to clarify for mathematics and science educators how the CA ELD Standards correspond to these implicit language demands, WestEd proposes to develop augmentation documents that provide additional notes and
examples for the CA ELD Standards on how the knowledge, skills, and abilities described in the ELD standards can be applied within teaching and learning mathematics and science. A sample of this augmentation document—one for mathematics and one for science—is provided in Appendix E. Our recommendation is to develop one such augmentation document for the elementary grade span (K–5) and one for the secondary grade span (6–12). These two augmentation documents would complement what is currently provided in the Science, Mathematics, and ELA/ELD Curriculum Frameworks for K–12 Public Schools. In addition, the augmentation documents would refer readers to additional examples of the tandem implementation of California Science, Mathematics, and ELA/Literacy Standards with CA ELD Standards.

At the public expert panel meeting convened by the CDE on April 2, 2015, experts in ELD and mathematics and science education will review this correspondence study report and review the sample augmentation documents. Based on feedback from the CDE and from expert panel members and public input, WestEd will develop a format and organization for a complete draft augmentation document to be reviewed by the CDE and by expert panel members at a public meeting on May 28, 2015.
Appendix A: Standards for Mathematical Practice

Taken from:

1) Make sense of problems and persevere in solving them.
Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2) Reason abstractly and quantitatively.
Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

3) Construct viable arguments and critique the reasoning of others.
Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen to or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments. Students build proofs by induction and proofs by contradiction. CA 3.1 (for higher mathematics only).
4) Model with mathematics.
Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5) Use appropriate tools strategically.
Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

6) Attend to precision.
Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.
7) **Look for and make use of structure.**

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see $7 \times 8$ equals the well-remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as $2 \times 7$ and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers $x$ and $y$.

8) **Look for and express regularity in repeated reasoning.**

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through $(1, 2)$ with slope 3, middle school students might abstract the equation $(y - 2)/(x - 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x - 1)(x + 1), (x - 1)(x^2 + x + 1)$, and $(x - 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.
Appendix B: Science and Engineering Practices in the NGSS

Taken from:

**Practice 1: Asking Questions and Defining Problems**

Scientific questions arise in a variety of ways. They can be driven by curiosity about the world, inspired by the predictions of a model, theory, or findings from previous investigations, or they can be stimulated by the need to solve a problem. Scientific questions are distinguished from other types of questions in that the answers lie in explanations supported by empirical evidence, including evidence gathered by others or through investigation.

While science begins with questions, engineering begins with defining a problem to solve. However, engineering may also involve asking questions to define a problem, such as: What is the need or desire that underlies the problem? What are the criteria for a successful solution? Other questions arise when generating ideas, or testing possible solutions, such as: What are the possible tradeoffs? What evidence is necessary to determine which solution is best?

Asking questions and defining problems also involves asking questions about data, claims that are made, and proposed designs. It is important to realize that asking a question also leads to involvement in another practice. A student can ask a question about data that will lead to further analysis and interpretation. Or a student might ask a question that leads to planning and design, an investigation, or the refinement of a design.

Whether engaged in science or engineering, the ability to ask good questions and clearly define problems is essential for everyone.

**Practice 2: Developing and Using Models**

Models include diagrams, physical replicas, mathematical representations, analogies, and computer simulations. Although models do not correspond exactly to the real world, they bring certain features into focus while obscuring others. All models contain approximations and assumptions that limit the range of validity and predictive power, so it is important for students to recognize their limitations.

In science, models are used to represent a system (or parts of a system) under study, to aid in the development of questions and explanations, to generate data that can be used to make predictions, and to communicate ideas to others. Students can be expected to evaluate and refine models through an iterative cycle of comparing their predictions with the real world and then adjusting them to gain insights into the phenomenon being modeled. As such, models are based upon evidence. When new evidence is uncovered that the models can’t explain, models are modified.

In engineering, models may be used to analyze a system to see where or under what conditions flaws might develop, or to test possible solutions to a problem. Models can also be used to visualize and refine a design, to communicate a design’s features to others, and as prototypes for testing design performance.
Practice 3: Planning and Carrying Out Investigations

Scientific investigations may be undertaken to describe a phenomenon, or to test a theory or model for how the world works. The purpose of engineering investigations might be to find out how to fix or improve the functioning of a technological system or to compare different solutions to see which best solves a problem. Whether students are doing science or engineering, it is always important for them to state the goal of an investigation, predict outcomes, and plan a course of action that will provide the best evidence to support their conclusions. Students should design investigations that generate data to provide evidence to support claims they make about phenomena. Data aren’t evidence until used in the process of supporting a claim. Students should use reasoning and scientific ideas, principles, and theories to show why data can be considered evidence.

Over time, students are expected to become more systematic and careful in their methods. In laboratory experiments, students are expected to decide which variables should be treated as results or outputs, which should be treated as inputs and intentionally varied from trial to trial, and which should be controlled, or kept the same across trials. In the case of field observations, planning involves deciding how to collect different samples of data under different conditions, even though not all conditions are under the direct control of the investigator. Planning and carrying out investigations may include elements of all of the other practices.

Practice 4: Analyzing and Interpreting Data

As students mature, they are expected to expand their capabilities to use a range of tools for tabulation, graphical representation, visualization, and statistical analysis. Students are also expected to improve their abilities to interpret data by identifying significant features and patterns, use mathematics to represent relationships between variables, and take into account sources of error. When possible and feasible, students should use digital tools to analyze and interpret data. Whether analyzing data for the purpose of science or engineering, it is important students present data as evidence to support their conclusions.

Practice 5: Using Mathematics and Computational Thinking

Students are expected to use mathematics to represent physical variables and their relationships, and to make quantitative predictions. Other applications of mathematics in science and engineering include logic, geometry, and at the highest levels, calculus. Computers and digital tools can enhance the power of mathematics by automating calculations, approximating solutions to problems that cannot be calculated precisely, and analyzing large data sets available to identify meaningful patterns. Students are expected to use laboratory tools connected to computers for observing, measuring, recording, and processing data. Students are also expected to engage in computational thinking, which involves strategies for organizing and searching data, creating sequences of steps called algorithms, and using and developing new simulations of natural and designed systems. Mathematics is a tool that is key to understanding science. As such, classroom instruction must include critical skills of mathematics. The NGSS displays many of those skills through the performance expectations, but classroom instruction should enhance all of science through the use of quality mathematical and computational thinking.
Practice 6: Constructing Explanations and Designing Solutions
The goal of science is to construct explanations for the causes of phenomena. Students are expected to construct their own explanations, as well as apply standard explanations they learn about from their teachers or reading.

An explanation includes a claim that relates how a variable or variables relate to another variable or a set of variables. A claim is often made in response to a question and in the process of answering the question, scientists often design investigations to generate data.

The goal of engineering is to solve problems. Designing solutions to problems is a systematic process that involves defining the problem, then generating, testing, and improving solutions.

Practice 7: Engaging in Argument from Evidence
Argumentation is a process for reaching agreements about explanations and design solutions. In science, reasoning and argument based on evidence are essential in identifying the best explanation for a natural phenomenon. In engineering, reasoning and argument are needed to identify the best solution to a design problem. Student engagement in scientific argumentation is critical if students are to understand the culture in which scientists live, and how to apply science and engineering for the benefit of society. As such, argument is a process based on evidence and reasoning that leads to explanations acceptable by the scientific community and design solutions acceptable by the engineering community.

Argument in science goes beyond reaching agreements in explanations and design solutions. Whether investigating a phenomenon, testing a design, or constructing a model to provide a mechanism for an explanation, students are expected to use argumentation to listen to, compare, and evaluate competing ideas and methods based on their merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.

Practice 8: Obtaining, Evaluating, and Communicating Information
Being able to read, interpret, and produce scientific and technical text are fundamental practices of science and engineering, as is the ability to communicate clearly and persuasively. Being a critical consumer of information about science and engineering requires the ability to read or view reports of scientific or technological advances or applications (whether found in the press, the Internet, or in a town meeting) and to recognize the salient ideas, identify sources of error and methodological flaws, distinguish observations from inferences, arguments from explanations, and claims from evidence. Scientists and engineers employ multiple sources to obtain information used to evaluate the merit and validity of claims, methods, and designs. Communicating information, evidence, and ideas can be done in multiple ways: using tables, diagrams, graphs, models, interactive displays, and equations as well as orally, in writing, and through extended discussions.