College and Career Readiness Standards for Adult Education

Susan Pimentel

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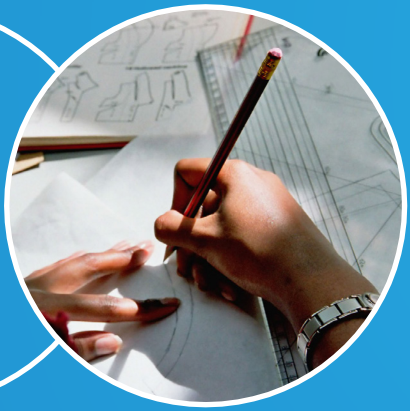

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College and Career Readiness Standards for Adult Education

By
Susan Pimentel

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Washington, DC

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U.S. Department of Education
Arne Duncan
Secretary

Office of Vocational and Adult Education
Brenda Dann-Messier
Assistant Secretary

Division of Adult Education and Literacy
Cheryl Keenan
Director

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Panel Members

Gayle Box
Associate
Strategic Initiatives
Kentucky Adult Education, Council on Postsecondary Education
Frankfort, KY

Donna Curry
Senior Professional Development Specialist
Tech Education Research Center (TERC)
Cambridge, MA

Robert Curry
Associate Professor and Chair of English and Humanities
Alfred State, State University of New York College of Technology
Alfred, NY

Mary Beth Curtis
Director
Center for Special Education
Lesley University
Cambridge, MA

Margo Gottlieb
Lead Developer
World-Class Instructional Design and Assessment Consortium
Wisconsin Center for Education Research
Director
Assessment and Evaluation
Illinois Resource Center
Arlington Heights, IL

Arthur Heinricher
Dean of Undergraduate Studies and Professor of Mathematical Sciences
Worcester Polytechnic Institute
Worcester, MA

Lisa Hertzog
Executive Director of Academic Support
New York City Department of Education, District 79
Alternative Schools and Programs
New York, NY

Steve Hinds
Mathematics Curriculum Developer
City Colleges of Chicago
Chicago, IL

Lorretta Holloway
Program Advisor and Associate Professor
Department of English
Framingham State University
Framingham, MA

Joanne Kantner
Dean
Adult Education and Transition Programs
Kishwaukee College
Malta, IL

Karen King
Former Director of Research
National Council of Teachers of Mathematics
Reston, VA

Henry Kranendonk
Mathematics Specialist Educational Opportunity Program
Marquette University
Milwaukee, WI

Miriam A. Leiva
B. Cone Distinguished Professor Emerita
Professor of Mathematics Emerita
University of North Carolina Charlotte
Charlotte, NC

Meredith Liben
English Language Arts and Literacy Team Director
Student Achievement Partners
Liben Education Consulting
Hartland, VT

Jane Meyer
Adult Basic and Literacy Education Coordinator
Canton City Schools
Canton, OH

Jane Roy
Adjunct Instructor/Consultant
South Dakota State University
Brookings, SD

Virginia (Ginny) Seltenright
Academic Support and Compliance Manager
Adult Education Services
Arizona Department of Education
Phoenix, AZ

Barbara Van Horn
Co-Director
Goodling Institute for Research in Family Literacy
College of Education
The Pennsylvania State University
University Park, PA

1 INTRODUCTION

Overview of Project

For over a decade, standards-based education has been an integral part of the Office of Vocational and Adult Education's (OVAE) program of national leadership activities to improve the quality of adult education and literacy programs nationwide. The standards-based education movement in adult education has resulted in communicating clearer expectations for students, using content standards to improve curriculum and instruction, and creating professional development to help staff develop the expertise to implement standards.

Standards-based education begins, of course, with the standards themselves. Clear standards allow educators to understand where to focus their efforts and shape overall instruction. Standards then are translated into curriculum and lessons for teaching the content of the standards to students. Classroom activities, assignments, and a range of formative and summative assessments all help determine whether or not students are absorbing the essential skills and knowledge included in the standards.[1]

Building on OVAE's long commitment to promoting state-level institutionalization of adult education content standards, the central purpose of this effort—*Promoting College and Career Ready Standards in Adult Basic Education*—is to forge a stronger link among adult education, postsecondary education, and the world of work. It presents a starting point for raising awareness and understanding of the critical skills and knowledge expected and required for success in colleges, technical training programs, and employment in the 21st century.

While the academic standards developed by states in recent decades reflected broad agreement among experts about what was desirable for students to learn, they did not necessarily identify what was *essential* for students to know to be prepared for the rigors of postsecondary training, work, or citizenship. It was not until the development of the Common Core State Standards (CCSS) in 2010—to date adopted by 46 states for K–12 programs—that such a consensus emerged. Based on evidence from a wide array of sources, including student performance data, academic research, assessment data, and results of large-scale surveys of postsecondary instructors and

[1] For more information on standards-based education in adult education, see *A Process Guide for Establishing State Adult Education Content Standards* (American Institutes for Research 2005).

employers, the CCSS offer clear signposts indicating what is most important for college and career readiness (National Governors Association [NGA] 2010b, 2010c, pp. 91–93).

Thus, the CCSS were selected as the basis for the review and recommendations in this report. The report describes how these College and Career Readiness (CCR) standards can enable adult education programs to establish a framework for developing or updating their standards. The following questions guided the review:

1. What content in the area of English language arts and literacy (ELA/literacy) is most relevant to preparing adult students for success in higher education and training programs?
2. What content in the area of mathematics is most relevant to preparing adult students for success in higher education and training programs?
3. Which standards in each content area are most important for adult students?

In Sections 4 and 5 of this report, state administrators and instructors will find a set of CCR standards that reflect the answers these questions generated. It is important to note that this report does not specify a *required* set of national or federal standards; rather, it provides benchmarks aligned to the CCSS for states to consider in creating or evaluating their own adult education standards.

Rationale for the Project

The importance of college and career readiness for adult students cannot be overstated. Increasingly, students entering the workforce are discovering that they need critical knowledge and skills that are used on a regular basis. They recognize that pursuing a career pathway that pays enough to support a family and provides genuine potential for advancement hinges on being able to perform the complex tasks identified by the CCSS as critical for postsecondary success. Leading economists who have examined labor market projections note that key college and career ready knowledge and skills are closely linked to being able to get the training necessary to earn a living wage in high-growth industries (Carnevale and Desrochers 2002, 2003). It is crucial, then, that adult education programs provide students the opportunity to acquire these skills to pursue their long-term career aspirations and goals.

The CCSS are ambitious. In mathematics, they reflect content typically taught in both beginning and more advanced algebra and geometry courses, as well as in data analysis and statistics classes. The ELA/literacy standards demand robust analytic and reasoning skills and strong oral and written communication skills. It is understandable that some educators may be daunted by the prospect of making academic requirements in adult education programs even more demanding. However genuine the concerns about setting the bar higher for college and career readiness, a willingness to act on what educators and employers have clearly identified as non-negotiable knowledge and skills is essential to enabling adult learners to meet the real-world demands of postsecondary training and employment.

The integration of CCR standards into adult education programs is intended to provide all adult students with the opportunity to be prepared for postsecondary training without needing remediation. To that end, the CCSS selected for inclusion here identify *beginning levels* of study, reaching students at their instructional levels upon program entry and positioning them for successful progress toward college and career readiness.

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2 APPLICABILITY OF THE COMMON CORE TO ADULT EDUCATION

The initial Common Core State Standards (CCSS) initiative was a state-led effort coordinated by the National Governors Association Center for Best Practices and the Council of Chief State School Officers to develop education standards for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects and Mathematics for voluntary state adoption. The CCSS differ in one noteworthy respect from earlier state standards efforts: the CCSS are anchored by empirical evidence of what employers and educators actually demand of prospective employees and students. Indeed, standards were selected only when the best available evidence indicated that their mastery was needed for college and career readiness (NGA 2010b, 2010c, pp. 91–93).

With 46 states adopting the CCSS, a full range of standards-based resources are being developed from which adult education can benefit. These include formative and summative assessments, instructional materials, teacher preparation, and professional development opportunities. In addition, publishers and assessment designers have considerable incentive to align materials carefully and closely, including textbooks, technology-based resources, and a range of formative and summative assessments. These materials will be more robust than any one state—or any one program—could afford to develop on its own.

While adult educators have expressed interest in the CCSS, they have also raised challenges to accepting outright for adult education the expansive list of K–12 standards. Limits on how much time most adult learners can devote to their learning are genuine; many students are interested in just-in-time learning and cannot devote time equal to a K–12 course of study spelled out in the standards. The 2012 National Research Council report, *Improving Adult Literacy Instruction: Options for Practice and Research*, pointed out that, "On average, learners participate in adult education programs for less than 100 hours over the course of a program year, according to the Adult Education Program Survey" (Lesgold and Welch-Ross 2012, p. 77). Further, adult students often come to programs with some measure of schooling and a wealth of life experiences, making some CCSS content unnecessary to include.

Thus, adult educators expressed a need to identify a manageable set of the CCSS most indispensible for college and career readiness and important to adult students.

Identifying these standards will benefit states in a variety of ways, including the promotion of:

- Consistent expectations between K–12 and adult education systems so all students—whatever their pathway to graduation—will have access to the preparation they need to enter credit-bearing freshman courses without a need for remediation;

- Partnerships between and among states and programs to combine financial resources and human capital to create common tools and materials to support implementation; and

- Student preparation for new assessment models using knowledge and skills identified by the CCSS required for the attainment of a high school diploma or its equivalent (e.g., GED®, Partnership for Assessment of Readiness for College and Careers, and Smarter Balanced Assessment Consortium).

3 PROCESS OF SELECTING COLLEGE AND CAREER READINESS STANDARDS FOR ADULT EDUCATION

To identify a set of College and Career Readiness (CCR) standards for adult education, MPR Associates, Inc. convened two independent panels—one each for English language arts and literacy (ELA/literacy) and mathematics—to look at the Common Core State Standards (CCSS) from the perspective of adult education. Rather than asking Adult Basic Education experts to work in isolation, a cross section of stakeholders who serve adults participated. To forge a vigorous synergy, each panel included a mix of expertise and experience, including representatives from adult education, community colleges, career and technical training, and the military.

The methodology employed was deliberative, multilayered, iterative, and evidence-based (see In-Depth Description of the Selection Process in Appendix A for more detail). Over nine months, panelists were asked to make reasoned judgments about the relevance of the CCSS for adults, based on where the evidence for college and career readiness was most compelling, and to revisit and verify those judgments in light of feedback and new questions.[2]

Because the goal was to determine the applicability of an accepted set of essential CCR standards, judgments about relevance and importance were made based on each standard *as written*. This project was not designed to edit or refine the wording of the CCSS or otherwise develop CCR standards *de novo*; panelists did not have the autonomy to add content to the CCSS. The only exceptions made to maintaining the exact wording of the CCSS were the following:

- Some examples included with the standards for K–12 students (usually found in parentheses or italics within the standards) were adapted to be more appropriate for adult students because these were only illustrations and not meant to be mandatory or to apply universally.

[2] Data from national surveys were compiled as background for the panel review from: ACT (2009); Conley et al. (2011) (referred to in this report as the EPIC faculty survey); and Casner-Lotto and Barrington (2006) (referred to in this report as the employer survey). Refer to Appendix A for descriptions of these resources.

- When wording made specific references to grades K–12, levels of K–12 schooling, or "children," changes were made to adapt the CCSS appropriately to adult education.

Additionally, while the selected set of standards reflects the broad goals articulated above, the selected standards should be recognized for what they *are not* as well as what they are. The central design parameters that guided the work of the panels include:[3]

- First and foremost, the selected standards do not specify a national or federal set of mandates, but rather articulate a framework of standards for states to employ voluntarily in strengthening their adult education programs with respect to college and career readiness.

- Second, the order of the selected standards within a level does not represent an order in which they are to be taught or a hierarchy of importance.

- Third, the selected standards do not specify how instructors should teach, but rather merely define what all students should be expected to know and be able to do to be prepared for postsecondary success.

- Fourth, the standards are not a curriculum, and states or programs choosing to adopt them will need to complement the standards with high-quality curricula that align with the content and expectations.

- Fifth, the standards are not meant to specify the full spectrum of support and interventions appropriate for English language learners and students with special needs to meet these standards, nor do they mirror the significant diversity of students' learning needs, abilities, and achievement levels.

- Sixth, the standards do not offer an exhaustive list of what can be taught beyond the fundamentals specified within these CCR standards; much is purposefully left to the discretion of teachers, curriculum developers, program administrators, and states in deciding what (if any) content to add.

- Finally, while the mathematics and ELA/literacy components in this report are crucial to college and career readiness, they do not define the whole of such preparedness; students depend on a variety of readiness skills and preparation, including habits of mind such as stamina, persistence, punctuality, and time and workload management skills.

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[3] These reflect many of the same design parameters for K-12 standards set out in the introduction to the CCSS for ELA/literacy and mathematics (NGA 2010a).

4 THE RESULTS: COLLEGE AND CAREER READINESS STANDARDS FOR ENGLISH LANGUAGE ARTS AND LITERACY

Key Shifts in the Standards

Through their selections, panelists validated three key shifts in instruction prompted by the Common Core State Standards (CCSS) and outlined by Student Achievement Partners (2012). The shifts described below identify the most significant elements of the CCSS for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects (ELA/literacy). At the heart of these shifts is a focus in literacy instruction on the careful examination of the text itself. Thus the selections outlined below revolve around the texts that students read and the kinds of questions students should address as they write and speak about them. The standards sharpen the focus on the close connection between comprehension of text and acquisition of knowledge.

Shift 1 – Complexity: *Regular practice with complex text and its academic language*

Underlying the standards—and panelists' selections—is research indicating that the complexity of text that students are able to read is the greatest predictor of success in college and careers (ACT 2006). Other research shows that the current gap in complexity between secondary texts and college/career texts is roughly four grade levels (Williamson 2006). Therefore, the first key shift required by the standards is exposing students to appropriately complex texts in both instruction and assessment. This important shift finds explicit expression in CCSS Reading Standard 10, which includes a staircase of increasing text complexity for students to read independently and proficiently. Rather than focusing solely on how students read, the focus also is on the complexity of texts read by students. Closely related to text complexity and inextricably related to reading comprehension is a focus on frequently encountered academic vocabulary—language common to complex texts across the disciplines of literature, science, history, and the arts. Thus, panelists also selected several standards (Reading Standard 4 and Language Standard 6) that focus precisely on academic vocabulary.

Shift 2 – Evidence: *Reading, writing, and speaking grounded in evidence from text, both literary and informational*

The second key shift required by the standards and reflected in panelists' selections is the prioritization of textual evidence across the domains of reading, writing, and speaking and listening—a decision based on national assessment data and input from college faculty indicating that command of evidence is a key college and career readiness skill. For reading, the focus is on students' ability to cite evidence from texts to present careful analyses, well-defended claims, and clear information, as described in Reading Standard 1. For writing, the focus is on analyzing sources and conducting research, as described in Writing Standards 7–9. For speaking and listening, the focus is on purposeful academic talk, in which students contribute accurate, relevant information about a multitude of ideas they have studied or researched in various domains, as described in Speaking and Listening Standard 1. The standards require students to answer questions based on their understanding of having read a text, or multiple texts, not entirely relying on prior knowledge or experience.

Shift 3 – Knowledge: *Building knowledge through content-rich nonfiction*

The third key shift required by the CCSS and echoed in panelists' selections is a focus not only on English language arts, but also on literacy across the disciplines of science, social studies, and technical subjects. Informational text makes up the vast majority of required reading in college and the workplace. Through an extended focus on literacy in the domains of science, history, and technical subject areas, students can build the knowledge that will prepare them for college and careers. Given that literacy across the disciplines is one of the goals of adult education, panelists placed special emphasis on standards for the comprehension of informational text.

Key Features of the ELA/Literacy Standards Charts

The charts below contain the panel's selections from the earliest levels of learning through adult secondary education in the ELA/literacy domains of Reading, Writing, Speaking and Listening, and Language. Rather than present the selected standards grade-by-grade for K-12, the standards have been bundled into five grade-level groupings: A (K–1), B (2–3), C (4–5), D (6–8), and E (9–12) to more closely reflect adult education levels of learning: Beginning Adult Basic Education Literacy, Beginning Basic Education, Low Intermediate Basic Education, High Intermediate Basic Education, and Low Adult Secondary and High Adult Secondary Education. The CCSS Reading Standards: Foundational Skills (K–5) also are included, outlining a set of reading acquisition skills designed to develop proficient readers with the capacity to comprehend varied texts across a range of disciplines.

The CCSS define requirements not only for ELA but also for literacy in history/social studies, science, and technical subjects. The rationale for this interdisciplinary approach is based on extensive research establishing the need for students to be proficient in reading complex informational text independently in a variety of content areas. Most required reading in college and workforce training programs is informational in structure and challenging in content (NGA 2010b, pp. 2–4). Given that most adult education classes combine literacy with science and history study, panelists often selected a science or history reading standard to serve as a specific application of an ELA standard. Where two reading standards are identical in wording, with one relating to literature and the other to informational text, both standard numbers were cited together, but the text of the standard was included just once (e.g., Reading Standard 1, Reading Standard 4, and Reading Standard 10 for each level are identical in wording for literature and informational text, so they include citations such as RI/RL.6.1, RI/RL.6.4, RI/RL.6.10). This notation also applies to the Writing Standards that are identified as W/WHST for Writing Standards in ELA and Writing Standards for History/Social Studies and Science and Technology subjects.

The standards are separated into four *strands*: Reading, Writing, Speaking and Listening, and Language. Each strand is headed by a strand-specific set of *College and Career Readiness (CCR) Anchor Standards* identical across all levels of learning. Each *level-specific standard* corresponds to the same-numbered CCR anchor standard. In other words, each anchor standard identifying broad college and career readiness skills has a corresponding level-specific standard illustrating specific level-appropriate expectations.

The CCR anchor standards provide focus and coherence. The same 10 CCR anchor standards for Reading, for example, apply to both literary and informational texts, including texts in history/social studies, science, and technical subjects. Another 10 CCR anchor standards for Writing cover numerous text types and subject areas. This allows students to "develop mutually reinforcing skills and exhibit mastery of standards for reading and writing across a range of texts and classrooms" (NGA 2010a).

The introductions to the Reading and Writing standards below are modified descriptions of those found in the CCSS, to respond to requests from the panel to clarify how the standards work together. The Speaking and Listening, Language, and Reading Foundation Skills standards introductions were taken from the CCSS. To show how the standards for Writing and Speaking and Listening progress, differences in wording from level to level are underlined.

ELA/Literacy Standards Key

The citation at the end of each standard in the following charts identifies the CCSS strand, grade, and number (or standard number and letter, where applicable). So, RI.4.3, for example, stands for Reading, Informational Text, Grade 4, Standard 3. W.5.1a stands for Writing, Grade 5, Standard 1a.

RI: Reading Informational Text

RL: Reading Literature

RH: Reading Historical/Social Studies Text

RST: Reading Scientific and Technical Text

W: Writing

WHST: Writing for History/Social Studies, Scientific and Technical Subjects

SL: Speaking and Listening

L: Language

RF: Reading Foundations

Reading Standards

To become college and career ready, students need to grapple with works of exceptional craft and thought whose range extends across genres, cultures, and centuries. By engaging with increasingly complex readings, students gain the ability to evaluate intricate arguments and the capacity to surmount the challenges posed by complex texts. Standards 1 and 10 play a special role since they operate whenever students are reading: Standard 1 outlines the command of evidence required to support any analysis of text (e.g., analyzing structure, ideas, or the meaning of word as defined by Standards 2-9); Standard 10 defines the range and complexity of what students need to read.

Reading Strand	
Key: The citation at the end of each standard in the following chart identifies the CCSS strand, grade, and number (or standard number and letter, where applicable). For example, RI.4.3 stands for Reading, Informational Text, Grade 4, Standard 3.	
RI: Reading Informational Text	RH: Reading Historical/Social Studies Text
RL: Reading Literature	RST: Reading Scientific and Technical Text

A	B	C	D	E
CCR Anchor 1: Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. ***(Apply this standard to texts of appropriate complexity as outlined by Standard 10.)***[4]				
Ask and answer questions about key details in a text. (RI/RL.1.1)	Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. (RI/RL.2.1)	Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (RI/RL.4.1) Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (RI/RL.5.1)	Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text. (RI/RL.7.1) • *Application:* cite specific textual evidence to support analysis of primary and secondary sources. (RH.6-8.1) • *Application:* cite specific textual evidence to support analysis of science and technical texts. (RST.6-8.1)	Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text. (RI/RL.9-10.1) • *Application:* cite specific textual evidence to support analysis of primary and secondary sources, attending to such features as the date and origin of the information. (RH.9-10.1) • *Application:* cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (RST.9-10.1)

[4] Standard 10 defines a staircase of increasing text complexity that rises from beginning reading to the college and career readiness level. Panel members added this statement to Anchor Standards 1-9 to make sure it is understood that the skills of reading are to be applied to level-appropriate complex text.

A	B	C	D	E
CCR Anchor 2: Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas. ***(Apply this standard to texts of appropriate complexity as outlined by Standard 10.)***				
Identify the main topic and retell key details of a text. (RI.1.2)	Determine the main idea of a text; recount the key details and explain how they support the main idea. (RI.3.2)	Determine the main idea of a text and explain how it is supported by key details; summarize the text. (RI.4.2) Determine a theme of a story, drama, or poem from details in the text; summarize the text. (RL.4.2)	Determine a theme or central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments. (RI/RL.6.2) • *Application*: determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (RST.6-8.2)	Determine a theme or central idea of a text and analyze in detail its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text. (RI/RL.9-10.2) Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (RST.11-12.2)

A	B	C	D	E
CCR Anchor 3: Analyze how and why individuals, events, and ideas develop and interact over the course of a text. ***(Apply this standard to texts of appropriate complexity as outlined by Standard 10.)***				
Describe the connection between two individuals, events, ideas, or pieces of information in a text. (RI.1.3)	Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (RI.3.3)	Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (RI.4.3)	Analyze how a text makes connections among and distinctions between individuals, ideas, or events (e.g., through comparisons, analogies, or categories). (RI.8.3) • *Application:* identify key steps in a text's description of a process related to history/social studies (e.g., how a bill becomes law, how interest rates are raised or lowered). (RH.6-8.3) Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (RST.6-8.3)	Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact and develop over the course of the text. (RI.11-12.3) Analyze in detail a series of events described in a text; determine whether earlier events caused later ones or simply preceded them. (RH.9-10.3) Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. (RST.9-10.3)

A	B	C	D	E
CCR Anchor 4: Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. ***(Apply this standard to texts of appropriate complexity as outlined by Standard 10.)***				
Ask and answer questions to help determine or clarify the meaning of words and phrases in a text. (RI.1.4)	Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a topic or subject area. (RI.3.4)	Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a topic or subject area. (RI.5.4) Determine the meaning of words and phrases as they are used in a text, including figurative language such as metaphors and similes. (RL.5.4)	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of a specific word choice on meaning and tone. (RI/RL.6.4)	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language of a court opinion differs from that of a newspaper). (RI/RL.9-10.4) • *Application:* determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context. (RST.9-10.4)
CCR Anchor 5: Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text (e.g., a section, chapter, scene, or stanza) relate to each other and the whole. ***(Apply this standard to texts of appropriate complexity as outlined by Standard 10.)***				
Know and use various text features (e.g., headings, tables of contents, glossaries, electronic menus, icons) to locate key facts or information in a text. (RI.1.5)	Know and use various text features (e.g., captions, bold print, subheadings, glossaries, indexes, electronic menus, icons) to locate key facts or information in a text efficiently. (RI.2.5) Use text features and search tools (e.g., key words, sidebars, hyperlinks) to locate information relevant to a given topic efficiently. (RI.3.5)	Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text. (RI.4.5) Compare and contrast the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in two or more texts. (RI.5.5)	Analyze how a particular sentence, paragraph, chapter, or section fits into the overall structure of a text and contributes to the development of the ideas. (RI.6.5) Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to the development of the ideas. (RI.7.5)	Analyze in detail how an author's ideas or claims are developed and refined by particular sentences, paragraphs, or larger portions of a text (e.g., a section or chapter). (RI.9-10.5) Analyze and evaluate the effectiveness of the structure an author uses in his or her exposition or argument, including whether the structure makes points clear, convincing, and engaging. (RI.11-12.5)

A	B	C	D	E
CCR Anchor 6: Assess how point of view or purpose shapes the content and style of a text. ***(Apply this standard to texts of appropriate complexity as outlined by Standard 10.)***				
	Identify the main purpose of a text, including what the author wants to answer, explain, or describe. (RI.2.6) Distinguish their own point of view from that of the author of a text. (RI.3.6)	Analyze multiple accounts of the same event or topic, noting important similarities and differences in the point of view they represent. (RI.5.6) Describe how a narrator's or speaker's point of view influences how events are described. (RL.5.6)	Determine an author's point of view or purpose in a text and analyze how the author acknowledges and responds to conflicting evidence or viewpoints. (RI.8.6) Identify aspects of a text that reveal an author's point of view or purpose (e.g., loaded language, inclusion or avoidance of particular facts). (RH.6-8.6)	Determine an author's point of view or purpose in a text and analyze how an author uses rhetoric to advance that point of view or purpose. (RI.9-10.6) • *Application:* analyze a particular point of view or cultural experience reflected in a work of literature from outside the United States, drawing on a wide reading of world literature. (RL.9-10.6) Analyze a case in which grasping point of view requires distinguishing what is directly stated in a text from what is really meant (e.g., satire, sarcasm, irony, or understatement). (RL.11-12.6) Compare the point of view of two or more authors for how they treat the same or similar topics, including which details they include and emphasize in their respective accounts. (RH.9-10.6)

A	B	C	D	E
CCR Anchor 7: Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. ***(Apply this standard to texts of appropriate complexity as outline by Standard 10.)***				
Use the illustrations and details in a text to describe its key ideas (e.g., maps, charts, photographs, political cartoons, etc.). (RI.1.7)	Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur). (RI.3.7) Explain how specific aspects of a text's illustrations contribute to what is conveyed by the words in a story (e.g., create mood, emphasize aspects of a character or setting). (RL.3.7)	Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (RI.4.7) Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (RI.5.7)	Integrate information presented in different media or formats (e.g., in charts, graphs, photographs, videos, or maps) as well as in words to develop a coherent understanding of a topic or issue. (RI.6.7) Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (RST.6-8.7)	Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text. (RH.9-10.7) Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. (RST.9-10.7) Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem. (RI.11-12.7)
CCR Anchor 8: Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence. ***(Apply this standard to texts of appropriate complexity as outlined by Standard 10.)***				
Identify the reasons an author gives to support points in a text. (RI.1.8)	Describe how reasons support specific points the author makes in a text. (RI.2.8)	Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s). (RI.5.8)	Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced. (RI.8.8)	Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning. (RI.9-10.8)

A	B	C	D	E
CCR Anchor 9: Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take. ***(Apply this standard to texts of appropriate complexity as outlined by Standard 10.)***				
Identify basic similarities in and differences between two texts on the same topic (e.g., in illustrations, descriptions, or procedures). (RI.1.9)	Compare and contrast the most important points and key details presented in two texts on the same topic. (RI.3.9)	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (RI.5.9)	Analyze a case in which two or more texts provide conflicting information on the same topic and identify where the texts disagree on matters of fact or interpretation. (RI.8.9)	Analyze seminal U.S. documents of historical and literary significance (e.g., Washington's Farewell Address, the Gettysburg Address, Roosevelt's Four Freedoms speech, King's "Letter from Birmingham Jail"), including how they address related themes and concepts. (RI.9-10.9) Analyze seventeenth-, eighteenth-, and nineteenth-century foundational U.S. documents of historical and literary significance (including The Declaration of Independence, the Preamble to the Constitution, the Bill of Rights, and Lincoln's Second Inaugural Address) for their themes, purposes, and rhetorical features. (RI.11-12.9) Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. (RST.9-10.9) • *Application:* compare and contrast treatments of the same topic in several primary and secondary sources. (RH.9-10.9)

CCR Anchor 10: Read and comprehend complex literary and informational texts independently and proficiently.[5]

Associated Quantitative Measures of Text Complexity to B-E Levels of Learning

Common Core Band	ATOS	Degrees of Reading Power®	Flesch-Kincaid	The Lexile Framework®	Reading Maturity	SourceRater
2nd – 3rd (B)	2.75 – 5.14	42 – 54	1.98 – 5.34	420 – 820	3.53 – 6.13	0.05 – 2.48
4th – 5th (C)	4.97 – 7.03	52 – 60	4.51 – 7.73	740 – 1010	5.42 – 7.92	0.84 – 5.75
6th – 8th (D)	7.00 – 9.98	57 – 67	6.51 – 10.34	925 – 1185	7.04 – 9.57	4.11 – 10.66
9th – 10th (E)	9.67 – 12.01	62 – 72	8.32 – 12.12	1050 – 1335	8.41 – 10.81	9.02 – 13.93
11th – CCR (E)	11.20 – 14.10	67 – 74	10.34 – 14.2	1185 – 1385	9.57 – 12.00	12.30 – 14.50

[5] See Appendix D of this report for the research explaining the importance of text complexity in reading achievement.

Writing Standards

To be college and career ready writers, students must take task, purpose, and audience into careful consideration, choosing words, information, structures, and formats deliberately. The Writing Standards cultivate the development of three mutually reinforcing writing capacities: crafting arguments, writing to inform and explain, and fashioning narratives about real or imagined experiences. The overwhelming focus of writing throughout the levels is on arguments and informative/explanatory texts. Writing Standard 9 is a standout because it stresses the importance of the writing-reading connection by requiring students to draw upon and use evidence from literary and informational texts as they write arguments or inform/explain. Because of the centrality of writing to most forms of inquiry, research standards are prominently included in this strand as well.

Writing Strand

Key: The citation at the end of each standard in the following chart identifies the CCSS strand, grade, and number (or standard number and letter, where applicable).

For example, W.5.1a stands for Writing, Grade 5, Standard 1a.

W: Writing

WHST: Writing for History/Social Studies, Scientific and Technical Subjects

A	B	C	D	E
CCR Anchor 1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.				
	Write opinion pieces on topics or texts, supporting a point of view with reasons. a. Introduce the topic or text they are writing about, state an opinion, and create an organizational structure that lists reasons. b. Provide reasons that support the opinion.	Write opinion pieces on topics or texts, supporting a point of view with reasons and information.[6] a. Introduce a topic or text clearly, state an opinion, and create an organizational structure in which ideas are logically grouped to support the writer's purpose.	Write arguments to support claims with clear reasons and relevant evidence. a. Introduce claim(s), acknowledge alternate or opposing claims, and organize the reasons and evidence logically. b. Support claim(s) with logical reasoning and relevant evidence, using	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization

[6] To show how the standards for Writing and Speaking and Listening progress, differences in wording from level to level are underlined.

A	B	C	D	E
CCR Anchor 1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.				
	c. Use linking words and phrases (e.g., *because, therefore*, *since*, *for example*) to connect opinion and reasons. d. Provide a concluding statement or section. (W.3.1)	b. Provide <u>logically ordered</u> reasons <u>that are supported by facts and details</u>. c. <u>Link opinion and reasons using</u> words, phrases, <u>and clauses</u> (e.g., <u>*consequently*</u>, <u>*specifically*</u>). d. Provide a concluding statement or section <u>related to the opinion presented</u>. (W.5.1)	<u>accurate, credible sources and demonstrating an understanding of the topic or text</u>. c. <u>Use</u> words, phrases, and clauses <u>to create cohesion and clarify the relationships among claim(s), reasons, and evidence</u>. d. <u>Establish and maintain a formal style</u>. e. Provide a concluding statement or section <u>that follows from and supports the argument</u> presented. (W.7.1)	<u>that establishes clear relationships among the claim(s), counterclaims</u>, reasons, and evidence. b. <u>Develop</u> claim(s) <u>and counterclaims fairly, supplying</u> evidence <u>for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns</u>. c. Use words, phrases, and clauses <u>to link the major sections of the text</u>, create cohesion, and clarify the relationships <u>between</u> claim(s) and reasons, <u>between reasons</u> and evidence, <u>and between claim(s) and counterclaims</u>. d. Establish and maintain a formal style and <u>objective tone while attending to the norms and conventions of the discipline in which they are writing</u>. e. Provide a concluding statement or section that follows from and supports the argument presented. (W/WHST.9-10.1)

A	B	C	D	E
CCR Anchor 2: Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.				
Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure. (W.1.2)	Write informative/explanatory texts to examine a topic and convey ideas and information clearly. a. Introduce a topic and group related information together; include illustrations when useful to aiding comprehension. b. Develop the topic with facts, definitions, and details. c. Use linking words and phrases (e.g., *also*, *another*, *and*, *more*, *but*) to connect ideas within categories of information. d. Provide a concluding statement or section. (W.3.2)	Write informative/explanatory texts to examine a topic and convey ideas and information clearly. a. Introduce a topic clearly and group related information in paragraphs and sections; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension. b. Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic. c. Link ideas within categories of information using words and phrases (e.g., *another*, *for example*, *also*, *because*). d. Use precise language and domain-specific vocabulary to inform about or explain the topic. e. Provide a concluding statement or section related to the information or explanation presented. (W.4.2)	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. [This includes the narration of historical events, scientific procedures/experiments, or technical processes.] a. Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information, using strategies such as definition, classification, comparison/contrast, and cause/effect; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. b. Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples. c. Use appropriate transitions to create cohesion and clarify the relationships among ideas and concepts. d. Use precise language and domain-specific vocabulary to inform about or explain the topic.	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. [This includes the narration of historical events, scientific procedures/experiments, or technical processes.] a. Introduce a topic and organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. c. Use appropriate and varied transitions to link the major sections of the text, create cohesion, and

A	B	C	D	E
CCR Anchor 2: Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.				
			e. Establish and maintain a formal style. f. Provide a concluding statement or section that follows from and supports the information or explanation presented. (W/WHST.6-8.2)	clarify the relationships among complex ideas and concepts. d. Use precise language and domain-specific vocabulary to manage the complexity of the topic. e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). (W/WHST.9-10.2)

A	B	C	D	E
CCR Anchor 3: Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details and well-structured event sequences.				
Write narratives in which they recount two or more appropriately sequenced events, include some details regarding what happened, use temporal words to signal event order, and provide some sense of closure. (W.1.3)	Write narratives in which they recount a well-elaborated event or short sequence of events, include details to describe actions, thoughts, and feelings, use temporal words to signal event order, and provide a sense of closure. (W.2.3)	Note: Students' narrative skills continue to grow in these levels as students work to incorporate narrative elements effectively into their arguments and informative/explanatory texts.		
CCR Anchor 4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.				
	Produce writing in which the development and organization are appropriate to task and purpose. (W.3.4)	Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience. (W.5.4)	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (W/WHST.6-8.4)	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (W/WHST.11-12.4)
CCR Anchor 5: Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.				
With guidance and support focus on a topic, respond to questions and suggestions from peers, and add details to strengthen writing as needed. (W.1.5)	With guidance and support from peers and others, develop and strengthen writing as needed by planning, revising, and editing. (Editing for conventions should demonstrate command of Language standards 1–3 at this level.) (W.3.5)	With guidance and support from peers and others, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach. (Editing for conventions should demonstrate command of Language standards 1–3 at this level.) (W.5.5)	With some guidance and support from peers and others, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed. (Editing for conventions should demonstrate command of Language standards 1–3 at this level.) (W/WHST.6-8.5)	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 at this level.) (W.11-12.5)

A	B	C	D	E
CCR Anchor 6: Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.				
With guidance and support, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (W.1.6)	With guidance and support, use technology to produce and publish writing (using keyboarding skills) as well as to interact and collaborate with others. (W.3.6)	With some guidance and support, use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of one page in a single sitting. (W.4.6)	Use technology, including the Internet, to produce and publish writing and link to and cite sources as well as to interact and collaborate with others, including linking to and citing sources. (W.7.6)	Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. (W.9-10.6)
CCR Anchor 7: Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.				
Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (W.1.7)	Conduct short research projects that build knowledge about a topic. (W.3.7)	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (W.5.7)	Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation. (W.7.7)	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (W/WHST.11-12.7)
CCR Anchor 8: Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.				
With guidance and support, recall information from experiences or gather information from provided sources to answer a question. (W.1.8)	Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (W.3.8)	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (W.5.8)	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the

A	B	C	D	E
			citation. (W/WHST.6-8.8)	flow of ideas, avoiding plagiarism and following a standard format for citation. (W/WHST.9-10.8)
CCR Anchor 9: Draw evidence from literary or informational texts to support analysis, reflection, and research. (Apply this standard to texts of appropriate complexity as outlined by Standard 10.)				
Note: This standard does not begin until grade 4 in the Common Core State Standards.		Draw evidence from literary or informational texts to support analysis, reflection, and research. a. Apply Reading standards from this level to literature (e.g., "Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text"). b. Apply Reading standards from this level to informational text (e.g., "Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s)"). (W.5.9)	Draw evidence from literary or informational texts to support analysis, reflection, and research. a. Apply Reading standards from this level to literature (e.g., "Determine a theme or central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments"). b. Apply Reading standards from this level to literary nonfiction (e.g., "Analyze how a text makes connections among and distinctions between individuals' ideas or events"). (W/WHST.6-8.9)	Draw evidence from literary or informational texts to support analysis, reflection, and research. a. Apply Reading standards from this level to literature (e.g., "Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone"). b. Apply Reading standards from this level to literary nonfiction (e.g., "Integrate quantitative or technical analysis with qualitative analysis in print or digital text"). (W/WHST.11-12.9)

Speaking and Listening

Including, but not limited to, skills necessary for formal presentations, the Speaking and Listening Standards require students to develop a range of broadly useful oral communication and interpersonal skills. The standards ask students to learn to work together, express and listen carefully to ideas, integrate information from oral, visual, quantitative, and media sources, evaluate what they hear, use media and visual displays strategically to help achieve communicative purposes, and adapt speech to context and task.[7]

Speaking and Listening Strand

Key: The citation at the end of each standard in the following chart identifies the CCSS strand, grade, and number (or standard number and letter, where applicable).

For example, SL.K.2 stands for Speaking and Listening, Grade K, Standard 2.

SL: Speaking and Listening

A	B	C	D	E
CCR Anchor 1: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.				
Participate in collaborative conversations with diverse partners in small and larger groups. a. Follow agreed-upon rules for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion). b. Build on others' talk in conversations by responding to the comments of others through multiple exchanges.	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners, building on others' ideas and expressing their own clearly.[8] a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners, building on others' ideas and expressing their own clearly. a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners, building on others' ideas and expressing their own clearly. a. Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners, building on others' ideas and expressing their own clearly and persuasively. a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic

[7] NGA (2010a), p. 8.
[8] To show how the standards for Writing and Speaking and Listening progress, differences in wording from level to level are underlined.

A	B	C	D	E
CCR Anchor 1: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.				
c. Ask questions to clear up any confusion about the topics and texts under discussion. (SL.1.1)	b. Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion). c. Ask questions to check understanding of information presented, stay on topic, and link their comments to the remarks of others. d. Explain their own ideas and understanding in light of the discussion. (SL.3.1)	b. Follow agreed-upon rules for discussions and carry out assigned roles. c. Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others. d. Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions. (SL.5.1)	b. Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed. c. Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas. d. Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented. (SL.8.1)	or issue to stimulate a thoughtful, well-reasoned exchange of ideas. b. Work with peers to set rules for collegial discussions and decision-making (e.g., informal consensus, taking votes on key issues, presentation of alternate views), clear goals and deadlines, and individual roles as needed. c. Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions. d. Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented. (SL.9-10.1)

A	B	C	D	E
CCR Anchor 2: Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.				
Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood. (SL.K.2)	Determine the main ideas and supporting details of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. (SL.3.2)	Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. (SL.4.2) Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. (SL.5.2)	Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation. (SL.8.2)	Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data. (SL.11-12.2)
CCR Anchor 3: Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.				
Ask and answer questions in order to seek help, get information, or clarify something that is not understood. (SL.K.3)	Ask and answer questions about information from a speaker, offering appropriate elaboration and detail. (SL.3.3)	Summarize the points a speaker makes and explain how each claim is supported by reasons and evidence. (SL.5.3)	Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced. (SL.8.3)	Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used. (SL.11-12.3)
CCR Anchor 4: Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.				
Describe people, places, things, and events with relevant details, expressing ideas and feelings clearly. (SL.1.4)	Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. (SL.3.4)	Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace. (SL.5.4)	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (SL.8.4)	Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task. (SL.9-10.4)

A	B	C	D	E
CCR Anchor 5: Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.				
		Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (SL.5.5)	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (SL.8.5)	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (SL.11-12.5)
CCR Anchor 6: Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.				
Speak audibly and express thoughts, feelings, and ideas clearly. (SL.K.6) Produce complete sentences when appropriate to task and situation. (See Language standards 1 and 3.) (SL.1.6)	Speak in complete sentences when appropriate to task and situation in order to provide requested detail or clarification. (See Language standards 1 and 3.) (SL.3.6)	Differentiate between contexts that call for formal English (e.g., presenting ideas) and situations where informal discourse is appropriate (e.g., small-group discussion); use formal English when appropriate to task and situation. (See Language standards 1 and 3.) (SL.4.6)	Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See Language standards 1 and 3 for specific expectations.) (SL.8.6)	Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate. (See Language standards 1 and 3 for specific expectations.) (SL.11-12.6)

Language Standards

The Language Standards include the essential "rules" of standard written and spoken English, but they also approach language as a matter of craft and informed choice among alternatives. The vocabulary standards focus on understanding words and phrases and their nuances and relationships, and on acquiring new vocabulary, particularly general academic and domain-specific words and phrases. Students advancing through the levels are expected to meet each level's specific standards and retain or further develop skills and understanding mastered in preceding levels.[9]

Language Strand

Key: The citation at the end of each standard in the following chart identifies the CCSS strand, grade, and number (or standard number and letter, where applicable).

For example, L.9-10.1 stands for Language, Grade 9-10, Standard 1.

L: Language

A	B	C	D	E
CCR Anchor 1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.				
Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. a. Print all upper- and lowercase letters. b. Use common, proper, and possessive nouns. c. Use singular and plural nouns with matching verbs in basic sentences (e.g., *He hops*; *We hop*). d. Use personal, possessive, and indefinite pronouns (e.g., *I*, *me*, *my*; *they*, *them*, *their*; *anyone*, *everything*).	Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. a. Use collective nouns (e.g., *group*). b. Explain the function of nouns, pronouns, verbs, adjectives, and adverbs in general and their functions in particular sentences. c. Form and use regular and irregular plural nouns. d. Use reflexive pronouns (e.g., *myself*, *ourselves*). e. Form and use the past tense	Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. a. Explain the function of conjunctions, prepositions, and interjections in general and their function in particular sentences. b. Use relative pronouns (*who*, *whose*, *whom*, *which*, *that*) and relative adverbs (*where*, *when*, *why*). c. Form and use the progressive (e.g., *I was walking*; *I am walking*; *I will be walking*) verb tenses.	Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. a. Ensure that pronouns are in the proper case (subjective, objective, possessive). b. Use intensive pronouns. c. Recognize and correct inappropriate shifts in pronoun number and person. d. Recognize and correct vague or unclear pronouns. e. Recognize variations from standard English in their own	Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. a. Use parallel structure. b. Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations. (L.9-10.1)

[9] NGA (2010a), p. 8.

A	B	C	D	E
CCR Anchor 1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.				
e. Use verbs to convey a sense of past, present, and future (e.g., *Yesterday I walked home*; *Today I walk home*; *Tomorrow I will walk home*). f. Use frequently occurring adjectives. g. Use frequently occurring nouns and verbs. h. Use frequently occurring conjunctions (e.g., *and*, *but*, *or*, *so*, *because*). i. Use determiners (e.g., articles, demonstratives). j. Use frequently occurring prepositions (e.g., *during*, *beyond*, *toward*). k. Understand and use question words (interrogatives) (e.g., *who*, *what*, *where*, *when*, *why*, *how*). l. Produce and expand complete simple and compound declarative, interrogative, imperative, and exclamatory sentences in response to prompts. (L.K.1 and 1.1 merge)[10]	of frequently occurring irregular verbs (e.g., *sat*, *hid*, *told*). f. Use abstract nouns (e.g., *childhood*). g. Form and use regular and irregular verbs. h. Form and use the simple (e.g., *I walked*; *I walk*; *I will walk*) verb tenses. i. Ensure subject-verb and pronoun-antecedent agreement. j. Form and use comparative and superlative adjectives and adverbs, and choose between them depending on what is to be modified. k. Use coordinating and subordinating conjunctions. l. Produce simple, compound, and complex sentences. m. Produce, expand, and rearrange complete simple and compound sentences (e.g., *The boy watched the movie*; *The little boy watched the movie*; *The action movie was watched by the little boy*). (L.2.1 and 3.1 merge)	d. Use modal auxiliaries (e.g., *can*, *may*, *must*) to convey various conditions. e. Form and use the perfect (e.g., *I had walked*; *I have walked*; *I will have walked*) verb tenses. f. Use verb tense to convey various times, sequences, states, and conditions. g. Recognize and correct inappropriate shifts in verb tense. h. Order adjectives within sentences according to conventional patterns (e.g., *a small red bag* rather than *a red small bag*). i. Form and use prepositional phrases. j. Use correlative conjunctions (e.g., *either/or*, *neither/nor*). k. Produce complete sentences, recognizing and correcting inappropriate fragments and run-ons. l. Correctly use frequently confused words (e.g., *to*, *too*, *two; there*, *their*). (L.4.1 and 5.1 merge)	and others' writing and speaking, and identify and use strategies to improve expression in conventional language. f. Explain the function of verbals (gerunds, participles, infinitives) in general and their function in particular sentences. g. Form and use verbs in the active and passive voice. h. Form and use verbs in the indicative, imperative, interrogative, conditional, and subjunctive mood. i. Recognize and correct inappropriate shifts in verb voice and mood. j. Explain the function of phrases and clauses in general and their function in specific sentences. k. Choose among simple, compound, complex, and compound-complex sentences to signal differing relationships among ideas. l. Place phrases and clauses within a sentence, recognizing and correcting misplaced and dangling modifiers. (L.6.1 through 8.1 merge)	

[10] "Merge" signifies panelists selected all of the standards from the two grades indicated. In the merge, any repetition in content grade-to-grade was deleted; occasionally where similar content was covered grade-to-grade a single standard was edited, combining the text of both standards, to include the demands of both grades.

A	B	C	D	E
CCR Anchor 2: Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.				
Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. a. Capitalize the first word in a sentence and the pronoun *I*. b. Capitalize dates and names of people. c. Recognize and name end punctuation. d. Use end punctuation for sentences. e. Use commas in dates and to separate single words in a series. f. Write a letter or letters for most consonant and short-vowel sounds (phonemes). g. Spell simple words phonetically, drawing on knowledge of sound-letter relationships. h. Use conventional spelling for words with common spelling patterns and for frequently occurring irregular words. i. Spell untaught words phonetically, drawing on phonemic awareness and spelling conventions. (L.K.2 and 1.2 merge)	Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. a. Capitalize holidays, product names, and geographic names. b. Capitalize appropriate words in titles. c. Use commas in greetings and closings of letters. d. Use commas in addresses. e. Use commas and quotation marks in dialogue. f. Use an apostrophe to form contractions and frequently occurring possessives. g. Form and use possessives. h. Use conventional spelling for high-frequency and other studied words and for adding suffixes to base words (e.g., *sitting*, *smiled*, *cries*, *happiness*). i. Generalize learned spelling patterns when writing words (e.g., *cage* → *badge*; *boy* → *boil*). j. Use spelling patterns and generalizations (e.g., word families, position-based spellings, syllable patterns, ending rules, meaningful word parts) in	Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. a. Use correct capitalization. b. Use commas and quotation marks to mark direct speech and quotations from a text. c. Use punctuation to separate items in a series. d. Use a comma to separate an introductory element from the rest of the sentence. e. Use a comma to set off the words *yes* and *no* (e.g., *Yes, thank you*), to set off a tag question from the rest of the sentence (e.g., *It's true, isn't it?*), and to indicate direct address (e.g., *Is that you, Steve?*). f. Use underlining, quotation marks, or italics to indicate titles of works. g. Use a comma before a coordinating conjunction in a compound sentence. h. Spell grade-appropriate words correctly, consulting references as needed. (L.4.2 and 5.2 merge)	Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. a. Use punctuation (commas, parentheses, ellipsis, dashes) to set off nonrestrictive/parenthetical elements. b. Use a comma to separate coordinate adjectives (e.g., *It was a fascinating, enjoyable movie* but not *He wore an old[,] green shirt*). c. Use an ellipsis to indicate an omission. d. Spell correctly. (L.6.2 through 8.2 merge)	Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. a. Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses. b. Use a colon to introduce a list or quotation. c. Spell correctly. (L.9-10.2)

A	B	C	D	E
CCR Anchor 2: Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.				
	writing words. k. Consult reference materials, including beginning dictionaries, as needed to check and correct spellings. (L.2.2 and 3.2 merge)			
CCR Anchor 3: Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.				
Note: This standard does not begin until grade 2 in the Common Core State Standards.	Use knowledge of language and its conventions when writing, speaking, reading, or listening. a. Choose words and phrases for effect. b. Recognize and observe differences between the conventions of spoken and written standard English. (L.3.3)	Use knowledge of language and its conventions when writing, speaking, reading, or listening. a. Choose words and phrases to convey ideas precisely. b. Choose punctuation for effect. c. Differentiate between contexts that call for formal English (e.g., presenting ideas) and situations where informal discourse is appropriate (e.g., small-group discussion). d. Expand, combine, and reduce sentences for meaning, reader/listener interest, and style. e. Compare and contrast the varieties of English (e.g., dialects, registers) used in stories, dramas, or poems. (L.4.3 and 5.3 merge)	Use knowledge of language and its conventions when writing, speaking, reading, or listening. a. Vary sentence patterns for meaning, reader/listener interest, and style. b. Maintain consistency in style and tone. c. Choose language that expresses ideas precisely and concisely, recognizing and eliminating wordiness and redundancy. (L.6.3 and 7.3 merge)	

A	B	C	D	E
CCR Anchor 4: Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.				
Determine or clarify the meaning of unknown and multiple-meaning words and phrases, choosing flexibly from an array of strategies. a. Use sentence-level context as a clue to the meaning of a word or phrase. b. Use frequently occurring affixes as a clue to the meaning of a word. c. Identify frequently occurring root words (e.g., *look*) and their inflectional forms (e.g., *looks*, *looked*, *looking*). (L.1.4)	Determine or clarify the meaning of unknown and multiple-meaning words and phrases, choosing flexibly from an array of strategies. a. Use sentence-level context as a clue to the meaning of a word or phrase. b. Determine the meaning of the new word formed when a known prefix is added to a known word (e.g., *happy*/*unhappy*, *tell*/*retell*). c. Use a known root word as a clue to the meaning of an unknown word with the same root (e.g., *addition*, *additional*). d. Use knowledge of the meaning of individual words to predict the meaning of compound words (e.g., *birdhouse*, *lighthouse*, *housefly*; *bookshelf*, *notebook*, *bookmark*). e. Use glossaries and beginning dictionaries, both print and digital, to determine or clarify the meaning of words and phrases. (L.2.4)	Determine or clarify the meaning of unknown and multiple-meaning words and phrases, choosing flexibly from a range of strategies. a. Use context (e.g., definitions, examples, restatements, cause/effect relationships and comparisons in text) as a clue to the meaning of a word or phrase. b. Use common, grade-appropriate Greek and Latin affixes and roots as clues to the meaning of a word (e.g., *telegraph, autograph, photograph*, *photosynthesis*). c. Consult reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation and determine or clarify the precise meaning of key words and phrases. (L.4.4 and 5.4 merge)	Determine or clarify the meaning of unknown and multiple-meaning words and phrases, choosing flexibly from a range of strategies. a. Use context (e.g., the overall meaning of a sentence or paragraph; a word's position or function in a sentence) as a clue to the meaning of a word or phrase. b. Use common, grade-appropriate Greek or Latin affixes and roots as clues to the meaning of a word (e.g., *audience*, *auditory*, *audible*). c. Consult reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning or its part of speech. d. Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary). (L.6.4)	Determine or clarify the meaning of unknown and multiple-meaning words and phrases, choosing flexibly from a range of strategies. a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase. b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., conceive, conception, conceivable). c. Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, or its etymology or its standard usage. d. Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary). (L.11-12.4)

A	B	C	D	E
CCR Anchor 5: Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.				
With guidance and support, demonstrate understanding of word relationships and nuances in word meanings. a. Sort words into categories (e.g., colors, clothing) to gain a sense of the concepts the categories represent. b. Define words by category and by one or more key attributes (e.g., a *duck* is a bird that swims; a *tiger* is a large cat with stripes). c. Identify real-life connections between words and their use (e.g., note places at home that are *cozy*). d. Distinguish shades of meaning among verbs differing in manner (e.g., *look*, *peek*, *glance*, *stare*, *glare*, *scowl*) and adjectives differing in intensity (e.g., *large*, *gigantic*) by defining or choosing them or by acting out the meanings. (L.1.5)	Demonstrate understanding of word relationships and nuances in word meanings. a. Distinguish the literal and non-literal meanings of words and phrases in context (e.g., *take steps*). b. Identify real-life connections between words and their use (e.g., describe people who are *friendly* or *helpful*). c. Distinguish shades of meaning among related words that describe states of mind or degrees of certainty (e.g., *knew*, *believed*, *suspected*, *heard*, *wondered*). (L.3.5)	Demonstrate understanding of figurative language, word relationships, and nuances in word meanings. a. Interpret figurative language, including similes and metaphors, in context. b. Recognize and explain the meaning of common idioms, adages, and proverbs. c. Use the relationship between particular words (e.g., synonyms, antonyms, homographs) to better understand each of the words. (L.5.5)		

A	B	C	D	E
CCR Anchor 6: Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering a word or phrase important to comprehension or expression.				
Use words and phrases acquired through conversations, reading and being read to, and responding to texts, including using frequently occurring conjunctions to signal simple relationships (e.g., *because*). (L.1.6)	Use words and phrases acquired through conversations, reading and being read to, and responding to texts, including using adjectives and adverbs to describe (e.g., *When other people are happy that makes me happy*). (L.2.6) Acquire and use accurately level-appropriate conversational, general academic, and domain-specific words and phrases, including those that signal spatial and temporal relationships (e.g., *After dinner that night we went looking for them*). (L.3.6)	Acquire and use accurately level-appropriate general academic and domain-specific words and phrases, including those that: • signal precise actions, emotions, or states of being (e.g., *quizzed*, *whined*, *stammered*). • are basic to a particular topic (e.g., *wildlife*, *conservation*, and *endangered* when discussing animal preservation). • signal contrast, addition, and other logical relationships (e.g., *however*, *although*, *nevertheless*, *similarly*, *moreover*, *in addition*). (L.4.6 and 5.6 merge).	Acquire and use accurately level-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression. (L.8.6)	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression. (L.11-12.6)

Reading Standards: Foundational Skills K-5

The Reading Standards: Foundational Skills are directed toward fostering students' understanding and working knowledge of concepts of print, the alphabetic principle, and other basic conventions of the English writing system. These foundational skills are not an end in and of themselves; rather, they are necessary and important components of an effective, comprehensive reading program designed to develop proficient readers with the capacity to comprehend texts across a range of types and disciplines.[11]

Reading Standards: Foundational Skills K-5
Key: The citation at the end of each standard in the following chart identifies the CCSS strand, grade, and number (or standard number and letter, where applicable). For example, RF.4.4 stands for Reading Foundational Skills, Grade 4, Standard 4.
RF: Reading Foundational Skills

[11] NGA (2010a), p. 15.

A	B	C
RF.2. Demonstrate understanding of spoken words, syllables, and sounds (phonemes). (Phonological Awareness)		
Demonstrate understanding of spoken words, syllables, and sounds (phonemes). a. Recognize and produce rhyming words. b. Distinguish long from short vowel sounds in spoken single-syllable words. c. Count, pronounce, blend, and segment syllables in spoken words. d. Blend and segment onsets and rimes of single-syllable spoken words. e. Orally produce single-syllable words by blending sounds (phonemes), including consonant blends. f. Segment spoken single-syllable words into their complete sequence of individual sounds (phonemes). g. Isolate and pronounce initial, medial vowel, and final sounds (phonemes) in spoken single-syllable words. h. Add or substitute individual sounds (phonemes) in simple, one-syllable words to make new words. (RF.K.2 and 1.2 merge)		

A	B	C
RF.3. Know and apply grade-level phonics and word analysis skills in decoding words. (Phonics and Word Recognition)		
Know and apply grade-level phonics and word analysis skills in decoding words. a. Demonstrate basic knowledge of one-to-one letter-sound correspondences by producing the primary sound or many of the most frequent sounds for each consonant. b. Associate the long and short sounds with common spellings (graphemes) for the five major vowels. c. Know the spelling-sound correspondences for common consonant digraphs. d. Decode regularly spelled one-syllable words. e. Distinguish between similarly spelled words by identifying the sounds of the letters that differ. f. Know final *-e* and common vowel team conventions for representing long vowel sounds. g. Use knowledge that every syllable must have a vowel sound to determine the number of syllables in a printed word. h. Decode two-syllable words following basic patterns by breaking the words into syllables. i. Read words with inflectional endings. j. Read common high-frequency words by sight (e.g., *the*, *of*, *to*, *you*, *she*, *my*, *is*, *are*, *do*, *does*). k. Recognize and read grade-appropriate irregularly spelled words. (RF.K.3 and 1.3 merge)	Know and apply grade-level phonics and word analysis skills in decoding words. a. Distinguish long and short vowels when reading regularly spelled one-syllable words. b. Know spelling-sound correspondences for additional common vowel teams. c. Identify and know the meaning of the most common prefixes and derivational suffixes. d. Identify words with inconsistent but common spelling-sound correspondences. e. Identify words with inconsistent but common spelling-sound correspondences. f. Decode words with common Latin suffixes. g. Decode multisyllable words. h. Recognize and read grade-appropriate irregularly spelled words. (RF.2.3 and 3.3 merge)	Know and apply grade-level phonics and word analysis skills in decoding words. a. Use combined knowledge of all letter-sound correspondences, syllabication patterns, and morphology (e.g., roots and affixes) to read accurately unfamiliar multisyllabic words in context and out of context. (RF.4.3 and 5.3 merge)

A	B	C
RF.4 Read with sufficient accuracy and fluency to support comprehension. (Fluency)		
Read with sufficient accuracy and fluency to support comprehension. a. Read grade-level text with purpose and understanding. b. Read grade-level text orally with accuracy, appropriate rate, and expression on successive readings. c. Use context to confirm or self-correct word recognition and understanding, rereading as necessary. (RF.K.4 and 1.4 merge)	Read with sufficient accuracy and fluency to support comprehension. a. Read grade-level text with purpose and understanding. b. Read grade-level prose and poetry orally with accuracy, appropriate rate, and expression on successive readings. c. Use context to confirm or self-correct word recognition and understanding, rereading as necessary. (RF.2.4 and 3.4 merge)	Read with sufficient accuracy and fluency to support comprehension. a. Read grade-level text with purpose and understanding. b. Read grade-level prose and poetry orally with accuracy, appropriate rate, and expression on successive readings. c. Use context to confirm or self-correct word recognition and understanding, rereading as necessary. (RF.4.4 and 5.4 merge)

5 THE RESULTS: COLLEGE AND CAREER READINESS STANDARDS FOR MATHEMATICS

Key Shifts in the Standards

Through their selections, panelists validated three key shifts in instruction prompted by the Common Core State Standards (CCSS) and outlined by Student Achievement Partners (2012). The shifts described below identify the most significant elements of the CCSS for Mathematics. At the heart of these shifts is a focus in mathematics instruction on delving deeply into the key processes and ideas upon which mathematical thinking relies. The shifts below therefore center on the knowledge and skills students must master to be adept at understanding and applying mathematical ideas.

Shift 1 – Focus: *Focusing strongly where the standards focus*

Generally speaking, instructors need both to narrow significantly and to deepen the manner in which they teach mathematics, instead of racing to cover topics. Focusing deeply on the major work of each level will allow students to secure the mathematical foundations, conceptual understanding, procedural skill and fluency, and ability to apply the math they have learned to solve all kinds of problems—inside and outside the math classroom. This important shift finds explicit expression in the selection of priority content addressing a clear understanding of place value and its connection to operations in the early levels. The emphasis on numeracy in early grades leads to a deeper understanding of the properties of operations at subsequent levels, encouraging fluency in the application of those properties, eventually for all operations with all number systems in a variety of situations.

Shift 2 – Coherence: *Designing learning around coherent progressions level to level*

The second key shift required by the CCSS and reflected in panelists' selections is to create coherent progressions in the content within and across levels, so that students can build new understanding onto previous foundations. That way, instructors can count on students having conceptual understanding of core content. Instead of each standard signaling a new concept or idea, standards at higher levels become extensions of previous learning. The focus on understanding numbers and their properties through the levels also exemplifies the progression from number to expressions and equations and then to algebraic thinking. This is seen in the selected standards within and across the levels. For example, an emphasis on understanding place value, as indicated above for Shift 1, progresses to using place value to add and subtract two-digit numbers to fluency in addition and subtraction of whole numbers to 1000 (including a requirement to explain why the strategies for addition and subtraction work). An understanding of both the numbers and their operations grows from the emphasis on place value and follows a progression extending beyond operations with numbers to include algebraic expressions and equations and ultimately to a deep understanding of functions. These connections can be further exemplified in applications related to other domains within and across the levels, such as the connection between properties of operations (e.g., multiplication) and geometric applications (e.g., area).

Shift 3 – Rigor: *Pursuing conceptual understanding, procedural skill and fluency, and application—all with equal intensity*

The third key shift required by the CCSS and reinforced in panelists' selections is equal measures of conceptual understanding of key concepts, procedural skill and fluency, and rigorous application of mathematics in real-world contexts. Students with a solid conceptual understanding see mathematics as more than just a set of procedures. They know more than "how to get the answer" and can employ concepts from several perspectives. Students should be able to use appropriate concepts and procedures, even when not prompted, and in content areas outside of mathematics. Panelists therefore selected standards reflecting key concepts used in a variety of contexts, such as place value, ratios and proportional relationships, and linear algebra. They also selected standards calling for speed and accuracy in calculations using all number systems, as well as standards providing opportunities for students to apply math in context, such as calculations related to geometric figures involving rational number measures; calculation of probabilities as fractions, decimals, or percent; and statistical analysis of rational data.

Key Features of the Mathematics Standards Charts

The charts below contain the panel's selections for mathematics standards from the earliest levels of learning through adult secondary education over a range of domains (e.g., The Number System, Operations and Algebraic Thinking, Functions, Geometry, Measurement and Data, and Statistics and Probability). These have been placed into five grade-level groupings: A (K–1), B (2–3), C (4–5, 6), D (6, 7–8) and E (high school). (Note: Grade 6 standards are split between Level C and Level D.)

The CCSS for Mathematics have two central parts: the Standards for Mathematical Practice and the Standards for Mathematical Content. The Standards for Mathematical Practice (the Practices)—accepted in their entirety by the panel—describe habits of mind that mathematics educators at all levels of learning should seek to develop in their students. These practices rest on "processes and proficiencies" with established significance in mathematics education, including such skills as complex problem solving, reasoning and proof, modeling, precise communication, and making connections. The Standards for Mathematical Content are a balanced combination of procedural fluency and conceptual understanding intended to be connected to the Practices across domains and at each level. The Practices define ways students are to engage with the subject matter as they grow in mathematical maturity and expertise across levels. Content expectations that begin with the word "understand" highlight the relationship between the two parts of the CCSS for Mathematics and connect the practices and content standards.

Modeling is directly addressed in the Practices (MP.4 Model with mathematics) and also in the content standards. Since modeling is best understood in relation to the content and the context, the content standards addressing mathematical modeling can be found in Number and Quantity, Algebra, Functions, and Geometry and are indicated by an asterisk (*). In the CCSS document, when a star appears on a heading for a cluster of standards, it applies to all standards in that group.

The grades K–8 mathematics standards are organized by grade level, with four or five domains within each level. Under each domain are overarching standard statements followed by a cluster of related standards. For high school, the CCSS are organized by conceptual categories, which together portray a coherent view of high school mathematics and span traditional high school course boundaries. These conceptual categories include: Number and Quantity, Algebra, Functions, Modeling, Geometry, and Statistics and Probability. Under each conceptual category there is an organizing structure similar to that used in K–8: domains with overarching standard statements, with each followed by a cluster of related standards. Each grade level and conceptual category has an overview page that indicates the domain, their related standard statements, and the associated Mathematical Practices.

Mathematics Standards Key

The citation at the end of each standard identifies the CCSS grade, domain, and standard number (or standard number and letter, where applicable). So, 6.NS.6a, for example, stands for Grade 6, Number Sense domain, Standard 6a, and 5.OA.2 stands for Grade 5, Operations and Algebraic Thinking domain, Standard 2.

The CCSS domains for K–8 are:

- NBT: Number and Operations in Base Ten (K–5)
- NS: The Number System (6–8)
- NF: Number and Operations—Fractions (3–5)
- RP: Ratios and Proportional Relationships (6–7)
- OA: Operations and Algebraic Thinking (K–5)
- EE: Expressions and Equations (6–8)
- F: Functions (8)
- G: Geometry (K–8)
- MD: Measurement and Data (K–5)
- SP: Statistics and Probability (6–8)

The CCSS domains for high school are:

- N.RN: The Real Number System
- N.Q: Number and Quantity
- A.SSE: Algebra: Seeing Structure in Expressions
- A.APR: Algebra: Arithmetic with Polynomials and Rational Expressions
- A.CED: Algebra: Creating Equations
- A.REI: Algebra: Reasoning with Equations and Inequalities
- F.IF: Functions: Interpreting Functions
- F.BF: Functions: Building Functions
- F.LE: Functions: Linear, Quadratic, and Exponential Models
- G.CO: Geometry: Congruence
- G.SRT: Geometry: Similarity, Right Triangles, and Trigonometry
- G.GMD: Geometry: Geometric Measurement and Dimension
- G.MG: Geometry: Modeling with Geometry
- S.ID: Statistics and Probability: Interpreting Categorical and Quantitative Data

Mathematics Standards

Standards for Mathematical Practice
Make sense of problems and persevere in solving them. (MP.1) 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. 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. Less experienced 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.
Reason abstractly and quantitatively. (MP.2) 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.
Construct viable arguments and critique the reasoning of others. (MP.3) 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. Less experienced 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. Later, students learn to

determine domains to which an argument applies. Students at all levels can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

Model with mathematics. (MP.4)

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. This might be as simple as writing an addition equation to describe a situation. A student might apply proportional reasoning to plan a school event or analyze a problem in the community. 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.

Use appropriate tools strategically. (MP.5)

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 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 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 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.

Attend to precision. (MP.6)

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. Less experienced 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.

Look for and make use of structure. (MP.7)

Mathematically proficient students look closely to discern a pattern or structure. 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 7×8 equals the well-remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, students can see the 14 as 2×7 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.

Look for and express regularity in repeated reasoning. (MP.8)

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Early on, 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, 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.

Mathematics Standards Level A

Level A focuses almost entirely on counting, cardinality, number sense, and base-ten operations. This includes developing an understanding of whole number relationships and two-digit place value, as well as strategies for (and fluency with) addition and subtraction. To provide a foundation for algebra, standards introduce the concept of an equation, a variable, and the meaning of the equal sign, all within the context of addition and subtraction within 20. In addition to number, some attention is given to describing and reasoning about geometric shapes in space as a basis for understanding the properties of congruence, similarity, and symmetry, and developing an understanding of linear measurement (length).

LEVEL A (K-1)

Number and Operations: Base Ten
Understand place value. Understand that the two digits of a two-digit number represent amounts of tens and ones. Understand the following as special cases: a. 10 can be thought of as a bundle of ten ones — called a "ten." b. The numbers from 11 to 19 are composed of a ten and one, two, three, four, five, six, seven, eight, or nine ones. c. The numbers 10, 20, 30, 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five, six, seven, eight, or nine tens (and 0 ones). (1.NBT.2) Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and <. (1.NBT.3)
Use place value understanding and the properties of operations to add and subtract. Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten. (1.NBT.4) Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used. (1.NBT.5) Subtract multiples of 10 in the range 10-90 from multiples of 10 in the range 10-90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. (1.NBT.6)

Operations and Algebraic Thinking

Represent and solve problems involving addition and subtraction.

Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem. (1.OA.2)

Understand and apply properties of operations and the relationship between addition and subtraction.

Apply properties of operations as strategies to add and subtract. *Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. (Associative property of addition.)* (1.OA.3)

Understand subtraction as an unknown-addend problem. *For example, subtract 10 – 8 by finding the number that makes 10 when added to 8.* (1.OA.4)

Add and subtract with 20.

Relate counting to addition and subtraction (e.g., by counting on 2 to add 2). (1.OA.5)

Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13). (1.OA.6)

Work with addition and subtraction.

Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. *For example, which of the following equations are true and which are false? 6 = 6, 7 = 8 – 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.* (1.OA.7)

Determine the unknown whole number in an addition or subtraction equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations 8 + ? = 11, 5 = □ – 3, 6 + 6 = □* (1.OA.8)

Geometry

Analyze, compare, create, compose shapes.

Analyze and compare two- and three-dimensional shapes, in different sizes and orientations, using informal language to describe their similarities, differences, parts (e.g., number of sides and vertices/ "corners") and other attributes (e.g., having sides of equal length). (K.G.4)

Reason with shapes and their attributes.

Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.[12] (1.G.2)

Measurement and Data

Measure lengths indirectly and by iterating length units.

Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. *Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps.* (1.MD.2)

Represent and interpret data.

Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another. (1.MD.4)

[12] Students do not need to learn formal names such as “right rectangular prism.”

Mathematics Standards Level B

Level B emphasizes understanding base-ten notation (place value for whole numbers to 1000), developing fluency in addition and subtraction (to 3 digits), understanding and exploring strategies for multiplication and division (within 100), and a foundational understanding of fractions. These skills will prepare students for work with rational numbers, ratios, rates, and proportions in subsequent levels. A critical area of focus is on gaining a foundational understanding of fractions and preparing the way for work with rational numbers. In the areas of measurement and geometry, using standard units of measure and developing understanding of the structure of rectangular arrays and areas are priorities, as well as analyzing two-dimensional shapes as a foundation for understanding area, volume, congruence, similarity and symmetry.

LEVEL B (2-3)

Number and Operations: Base Ten

Understand place value.

Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones. Understand the following as special cases:

a. 100 can be thought of as a bundle of ten tens — called a "hundred."
b. The numbers 100, 200, 300, 400, 500, 600, 700, 800, 900 refer to one, two, three, four, five, six, seven, eight, or nine hundreds (and 0 tens and 0 ones). (2.NBT.1)

Count within 1000; skip-count by 5s, 10s, and 100s. (2.NBT.2)

Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. (2.NBT.3)

Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >, =, and < symbols to record the results of comparisons. (2.NBT.4)

Use place value understanding and properties of operations to add and subtract.

Add up to four two-digit numbers using strategies based on place value and properties of operations. (2.NBT.6)

Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds. (2.NBT.7)

Mentally add 10 or 100 to a given number 100–900, and mentally subtract 10 or 100 from a given number 100–900. (2.NBT.8)

Explain why addition and subtraction strategies work, using place value and the properties of operations. (2.NBT.9)

Use place value understanding and properties of operations to perform multi-digit arithmetic.[13]

Use place value understanding to round whole numbers to the nearest 10 or 100. (3.NBT.1)

Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction. (3.NBT.2)

Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., 9×80, 5×60) using strategies based on place value and properties of operations. (3.NBT.3)

Number and Operations: Fractions[14]

Develop understanding of fractions as numbers.

Understand a fraction $1/b$ as the quantity formed by 1 part when a whole is partitioned into b equal parts; understand a fraction a/b as the quantity formed by a parts of size $1/b$. (3.NF.1)

Understand a fraction as a number on the number line; represent fractions on a number line diagram. (3.NF.2)

- Represent a fraction $1/b$ on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into b equal parts. Recognize that each part has size $1/b$ and that the endpoint of the part based at 0 locates the number $1/b$ on the number line. (3.NF.2a)
- Represent a fraction a/b on a number line diagram by marking off a lengths $1/b$ from 0. Recognize that the resulting interval has size a/b and that its endpoint locates the number a/b on the number line. (3.NF.2b)

Explain equivalence of fractions in special cases, and compare fractions by reasoning about their size. (3.NF.3)

- Understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line. (3.NF.3a)
- Recognize and generate simple equivalent fractions, e.g., $1/2 = 2/4$, $4/6 = 2/3$. Explain why the fractions are equivalent, e.g., by using a visual fraction model. (3.NF.3b)
- Express whole numbers as fractions, and recognize fractions that are equivalent to whole numbers. *Examples: Express 3 in the form $3 = 3/1$; recognize that $6/1 = 6$; locate 4/4 and 1 at the same point of a number line diagram.* (3.NF.3c)
- Compare two fractions with the same numerator or the same denominator by reasoning about their size. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model. (3.NF.3d)

[13] A range of algorithms may be used.
[14] Expectations at this level in this domain are limited to fractions with denominators 2, 3, 4, 6, 8.

Operations and Algebraic Thinking

Represent and solve problems involving addition and subtraction.

Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem. (2.OA.1)

Add and subtract with 20.

Fluently add and subtract within 20 using mental strategies. Know from memory all sums of two one-digit numbers. (2.OA.2)

Represent and solve problems involving multiplication and division.

Interpret products of whole numbers, e.g., interpret 5 × 7 as the total number of objects in 5 groups of 7 objects each. *For example, describe a context in which a total number of objects can be expressed as 5 × 7.* (3.OA.1)

Interpret whole-number quotients of whole numbers, e.g., interpret 56 ÷ 8 as the number of objects in each share when 56 objects are partitioned equally into 8 shares, or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each. *For example, describe a context in which a number of shares or a number of groups can be expressed as 56 ÷ 8*. (3.OA.2)

Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem. (3.OA.3)

Determine the unknown whole number in a multiplication or division equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations 8 × ? = 48, 5 = □ ÷ 3, 6 × 6 = ?*. (3.OA.4)

Understand properties of multiplication and the relationship between multiplication and division.

Apply properties of operations as strategies to multiply and divide.[15] *Examples: If 6 × 4 = 24 is known, then 4 × 6 = 24 is also known. (Commutative property of multiplication.) 3 × 5 × 2 can be found by 3 × 5 = 15, then 15 × 2 = 30, or by 5 × 2 = 10, then 3 × 10 = 30. (Associative property of multiplication.) Knowing that 8 × 5 = 40 and 8 × 2 = 16, one can find 8 × 7 as 8 × (5 + 2) = (8 × 5) + (8 × 2) = 40 + 16 = 56. (Distributive property.)* (3.OA.5)

Understand division as an unknown-factor problem. *For example, find 32 ÷ 8 by finding the number that makes 32 when multiplied by 8.* (3.OA.6)

[15] Students need not use formal terms for these properties.

Multiply and divide within 100.

Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that $8 \times 5 = 40$, one knows $40 \div 5 = 8$) or properties of operations. Know from memory all products of two one-digit numbers. (3.OA.7)

Solve problems involving the four operations, and identify and explain patterns in arithmetic.

Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.[16] (3.OA.8)

Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations. *For example, observe that 4 times a number is always even, and explain why 4 times a number can be decomposed into two equal addends.* (3.OA.9)

Geometry

Reason with shapes and their attributes.

Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces.[17] Identify triangles, quadrilaterals, pentagons, hexagons, and cubes. (2.G.1)

Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words *halves, thirds, half of, a third of,* etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape. (2.G.3)

Reason with shapes and their attributes.

Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories. (3.G.1)

Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. *For example, partition a shape into 4 parts with equal area, and describe the area of each part as 1/4 of the area of the shape.* (3.G.2)

Measurement and Data

Measure and estimate lengths in standard units.

Measure the length of an object twice, using length units of different lengths for the two

[16] This standard is limited to problems posed with whole numbers having whole-number answers; students should know how to perform operations in the conventional order when there are no parentheses to specify a particular order (Order of Operations).
[17] Sizes are compared directly or visually, not compared by measuring.

measurements; describe how the two measurements relate to the size of the unit chosen. (2.MD.2)

Estimate lengths using units of inches, feet, centimeters, and meters. (2.MD.3)

Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit. (2.MD.4)

Relate addition and subtraction to length.

Represent whole numbers as lengths from 0 on a number line diagram with equally spaced points corresponding to the numbers 0, 1, 2, ..., and represent whole-number sums and differences within 100 on a number line diagram. (2.MD.6)

Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.

Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram. (3.MD.1)

Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l).[18] Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.[19] (3.MD.2)

Represent and interpret data.

Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (2.MD.10)

Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets.* (3.MD.3)

Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. (3.MD.4)

Geometric measurement: understand concepts of area and relate to area of multiplication and addition.

Recognize area as an attribute of plane figures and understand concepts of area measurement.

[18] Excludes compound units such as cm3 and finding geometric volume of a container.
[19] Excludes multiplicative comparison problems (problems involving notions of “times as much”).

a. A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area.

b. A plane figure which can be covered without gaps or overlaps by *n* unit squares is said to have an area of *n* square units. (3.MD.5)

Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units). (3.MD.6)

Relate area to the operations of multiplication and addition. (3.MD.7)

- Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths. (3.MD.7a)
- Multiply side lengths to find areas of rectangles with whole-number side lengths in the context of solving real world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning. (3.MD.7b)
- Use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths a and $b + c$ is the sum of $a \times b$ and $a \times c$. Use area models to represent the distributive property in mathematical reasoning. (3.MD.7c)
- Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems. (3.MD.7d)

Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.

Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters. (3.MD.8)

Mathematics Standards Level C

More than any other, Level C provides the foundation for all future mathematical studies. Fluency with multidigit whole and decimal numbers as well as calculations with fractions (and the relationships between them) carry the most weight at this level. This extends to working with the concept of ratio and rates, addition and subtraction of fractions, and understanding why the procedures for multiplying and dividing fractions make sense. While the greatest emphasis is still on standards for numbers and operations, attention to algebra and geometry increases considerably in Level C. Reading, writing, and interpreting expressions and equations and generating patterns in numbers and shapes provide a conceptual foundation for functions. In addition, analyzing geometric properties, such as parallelism, perpendicularity, and symmetry, and developing and finding volumes of right rectangular prisms take precedence. Level C also emphasizes sampling techniques and data collection through statistical questioning; to previous standards about data, it adds the understanding of measures of center and spread and display of collected data with line plots.

LEVEL C (4-5, +6)

Number and Operations: Base Ten (+ The Number System)
Generalize place value understanding for multi-digit whole numbers. Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division.* (4.NBT.1) Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. (4.NBT.2) Use place value understanding to round multi-digit whole numbers to any place. (4.NBT.3)
Use place value understanding and properties of operations to perform multi-digit arithmetic. Fluently add and subtract multi-digit whole numbers using the standard algorithm. (4.NBT.4) Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. (4.NBT.5) Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. (4.NBT.6)

Understand the place value system.

Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left. (5.NBT.1)

Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5.NBT.2)

Read, write, and compare decimals to thousandths. (5.NBT.3)

- Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., $347.392 = 3 \times 100 + 4 \times 10 + 7 \times 1 + 3 \times (1/10) + 9 \times (1/100) + 2 \times (1/1000)$. (5.NBT.3a)
- Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. (5.NBT.3b)

Use place value understanding to round decimals to any place. (5.NBT.4)

Perform operations with multi-digit whole numbers and with decimals to hundredths.

Fluently multiply multi-digit whole numbers using the standard algorithm. (5.NBT.5)

Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. (5.NBT.6)

Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. (5.NBT.7) [Note from panel: Applications involving financial literacy should be used.]

The Number System

Compute fluently with multi-digit numbers and find common factors and multiples.

Fluently divide multi-digit numbers using the standard algorithm. (6.NS.2)

Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation. (6.NS.3)

Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *For example, express 36 + 8 as 4 (9 + 2).* (6.NS.4)

Number and Operations: Fractions[20]

Extend understanding of fraction equivalence and ordering.

Explain why *a* fraction *a*/*b* is equivalent to a fraction (*n* × *a*)/(*n* × *b*) by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions. (4.NF.1)

Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model. (4.NF.2)

Build fractions from unit fractions by applying and extending previous understanding of operations on whole numbers.

Understand a fraction *a*/*b* with *a* > 1 as a sum of fractions 1/*b*. (4.NF.3)

- Understand addition and subtraction of fractions as joining and separating parts referring to the same whole. (4.NF.3a)
- Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model. *Examples: 3/8 = 1/8 + 1/8 + 1/8; 3/8 = 1/8 + 2/8; 2 1/8 = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8.* (4.NF.3b)
- Add and subtract mixed numbers with like denominators, e.g., by replacing each mixed number with an equivalent fraction, and/or by using properties of operations and the relationship between addition and subtraction. (4.NF.3c)
- Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using visual fraction models and equations to represent the problem. (4.NF.3d)

Apply and extend previous understandings of multiplication to multiply a fraction by a whole number. (4.NF.4)

- Understand a fraction *a*/*b* as a multiple of 1/*b*. *For example, use a visual fraction model to represent 5/4 as the product 5 × (1/4), recording the conclusion by the equation 5/4 = 5 × (1/4).* (4.NF.4a)
- Understand a multiple of *a*/*b* as a multiple of 1/*b*, and use this understanding to multiply a fraction by a whole number. *For example, use a visual fraction model to express 3 × (2/5) as 6 × (1/5), recognizing this product as 6/5. (In general, n × (a/b) = (n × a)/b.)* (4.NF.4b)
- Solve word problems involving multiplication of a fraction by a whole number, e.g., by using visual fraction models and equations to represent the problem. *For example, if each person at a party will eat 3/8 of a pound of roast beef, and there will be 5 people at the party, how many pounds of roast beef will be needed? Between what two whole numbers does your answer lie?* (4.NF.4c)

[20] Expectations at this level in this domain are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.

Understand decimal notation for fractions, and compare decimal fractions.

Use decimal notation for fractions with denominators 10 or 100. *For example, rewrite 0.62 as 62/100; describe a length as 0.62 meters; locate 0.62 on a number line diagram.* (4.NF.6)

Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual model. (4.NF.7)

Use equivalent fractions as strategy to add and subtract fractions.

Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. *For example, 2/3 + 5/4 = 8/12 + 15/12 = 23/12. (In general, a/b + c/d = (ad + bc)/bd.)* (5.NF.1)

Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. *For example, recognize an incorrect result 2/5 + 1/2 = 3/7, by observing that 3/7 < 1/2.* (5.NF.2)

Apply and extend previous understanding of multiplication and division to multiply and divide fractions.

Interpret a fraction as division of the numerator by the denominator ($a/b = a \div b$). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem. *For example, interpret 3/4 as the result of dividing 3 by 4, noting that 3/4 multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size 3/4. If 9 people want to share a 50-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie?* (5.NF.3)

Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction. (5.NF.4)

Interpret multiplication as scaling (resizing), by:

a. Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication.

b. Explaining why multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case); explaining why multiplying a given number by a fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence $a/b = (n \times a)/(n \times b)$ to the effect of multiplying a/b by 1. (5.NF.5)

Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem. (5.NF.6)

Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (5.NF.7)

- Interpret division of a unit fraction by a non-zero whole number, and compute such quotients. *For example, create a story context for (1/3) ÷ 4, and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that (1/3) ÷ 4 = 1/12 because (1/12) × 4 = 1/3.* (5.NF.7a)
- Interpret division of a whole number by a unit fraction, and compute such quotients. *For example, create a story context for 4 ÷ (1/5), and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that 4 ÷ (1/5) = 20 because 20 × (1/5) = 4.* (5.NF.7b)
- Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, how much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 1/3-cup servings are in 2 cups of raisins?* (5.NF.7c)

The Number System

Apply and extend previous understandings of multiplication and division to divide fractions by fractions.

Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, create a story context for (2/3) ÷ (3/4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3) ÷ (3/4) = 8/9 because 3/4 of 8/9 is 2/3. (In general, (a/b) ÷ (c/d) = ad/bc.) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi?* (6.NS.1)

Ratios and Proportional Relationships

Understand ratio concepts and use ratio reasoning to solve problems.

Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."* (6.RP.1)

Understand the concept of a unit rate a/b associated with a ratio a:b with $b \neq 0$, and use rate language in the context of a ratio relationship. *For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger."*[21] (6.RP.2)

[21] Expectations for unit rates at this level are limited to non-complex fractions.

Operations and Algebraic Thinking

Use the four operations with whole numbers to solve problems.

Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4.OA.1)

Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison. (4.OA.2)

Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. (4.OA.3)

Gain familiarity with factors and multiples.

Find all factor pairs for a whole number in the range 1–100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1–100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1–100 is prime or composite. (4.OA.4)

Generate and analyze patterns.

Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. *For example, given the rule "Add 3" and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.* (4.OA.5)

Write and interpret numerical expressions.

Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols. (5.OA.1)

Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. *For example, express the calculation "add 8 and 7, then multiply by 2" as 2 × (8 + 7). Recognize that 3 × (2100 + 425) is three times as large as the 2100 + 425, without having to calculate the indicated sum or product.* (5.OA.2)

Expressions and Equations

Apply and extend previous understandings of arithmetic to algebraic expressions.

Write and evaluate numerical expressions involving whole-number exponents. (6.EE.1)

Write, read, and evaluate expressions in which letters stand for numbers. (6.EE.2)

- Write expressions that record operations with numbers and with letters standing for numbers. *For example, express the calculation "Subtract y from 5" as* $5 - y$. (6.EE.2a)
- Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *For example, describe the expression* $2\ (8 + 7)$ *as a product of two factors; view* $(8 + 7)$ *as both a single entity and a sum of two terms.* (6.EE.2b)
- Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). *For example, use the formulas* $V = s^3$ *and* $A = 6\ s^2$ *to find the volume and surface area of a cube with sides of length* $s = 1/2$. (6.EE.2c)

Apply the properties of operations to generate equivalent expressions. *For example, apply the distributive property to the expression* $3\ (2 + x)$ *to produce the equivalent expression* $6 + 3x$*; apply the distributive property to the expression* $24x + 18y$ *to produce the equivalent expression* $6\ (4x + 3y)$*; apply properties of operations to* $y + y + y$ *to produce the equivalent expression* $3y$. (6.EE.3)

Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *For example, the expressions* $y + y + y$ *and* $3y$ *are equivalent because they name the same number regardless of which number y stands for.* (6.EE.4)

Reason about and solve one-variable equations and inequalities.

Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true. (6.EE.5)

Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (6.EE.6)

Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers. (6.EE.7)

Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions; represent solutions of such inequalities on number line diagrams. (6.EE.8)

Represent and analyze quantitative relationships between dependent and independent variables.

Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation* $d = 65t$ *to represent the relationship between distance and time.* (6.EE.9)

Geometry

Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4.G.1)

Graph points on the coordinate plane to solve real-world and mathematical problems.

Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate). (5.G.1)

Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5.G.2)

Classify two-dimensional figures into categories based on their properties.

Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. *For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.* (5.G.3)

Solve real-world and mathematical problems involving area, surface area, and volume.

Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems. (6.G.1)

Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems. (6.G.3)

Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems. (6.G.4)

Measurement and Data

Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. (4.MD.2)

Apply the area and perimeter formulas for rectangles in real world and mathematical problems. *For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.* (4.MD.3)

Geometric measurement: understand concepts of angle and measure angles.

Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:

a. An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is called a "one-degree angle," and can be used to measure angles.

b. An angle that turns through *n* one-degree angles is said to have an angle measure of *n* degrees. (4.MD.5)

Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure. (4.MD.6)

Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure. (4.MD.7)

Convert like measurement units within a given measurement system.

Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. (5.MD.1)

Represent and interpret data.

Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots. *For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.* (5.MD.2) [Note from panel: Plots of numbers other than measurements also should be encouraged.]

Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.

Recognize volume as an attribute of solid figures and understand concepts of volume measurement.

a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume.

b. A solid figure which can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units. (5.MD.3)

Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. (5.MD.4)

Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. (5.MD.5)

- Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication. (5.MD.5a)
- Apply the formulas $V = l \times w \times h$ and $V = b \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems. (5.MD.5b)
- Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems. (5.MD.5c)

Statistics and Probability

Develop understanding of statistical variability.

Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. *For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages.* (6.SP.1)

Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. (6.SP.2)

Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number. (6.SP.3)

Summarize and describe distributions.

Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (6.SP.4) [Also see S.ID.1]

Mathematics Standards Level D

Like preceding levels, Level D also emphasizes number sense and operations, but here the attention is on fluency with all four operations with rational numbers—both negative and positive. The foundation for understanding of irrational numbers is built here, including calculation with square and cube roots and solving simple quadratic equations. Another keen area of concentration is algebra and functions: formulating and reasoning about expressions, equations, and inequalities; solving linear equations and systems of linear equations; grasping the concept of a function; and using functions to describe quantitative relationships. Level D is also where understanding and applying ratios, rates, and proportional reasoning—forming a bridge between rational number operations and algebraic relationships—are developed. Building on the geometric analysis in Level C, the focus turns to analyzing two- and three-dimensional figures using distance, angle, similarity, and congruence, and understanding basic right triangle trigonometry. Having worked with measurement data in previous levels, students at this level develop notions of statistical variability and learn to understand summary statistics and distributions. The concept of probability is introduced and developed at this level.

LEVEL D (+6, 7-8)

The Number System
Apply and extend previous understandings of numbers to the system of rational numbers. Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (6.NS.5) Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates. (6.NS.6) • Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., $-(-3) = 3$, and that 0 is its own opposite. (6.NS.6a) • Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes. (6.NS.6b) • Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane. (6.NS.6c) Understand ordering and absolute value of rational numbers. (6.NS.7) • Interpret statements of inequality as statements about the relative position of two numbers on a

number line diagram. *For example, interpret –3 > –7 as a statement that –3 is located to the right of –7 on a number line oriented from left to right.* (6.NS.7a)

- Write, interpret, and explain statements of order for rational numbers in real-world contexts. *For example, write –3º C > –7º C to express the fact that –3º C is warmer than –7º C.* (6.NS.7b)
- Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. *For example, for an account balance of –30 dollars, write |–30| = 30 to describe the size of the debt in dollars.* (6.NS.7c)
- Distinguish comparisons of absolute value from statements about order. *For example, recognize that an account balance less than –30 dollars represents a debt greater than 30 dollars.* (6.NS.7d)

Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate. (6.NS.8)

Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram. (7.NS.1)

- Describe situations in which opposite quantities combine to make 0. *For example, if a check is written for the same amount as a deposit, made to the same checking account, the result is a zero increase or decrease in the account balance.* (7.NS.1a)
- Understand $p + q$ as the number located a distance $|q|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts. (7.NS.1b)
- Understand subtraction of rational numbers as adding the additive inverse, $p - q = p + (-q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts. (7.NS.1c)
- Apply properties of operations as strategies to add and subtract rational numbers. (7.NS.1d)

Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers. (7.NS.2)

- Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as $(-1)(-1) = 1$ and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts. (7.NS.2a)
- Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then $-(p/q) = (-p)/q = p/(-q)$. Interpret quotients of rational numbers by describing real-world contexts. (7.NS.2b)

- Apply properties of operations as strategies to multiply and divide rational numbers. (7.NS.2c)
- Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats. (7.NS.2d)

Solve real-world and mathematical problems involving the four operations with rational numbers. (7.NS.3)

Know that there are numbers that are not rational, and approximate them by rational numbers.

Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2). *For example, by truncating the decimal expansion of* $\sqrt{2}$, *show that* $\sqrt{2}$ *is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations*. (8.NS.2)

Understand ratio concepts and use ratio reasoning to solve problems.

Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. (6.RP.3)

- Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios. (6.RP.3a)
- Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?* (6.RP.3b)
- Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent. (6.RP.3c)
- Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities. (6.RP.3d)

Analyze proportional relationships and use them to solve real-world and mathematical problems.

Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction* ${}^{1/2}/_{1/4}$ *miles per hour, equivalently 2 miles per hour.* (7.RP.1)

Recognize and represent proportional relationships between quantities. (7.RP.2)

- Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin. (7.RP.2a)
- Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. (7.RP.2b) [Also see 8.EE.5]

- Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.* (7.RP.2c)
- Explain what a point *(x, y)* on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, *r)* where *r* is the unit rate. (7.RP.2d)

Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.* (7.RP.3) [Also see 7.G.1 and G.MG.2]

Expressions and Equations

Use properties of operations to generate equivalent expressions.

Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. (7.EE.1)

Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."* (7.EE.2) [Also see A.SSE.2, A.SSE.3, A.SSE.3a, A.CED.4]

Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.* (7.EE.3)

Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (7.EE.4) [Also see A.CED.1 and A.REI.3]

- Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?* (7.EE.4a) [Also see A.CED.1 and A.REI.3]
- Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.* (7.EE.4b) [Also see A.CED.1 and A.REI.3]

Work with radicals and integer exponents.

Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example,* $3^2 \times 3^{(-5)} = 3^{(-3)} = (1/3)^3 = 1/27$. (8.EE.1) [Also see F.IF.8b]

Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational. (8.EE.2) [Also see A.REI.2]

Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as* 3×10^8 *and the population of the world as* 7×10^9*, and determine that the world population is more than 20 times larger.* (8.EE.3)

Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology. (8.EE.4) [Also see N.Q.3]

Understand the connections between proportional relationships, lines, and linear equations.

Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.* (8.EE.5) [Also see 7.RP.2b]

Analyze and solve linear equations and pairs of simultaneous linear equations.

Solve linear equations in one variable. (8.EE.7) [Also see A.REI.3]

- Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers). (8.EE.7a)
- Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. (8.EE.7b)

Analyze and solve pairs of simultaneous linear equations. (8.EE.8)

- Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. (8.EE.8a)
- Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example,* $3x + 2y = 5$ *and* $3x + 2y = 6$ *have no solution because* $3x + 2y$ *cannot simultaneously be 5 and 6.* (8.EE.8b) [Also see A.REI.6]
- Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.* (8.EE.8c)

Functions

Define, evaluate, and compare functions.

Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.[22] (8.F.1) [Also see F.IF.1]

Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function* $A = s^2$ *giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.* (8.F.3)

Use functions to model relationships between quantities.

Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. (8.F.4) [Also see F.BF.1 and F.LE.5]

Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. (8.F.5) [Also see A.REI.10 and F.IF.7]

Geometry

Draw, construct, and describe geometrical figures and describe the relationships between them.

Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale. (7.G.1) [Also see 7.RP.3]

Solve real-life and mathematical problems involving angle, measure, area, surface area, and volume.

Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle. (7.G.4)

Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure. (7.G.5)

Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms. (7.G.6) [Also see G.GMD.3]

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[22] Function notation is not required at this level.

Understand congruence and similarity using physical models, transparencies, or geometry software.

Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. (8.G.2) [Also see G.SRT.5]

Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them. (8.G.4) [Also see G.SRT.5]

Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.* (8.G.5)

Understand and apply the Pythagorean Theorem.

Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. (8.G.7)

Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. (8.G.8)

Statistics and Probability

Summarize and describe distributions.

Summarize numerical data sets in relation to their context, such as by:

a. Reporting the number of observations.
b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.
d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered. (6.SP.5)

Use random sampling to draw inferences about a population.

Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences. (7.SP.1)

Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. *For example, estimate the mean word length in a book by randomly sampling* *words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.* (7.SP.2)

Draw informal comparative inferences about two populations.

Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. *For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.* (7.SP.3)

Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. *For example, decide whether the words in one chapter of a science book are generally longer or shorter than the words in another chapter of a lower level science book.* (7.SP.4) [Also see S.ID.3]

Investigate chance processes and develop, use, and evaluate probability models.

Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event. (7.SP.5)

Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.* (7.SP.6)

Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (7.SP.7)

- Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. *For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.* (7.SP.7a)
- Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. *For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?* (7.SP.7b)

Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs. (7.SP.8a)

Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., “rolling double sixes”), identify the outcomes in the sample space which compose the event. (7.SP.8b)

Investigate patterns of association in bivariate data.

Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. (8.SP.1) [Also see S.ID.1]

Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. (8.SP.2)

Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.* (8.SP.3) [Also see S.ID.7]

Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they like to cook and whether they participate actively in a sport. Is there evidence that those who like to cook also tend to play sports?* (8.SP.4) [Also see S.ID.5]

Mathematics Standards Level E

Themes introduced and developed in earlier levels continue and deepen in Level E. Having already extended arithmetic calculations from whole numbers to fractions and from fractions to rational and irrational numbers, understanding the real number system comes to the fore. Understanding radical expressions, using and interpreting units in problem solving, and attending to precision are important areas of focus. Prior work with proportional relationships and functions expands from linear expressions, equations, and functions to quadratic, rational, exponential, and polynomial. To bridge the gap between algebra and geometry, rates and relationships are applied to density models. Work also advances in geometry, including using congruence and similarity criteria to prove relationships in geometric figures and determining volumes of cylinders, pyramids, cones, and spheres. Basic skills and knowledge of statistics and probability are applied in a modeling context, in which students interpret and compare data distributions and understand issues of correlation and causation.

Note: Making mathematical models is a Standard for Mathematical Practice (MP.4), and specific modeling standards appear throughout the high school standards indicated by an asterisk (*).

LEVEL E (High School)

Number and Quantity: The Real Number System
Extend the properties of exponents to rational exponents. Rewrite expressions involving radicals and rational exponents using the properties of exponents. (N.RN.2)
Number and Quantity: Quantities
Reason quantitatively and use units to solve problems. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.* (N.Q.1) Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.* (N.Q.3) [Also see 8.EE.4]
Algebra: Seeing Structure in Expressions
Interpret the structure of expressions. Interpret expressions that represent a quantity in terms of its context.* (A.SSE.1) • Interpret parts of an expression, such as terms, factors, and coefficients.* (A.SSE.1a)

Use the structure of an expression to identify ways to rewrite it. *For example, see* $x^4 - y^4$ *as* $(x^2)^2 - (y^2)^2$*, thus recognizing it as a difference of squares that can be factored as* $(x^2 - y^2)(x^2 + y^2)$. (A.SSE.2) [Also see 7.EE.2]

Write expressions in equivalent forms to solve problems.

Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.* (A.SSE.3) [Also see 7.EE.2]

- Factor a quadratic expression to reveal the zeros of the function it defines.* (A.SSE.3a) [Also see 7.EE.2]

Algebra: Arithmetic with Polynomials and Rational Expressions

Perform arithmetic operations on polynomials.

Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials. (A.APR.1) [Note from panel: Emphasis should be on operations with polynomials.]

Rewrite rational expressions.

Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system. (A.APR.6)

Algebra: Creating Equations

Create equations that describe numbers or relationships.

Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions*.* (A.CED.1) [Also see 7.EE.4, 7.EE.4a, and 7.EE.4b]

Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.* (A.CED.2)

Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non- viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.** (A.CED.3)

Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law* $V = IR$ *to highlight resistance* R.* (A.CED.4) [Also see 7.EE.2]

Algebra: Reasoning with Equations and Inequalities

Understand solving equations as a process of reasoning and explain the reasoning.

Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. (A.REI.1)

Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. (A.REI.2) [Also see 8.EE.2]

Solve equations and inequalities in one equation.

Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. (A.REI.3) [Also see 7.EE.4, 7.EE.4a, 7.EE.4b, and 8.EE.7]

Solve quadratic equations in one variable. (A.REI.4)

Solve systems of equations.

Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. (A.REI.6) [Also see 8.EE.8b]

Represent and solve equations and inequalities graphically.

Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). (A.REI.10) [Also see 8.F.5]

Functions: Interpreting Functions

Understand the concept of a function and use function notation.

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$. (F.IF.1) [Also see 8.F.1]

Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. (F.IF.2)

Interpret functions that arise in applications in terms of the context.

For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *For example, for a quadratic function modeling a projectile in motion, interpret the intercepts and the vertex of the function in the context of the problem*.* (F.IF.4) [*Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.]*

Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble* *n engines in a factory, then the positive integers would be an appropriate domain for the function.** (F.IF.5)

Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.* (F.IF.6) [NOTE: See conceptual modeling categories.]

Analyze functions using different representations.

Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* (F.IF.7) [Also see 8.F.5]

Use properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in an exponential function and then classify it as representing exponential growth or decay.* (F.IF.8b) [Also see 8.EE.1]

Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.* (F.IF.9)

Functions: Building Functions

Build a function that models a relationship between two quantities.

Write a function that describes a relationship between two quantities.* (F.BF.1) [Also see 8.F.4]

Functions: Linear, Quadratic, and Exponential Models

Construct and compare linear, quadratic, and exponential models and solve problems.

Distinguish between situations that can be modeled with linear functions and with exponential functions.* (F.LE.1)

- Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.* (F.LE.1b)
- Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.* (F.LE.1c)

Interpret expressions for functions in terms of the situation they model.

Interpret the parameters in a linear or exponential function in terms of a context.* (F.LE.5) [Also see 8.F.4]

Geometry: Congruence

Experiment with transformations in the plane.

Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc. (G.CO.1)

Geometry: Similarity, Right Triangles, and Trigonometry

Prove theorems involving similarity.

Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. (G.SRT.5) [Also see 8.G.2 and 8.G.4]

Geometry: Geometric Measurement and Dimension

Explain volume formulas and use them to solve problems.

Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.* (G.GMD.3) [Also see 7.G.6]

Geometry: Modeling with Geometry

Apply geometric concepts in modeling situations.

Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).* (G.MG.2) [Also see 7.RP.3]

Statistics and Probability: Interpreting Categorical and Quantitative Data

Summarize, represent, and interpret data on a single count or measurable variable.

Represent data with plots on the real number line (dot plots, histograms, and box plots). (S.ID.1) [Also see 6.SP.4 and 8.SP.1]

Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). (S.ID.3) [Also see 7.SP.4]

Summarize, represent, and interpret data on two categorical and quantitative variables.

Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. (S.ID.5) [Also see 8.SP.4]

Interpret linear models.

Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. (S.ID.7) [Also see 8.SP.3]

Distinguish between correlation and causation. (S.ID.9)

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APPENDIX A

IN-DEPTH DESCRIPTION OF THE SELECTION PROCESS

Process Framework

Two expert panels (one for English language arts and literacy [ELA/literacy] and one for mathematics) were convened to review the Common Core State Standards (CCSS) for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects (ELA/literacy) and Mathematics in the fall of 2011. Their charge was to make recommendations regarding a manageable yet significant set of College and Career Readiness (CCR) content standards based on the CCSS and tailored for adult students. The challenge was to take an expansive list of standards—some 13 years' worth—and identify those standards most useful for adult education teachers in preparing adults across the United States. As explained below, several factors influenced their decisions.

A primary goal was to establish an evidence-based process and to arm the panels with the right kind of information. To support panelists in anchoring their decisions in evidence, project staff developed an extensive reference/support document summarizing relevant research and assessment information, including:

- Judgments of postsecondary faculty on the importance and relevance of a variety of content items (ACT National Curriculum survey; American Mathematical Association of Two-Year Colleges Standards; EPIC postsecondary faculty survey, *Reaching the Goal: The Applicability and Importance of the CCSS to College and Career Readiness*) (ACT 2009; AMATYC 1995; Conley et al. 2011).

- Judgments of employers on the importance and relevance of a variety of content items (*Are They Really Ready to Work?: Employers' Perspectives on the Basic Knowledge and Applied Skills of New Entrants to the 21st Century U.S. Workforce*) (Casner-Lotto and Barrington 2006).

- Content currently part of (or planned for inclusion in) pertinent assessments for adult students (new GED®, ACCUPLACER, and COMPASS) (ACT 2011; American Council on Education n.d.; College Board 2011).

Resources were categorized into two groups, providing two crosswalks for each content area: (A) resources providing evidence of skills and concepts determined by various reviewers (and assessments) to be necessary for college and career readiness; and (B) resources providing information from states and college faculty about which CCSS they believe should receive the highest priority because they are the most essential. Resources were evaluated and rated to show the level of match between the college and career readiness resource and each CCSS standard.[23]

In most cases, the evidence was clear. In writing, for example, college faculty and employers highly value the ability of prospective freshmen or new hires to write logical arguments based on substantive claims, sound reasoning, and relevant evidence. Likewise, standards from top-performing countries and states include the expectation that graduates will be able to produce logical and coherent arguments. In response to such clear evidence, the panel included writing arguments throughout the adult levels of learning—with opinion writing, a basic form of argument, extending down into the earliest levels.

Available evidence, however, was not always conclusive. For example, panelists reviewed data that showed little consensus on the need for incoming freshmen to understand graphs, charts, and tables and integrate this visual information with accompanying text to develop a coherent understanding of a topic. Some evidence indicated that this skill was crucial in the workplace and in entry-level courses, but other data disputed its value. The panel ultimately selected standards calling for the synthesis of text and data because the bulk of the evidence (and panelists' own experiences) suggested the importance of that skill in today's workplace and college classrooms.

Another priority was to make sure that a cross section of experts reviewed the standards selections to ensure the feedback was representative of a broad base of constituents. To gather this cross section of individuals to provide meaningful feedback, each panelist identified several people they believed would have interest and expertise in the area of college and career readiness in ELA/literacy or mathematics. Project staff received feedback from 64 stakeholders. Stakeholders included representatives from: 1) adult education (e.g., program directors, instructors); 2) higher education (e.g., developmental education specialists, faculty who teach freshman courses, and others with expertise in college readiness); 3) career/technical training (e.g., employers/industry representatives involved in training, career/technical trainers and teachers); and 4) the military.

[23] The level of match is a matter of judgment. To assist panelists, Susan Pimentel, Melanie (Mimi) Alkire, and Francis (Skip) Fennell made initial judgments based on their knowledge of the CCSS and the specific resources to assist panel members. This did not preclude panel members from reviewing each resource and making their own judgments.

Invitations were sent, along with the standards documents, guiding questions, and directions. Panelists were asked to schedule time—in person or by phone—with the reviewers they nominated to walk them through the materials and process. In addition, panelists and project staff made themselves available to respond to any stakeholder questions. Stakeholders submitted written feedback (many pages each) to project staff, who in turn analyzed the feedback for panel members.

A third priority was to introduce a series of checks and balances for the panels by setting up an ongoing feedback process and holding a series of meetings and calls to challenge panelists to revisit and refine their decisions. Susan Pimentel—founding partner of Student Achievement Partners, a nationally recognized standards expert, and lead writer of the CCSS ELA/literacy standards—led this process. She was assisted by Dr. Francis (Skip) Fennell, professor of education at McDaniel College and former president of the National Council of Teachers of Mathematics, and Melanie (Mimi) Alkire, an education consultant who has worked on CCSS implementation and several other college and career readiness projects.

Timeline of Deliberations

The process began by asking each panelist to make independent professional judgments about the CCSS exit standards (high school standards in ELA/literacy and high school and grades 7 and 8 standards in mathematics) based on where they found the strongest evidence for college and career readiness in the reference documents from an adult education perspective.

Before their first meeting, panelists were asked to review each high school standard (and those in mathematics for grades 7 and 8) to determine its relevance and practical applicability to one or more of the following adult student goals: a) life skills development; b) attainment of a high school credential; c) enrollment in credit-bearing college courses; and d) workforce training and placement. If the standard made it through the relevance gate, panelists were then asked to determine whether the standard was also important to adult education by considering the following questions:

- Does the standard have real significance and consequence to students in terms of their ability to reach any one (or more) of their goals?
- Is it worth spending precious instructional time on?

Panelists then brought their preliminary judgments about the relevance and importance of standards for adult students to the first meeting, relying on whether (and the extent to which) that content appeared in the related research on college and career readiness skills and knowledge. The selected standards were identified and refined into their final form over nine months of review and deliberations.

At the first full panel meetings in January 2012, panelists analyzed the standards, reported their findings, and categorized their reasons for considering a standard either relevant and important to adult education or not essential for adults. This meeting was followed by conference calls enabling panelists to verify and refine the key content decisions made in January and address any key issues emerging during the first deliberations.

During the second meeting, held in May 2012, panelists were asked to “backward-map” by determining which elementary and middle school CCSS were needed as a foundation (or prerequisites) for high school level standards. This meeting was followed by another conference call to organize the solicitation of feedback on panelists’ decisions.

In August 2012, the recommended stakeholders reviewed the interim sets of standards and provided their written feedback. In response to a set of five overarching statements (listed below), between 77 percent (disagreed with Statement #2) and 96 percent (agreed with Statement #3) of ELA/literacy responses supported the panel’s decisions. The mathematics responses ranged from a high of 88 percent (disagreed with Statement #2) to a still remarkably positive 78 percent (agreed with Statement #1). Overall, respondents praised the selected standards as coherent, rigorous, and supporting the preparation of adult students for postsecondary success. When they did not agree fully with the panels’ decisions, it was largely to round out the set of standards in a domain or offer a helpful insight. Following are the statements provided to the stakeholders:

Statement #1: The selected CCSS represent the ELA/literacy [mathematics] concepts and skills necessary for adult students to succeed in credit-bearing postsecondary courses (college or job training programs).

Statement #2: There are important concepts and skills missing from the selected CCSS for ELA/literacy [mathematics] that are necessary to prepare adult students for postsecondary success.

Statement #3: The selected CCSS in ELA/literacy [mathematics] are sufficiently focused for adult education, including only content required to prepare adult students for postsecondary success.

Statement #4: *The selected CCSS provide a set of building blocks to allow adult students to progress toward mastery of skills needed for career and college readiness.*

Statement #5: *The selected standards offer a coherent vision of the discipline of ELA/literacy [mathematics] for adult students.*

Additional feedback was also sought from lead writers of the CCSS, including David Coleman, Bill McCallum, and Jason Zimba, who were asked to review panelists' decisions and to answer the following questions:

1. What standards didn't the panel select as most relevant and important that you think adult students definitely need to be prepared for postsecondary work?

2. Alternatively, what standards did the panel select that you consider "nice to know" but not absolutely essential for adult learners' postsecondary success?

David Coleman, one of the lead writers of the CCSS for ELA/literacy, praised the panel decisions overall. Bill McCallum and Jason Zimba commended the panelists for "making a number of difficult—but apt—choices [in high school], and suggested that they hold firm on focus."

The final meeting, held in October 2012, was dedicated to reviewing and responding to the feedback collected. When conflicting suggestions were made by different stakeholders with regard to adding or deleting specific content, panelists returned to evidence from the reference document to determine how college faculty, key assessments, and employers rated the content. The panel then issued its final decisions regarding what standards should form the core of college and career readiness for adult learners.[24]

[24] A detailed explanation of the rationales for the selection of the Common Core for ELA/literacy and mathematics can be found in Appendix C.

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APPENDIX B CONNECTIONS BETWEEN STANDARDS

Deliberate ELA/Literacy Redundancies and Repetition of Similar Content

In some cases, the Common Core State Standards (CCSS) repeat the very same skill level to level with little or no variation in wording or demand. Literacy skills by their nature are recursive; therefore, certain skills need to be covered at both lower and higher levels of learning, but applied to increasingly sophisticated contexts. So, for example, students are asked by the CCSS to determine the theme or central idea of a text, summarize a text, determine the meaning of words in context, and produce clear and coherent writing in several levels of learning as applied to more challenging texts.

In other instances, content is repeated in more than one CCSS domain to underscore its importance. For example, standards focused on academic vocabulary exist in both the Reading (Standard 4) and Language domains (Standards 4–6) because of its central role in comprehending complex text. Likewise, the analysis and integration of information from media exist in both the Reading domain (Standard 7) and Speaking and Listening domain (Standards 2 and 5) to reflect the fact that students must be able to adapt quickly to new media and technology. Lastly, argument is covered in several domains: Reading (Standard 8), Writing (Standard 1), and Speaking and Listening (Standard 3).

In addition, while the standards delineate specific expectations in reading, writing, speaking, listening, and language, each standard is not meant to be a separate focus for instruction and assessment. In fact, content in one CCSS domain is sometimes explicitly referenced in another domain because the standards are meant to work together. Prime examples of these kinds of built-in connections and intentional redundancies include Writing Standard 9 and Reading Standard 1, which both refer to drawing evidence from texts, as well as Writing Standard 4 and Speaking and Listening Standard 6, which both mention Language Standards 1–3 (students' use of standard English). The following chart illustrates some of these connections and deliberate redundancies.

Connections Between and Among the Standards from the Domains of Reading, Writing, Speaking and Listening, and Language	
Reading Anchor 1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.	**Writing Anchor 9** Draw evidence from literary or informational texts to support analysis, reflection, and research. **Speaking and Listening Anchor1** Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
Reading Anchor 4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.	**Language Anchor 4** Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate. **Language Anchor 6** Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.
Reading Anchor 6 Assess how point of view or purpose shapes the content and style of a text.	**Speaking and Listening Anchor 3** Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.
Reading Anchor 7 Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.	**Speaking and Listening Anchor 2** Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
Reading Anchor 8 Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence	**Writing Anchor 1** Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence. **Speaking and Listening Anchor 3** Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.

Connections Between and Among the Standards from the Domains of Reading, Writing, Speaking and Listening, and Language	
Writing Anchor 4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.	**Language Anchor 1** Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. **Language Anchor 2** Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. **Speaking and Listening Anchor 6** Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.
Writing Anchor 6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.	**Speaking and Listening Anchor 5** Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
Writing Anchor 7 Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.	**Speaking and Listening Anchor 1** Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

Deliberate Selection of Mathematics Standards Repeating Similar Content

Panelists selected similar content—mainly in algebra, but also in functions, number, and geometry—from Levels D (grades 6–8) and E (high school). The overlapping high school content from Level E often subsumes its Level D counterpart, but at a higher level of rigor. For example, both levels emphasize linear equations, while the high school standards extend the requirements to quadratic and exponential functions. Panelists decided to include the overlapping grade 6–8 standards because they tended to offer a more thorough description of the demands. For example, standards 8.EE.8b and A.REI.6 both require the solution of a system of linear equations, yet both were selected. While the grade 8 standard is subsumed by the high school standard, it provides descriptions of methods of finding the solution, the reasons for using those methods, and useful examples.

Connections Between Level D and Level E		
Level D	**Level E**	**Comments on Connections**
7.EE.2 Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."*	**A.SSE.2** Use the structure of an expression to identify ways to rewrite it. *For example, see* $x^4 - y^4$ *as* $(x^2)^2 - (y^2)^2$*, thus recognizing it as a difference of squares that can be factored as* $(x^2 - y^2)(x^2 + y^2)$.	Both levels address various ways to rewrite an algebraic expression or equation and reasons for doing so.
	A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.	
	A.SSE.3a Factor a quadratic expression to reveal the zeros of the function it defines.	
	A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*)	
7.EE.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.	**A.CED.1** Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.* **A.REI.3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	Both levels require writing equations and inequalities. Level D standards here indicate only linear equations and inequalities, while the Level E connection includes linear but also extends to quadratic, simple rational, and exponential.
7.EE.4a Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?*		
7.EE.4b Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.*		

Connections Between Level D and Level E		
Level D	**Level E**	**Comments on Connections**
7.G.6 Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.	**G.GMD.3** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.	Both levels are concerned with finding volumes, although the Level E standard specifies and extends the types of 3-D figures required.
7.RP.3 Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.*	**G.MG.2** Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).	Both levels require problem solving using rates and ratios. Problems related to density in Level D are applications of rates and ratios as a geometric model.
7.SP.4 Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. *For example, decide whether the words in one chapter of a science book are generally longer or shorter than the words in another chapter of a lower level science book.*	**S.ID.3** Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	Both levels require interpretation of measures of center and spread (variability), and both imply comparison of two or more data sets. The Level E standard also adds interpretation of the shape of the data and the context in which it is found.
8.EE.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example,* $3^2 \times 3^{(-5)} = 3^{(-3)} = (1/3)^3 = 1/27$. (8.EE.1)	**F.IF.8b** Use the properties of exponents to interpret expressions for exponential functions. Use properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in an exponential function and then classify it as representing exponential growth or decay.* (F.IF.8b)	Both levels address using the properties of exponents. Level D deals with generating solutions; Level E extends the standard to interpreting expressions.
8.EE.2 Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.	**A.REI.2** Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	These connect through the solution to radical equations. The Level E standard extends to rational equations. The domain restriction in Level D hints at a knowledge of extraneous solutions.

Connections Between Level D and Level E		
Level D	**Level E**	**Comments on Connections**
8.EE.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.	**N.Q.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	Both levels deal with precision and accuracy in these standards. Using the appropriate level of precision (Level E) is important to calculations with scientific notation for quantities that are very large or small (Level D).
8.EE.7 Solve linear equations in one variable.	**A.REI.3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	Both Levels D and E require solving one-variable linear equations.
8.EE.8b Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.*	**A.REI.6** Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	These standards both require solutions for a system of linear equations, using multiple strategies.
8.F.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.	**F.IF.1** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$.	Defining a function and its graph is required in both Levels D and E.
8.F.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.	**F.BF.1** Write a function that describes a relationship between two quantities.*	This Level E standard is more generally stated than the Level D counterpart, but addresses the requirement to “construct” a function.
	F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.	Both levels require interpretation of the parameters of a linear function. Level E also extends to exponential functions.

Connections Between Level D and Level E		
Level D	**Level E**	**Comments on Connections**
8.F.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	**A.REI.10** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). [Also see 8.F.5]	While this Level E standard does not expressly address the “qualitative” description of the relationship, it does address the graphic analysis of that relationship.
	F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.	Both levels address the features of a graph, as stated in the second part of the Level D counterpart.
8.G.2 Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.	**G.SRT.5** Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.	While both levels address congruence and similarity, they are approached somewhat differently in the levels. In the Level D standards, the emphasis is on demonstrating congruence/similarity through transformations. The Level E counterpart does not imply that transformations must be used to prove congruence/similarity.
8.G.4 Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.		
8.SP.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.	**S.ID.1** Represent data with plots on the real number line (dot plots, histograms, and box plots).	Both levels require using scatter plots to represent data. The Level D counterpart also requires interpretation and analysis of the plots, while at Level E, other types of plots also are specified.
8.SP.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*	**S.ID.7** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.	Both levels address interpretation of slope and intercept in models created from data.

Connections Between Level D and Level E		
Level D	**Level E**	**Comments on Connections**
8.SP.4 Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they like to cook and whether they participate actively in a sport. Is there evidence that those who like to cook also tend to play sports?*	**S.ID.5** Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.	Analysis of frequency of data points and two-way tables to display and analyze those frequencies are required in both levels. Level D gives a detailed description of the tables, while Level E also requires interpretation in the context of the data, including recognition of associations and trends.

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APPENDIX C RATIONALES FOR THE SELECTION OF THE COMMON CORE

Rationales for the Selection of Standards for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects by Domain

An important goal in selecting the English language arts and literacy (ELA/literacy) standards was keeping the overall content demands manageable, while at the same time making sure core college and career readiness requirements for adult learners were represented. The standards not selected were omitted primarily because they were too specific, redundant, subsumed by other standards, or handled sufficiently in an earlier grade.

In its high school selections, the panel chose to focus primarily (though not exclusively) on the 9–10 reading, writing, and speaking and listening standards. Panel members selected a 9–10 standard over an 11–12 standard when they found the standard at the earlier high school grades both rigorous and comprehensive and when the grades 11–12 standard often only included minor additional demands considered unnecessary by panelists. For example, Reading Standard 1 for grades 9–10 states: “Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.” The standard for grades 11–12 adds to that statement, “including determining where the text leaves matters uncertain.” Because the level of text that students read is the greatest predictor of success in college and careers (rather than a graduate’s SAT scores, GPA, or even their critical thinking skills), applying rigorous content to college and career ready text will more than prepare adult students for the rigors of postsecondary training (ACT 2006).

Rationales for Selecting Reading Standards

In response to overwhelming data from college faculty and employers, the panel chose to emphasize informational text, with a more limited focus on literature. In fact, panelists chose to include several reading standards related particularly to historical, scientific, and technical text—principally because expository text makes up the vast majority of the required reading most students will face in college and the workplace.

The panel selected a full progression of informational text standards for the 10 Reading Anchor Standards, and only a few—but central—literature standards. Besides focusing on evidence (Reading Standard 1) and text complexity (Reading Standard 10) for all kinds of texts, panelists included standards that ask students to determine a theme or a main idea in texts (Reading Standard 2) or determine the meaning of words in context (Reading Standard 4).

Panelists also included a complement of standards requiring students to analyze how and why events and ideas interact over the course of an informational text (Reading Standard 3), because this was a critical skill for comprehending factual accounts and other nonfiction texts (including digital sources) written for a broad audience. They noted this skill as critical to informed civic engagement. Data from the ACT survey of college faculty supports their decision: the relationship of ideas and the relationship between sentences were rated as a high priority. The postsecondary faculty survey gave this standard a strong rating as well.

Panelists believed that several standards—besides being important for developing students' reading comprehension skills—would also help to improve student writing. These include analyzing in detail how an author's ideas or claims are developed and refined by particular sentences, paragraphs, or larger portions of a text (Reading Standard 5) and evaluating the claims, reasoning, and evidence of authors' arguments (Reading Standard 8) to understand the art of developing arguments and employing rhetoric to advance a particular purpose. Panelists stressed the importance (while noting that such instruction could be time consuming) of grasping authors' points of view (Reading Standard 6) and evaluating content presented in diverse formats and media (Reading Standard 7) to understanding political discourse and preparing for active civic engagement (e.g., voting, serving on a jury, campaigning, lobbying, testifying at hearings, demonstrating, petitioning), as well as making sound decisions as consumers.

David Coleman, one of the lead writers of the Common Core State Standards (CCSS) for ELA/literacy, made a single recommendation: that the panel reconsider and select the standards pertaining to reading and comprehending the United States Founding Documents and the Great Conversation that followed. While the panel was not unanimously in favor of including these standards as a backbone for the adult education standards, a majority of the panel saw the wisdom of the recommendations. In choosing these standards (Reading Standard 9 in both grades 9–10 and 11–12), panelists cited four reasons:

1. They are practical and educationally powerful, ensuring rigor and quality in terms of what students will be asked to read. Being able to handle informational texts of this nature is a strong predictor of college and career readiness and prepares students for a wide range of reading challenges. By requiring these documents alone, adult education instructors can be assured that they will be dealing with texts of sufficient rigor to meet the standards.

2. Overall, they invite careful and close analysis, making them ideal for instruction and for assessment. They are brief enough to be ideal for classroom use and typically can be excerpted beautifully for assessment use because of the density and repetition of ideas.

3. They ensure that adults will be ready for citizenship. Grasping the import of these works reflects an understanding of and commitment to participating in the civic life of the country. It is striking how much political conversation in the United States returns to the Founding Documents and the Great Conversation that they continue to generate. They are essential for participation in public discourse and being an informed citizen.

4. They provide important signals to the broader public that the selected standards for adult education are of high quality.

Several standards were not selected for inclusion, such as analyzing how complex characters develop and interact with other characters and analyzing the impact of the author's choices on developing and relating elements of a story. Panelists indicated that the former was too literature-focused and the latter focused more on analyzing the author's craft and style, rather than the text content. Both were viewed as much less critical than other comprehension standards. Panelists also decided not to select analyzing 18th-, 19th- and early-20th-century foundational works of American literature. Since adult students have limited time, panelists determined that a literature genre study should not be a priority. This standard also was rated very low by college faculty on the EPIC survey.

Stakeholders also made suggestions about other skills they believed students need to be prepared for college and other training beyond the CCSS for ELA/literacy, including study skills, test-taking skills, taking notes in class, and others. While states and programs have the autonomy to add content to the CCSS, this project was limited to selecting from only the CCSS for ELA/literacy those standards that are relevant and important for adult education, thus panelists did not add these skills.

Rationales for Selecting Writing Standards

While panelists gave narrative writing (Writing Standard 3) prominence in the beginning levels of adult education, by the time students reach Levels D or E, narrative writing gives way to writing arguments (Writing Standard 1), writing to inform and explain (Writing Standard 2), and writing to sources (Writing Standard 9). Several stakeholders wondered why the narrative writing standard had not been selected up through high school. As panelists noted, writing arguments and writing to inform and explain have enormous relevance in the workplace; writing narratives do not. Their decisions were supported by overpowering data from college faculty and employers about the importance of expository writing—almost all faculty in the EPIC survey rated these as more or most important.[25]

The panel's selections require students not only to show that they can analyze and synthesize sources, but also to present careful analyses, well-defended claims, and clear information in their writing (Writing Standards 4 and 5). Again, almost all of the data included in the reference documents rated these standards as important. Panelists also included a standard requiring students to produce, present, and exchange information using technology, including the Internet (Writing Standard 6). Employers specifically noted the importance of students' ability to retrieve, access, and evaluate digital sources of information and use technology to organize, share information, and give and receive feedback. Finally, panelists selected the three CCSS research standards—short, focused projects that include gathering, synthesizing, and drawing evidence from texts—citing them as commonly required in the workplace and important in much college instruction that asks students routinely to develop answers to questions (Writing Standards 7–9). Both the college faculty survey and the employer survey gave high marks to this content. While panel members expressed some concerns about the amount of time that could be devoted to research in adult education classes, on balance they recommended that this standard was worth the time and could easily be integrated with other standards.

Panelists declined to select Writing Standard 10, which calls for routine writing, stating that it was more an instructional strategy than a standard.

Rationales for Selecting Speaking and Listening Standards

Panelists cited the ability to work effectively in collaborative teamwork settings and articulate one's thoughts and ideas clearly and coherently (Speaking and Listening Standard 1) as critical to college and work. Data from the employer survey stressed the value of collaborating effectively with diverse people from different backgrounds

[25] Data from surveys of college faculty and employers show that they rate narrative writing as unimportant compared with other standards, so panelists chose not to extend narrative writing in its final analysis.

as a critical skill. Panelists also argued that articulating ideas and information orally with precision and coherence (Speaking and Listening Standard 4) is a skill students need in college or at work. Indeed, both employers and college faculty cite the ability to articulate thoughts and ideas clearly and coherently (orally and in writing) as key on their respective surveys.

Though Standard 7 in reading covers the integration and evaluation of information presented in diverse media, panelists chose to include a similar standard (Speaking and Listening Standard 2) from the Speaking and Listening domains. Panelists noted that, now more than ever, students live in and through the media culture surrounding them. Sound and moving images inform, entertain, and persuade in ways distinct from the printed word alone. Students need to learn to integrate and evaluate information obtained via non-print media. Employers also rate this as an essential skill.

Panelists deliberated about whether or not to include evaluating a speaker's point of view, reasoning, and use of evidence (Speaking and Listening Standard 3), as college faculty did not rate it as highly as they did others. Employers, on the other hand, included accurately interpreting conflicting points of view as an essential skill. Panelists stressed its importance to understanding political and policy discourse, ultimately deciding to include the standard.

Likewise, data were split on whether it was important for students to know how to make strategic use of digital media and visual displays to express information and enhance understanding (Speaking and Listening Standard 5). Employers cited this skill as key, while college faculty rated it as much less important. Panelists sided with employers, citing the rise of media and technology in every aspect of our lives and suggesting that a sophisticated workforce must be able to adapt continuously to new media and technology and to use the most appropriate media tools.

Panelists also selected Speaking and Listening Standard 6, requiring students to use formal English (and directly connected to the Language Standards) in their speaking as a college and career readiness skill. All references cited this as important.

Rationales for Selecting Language Standards

Panelists underscored the importance of students' use of formal English in writing and speaking when appropriate (Language Standards 1–3). All references cited this as valuable. Likewise, panelists included a progression of vocabulary standards (Language Standards 4 and 6) with a focus on academic vocabulary from the earliest levels of adult learning, citing vocabulary as a key component of reading comprehension. College faculty rated this standard as extremely important.

The only vocabulary standard the panel did not select is that addressing students' understanding of figurative language, in part because this standard rated very low on faculty surveys.

Rationales for the Selection of Standards for Mathematics by Conceptual Category

An important goal in selecting the mathematics standards was keeping the overall content demands manageable, while at the same time making sure core college and career readiness requirements for adult learners were represented. A suggestion made by one stakeholder and endorsed by the CCSS writers was to narrow the K–6 selections further, partly because of adult students' time constraints, but also because most adult students typically arrive at mathematics classes with some conceptual understanding of numbers and quantity. By focusing on "key takeaways" for grades K–5 (a subset of standards representing progress towards mastering algebra) and the major work of each grade indentified in the *K–8 Publishers' Criteria for the Common Core State Standards for Mathematics* (NGA 2012), the panel was able to increase the focus on critical areas of mathematics and reduce the number of standards required in Levels A and B.

Levels C and D (CCSS requirements for grades 4 through 8) represent the bulk of the adult learning requirements (89 percent of the total number of standards for these grade levels were selected). The standards not selected were omitted primarily because they were too specific, redundant, subsumed by other standards, or handled sufficiently in an earlier level. For example, 6.G.2 was not selected because the strategy for finding volume required in the standard was too specific; 4.MD.4 was not selected because it was subsumed by 5.MD.2; and 5.G.4 was not selected because categorization of two-dimensional figures is already covered in Level B.

Panelists selected 42 (or about 31 percent) of the remaining 136 high school standards as requirements for adult learners, drawing most of them from the domains of algebra (17) and functions (13). These selections were based largely on the knowledge and skills needed to succeed on high-stakes assessments, such as the Partnership for Assessment of Readiness for College and Careers (PARCC) Draft Model Content Framework for Mathematics; the new GED® Program Assessment Targets; ACCUPLACER Sample Questions for Students; COMPASS Sample Test Questions and Guide for Students and Parents; and Standards for Introductory College Mathematics Before Calculus—Crossroads in Mathematics, as defined by the American Mathematical Association of Two-Year Colleges (ACT 2011; American Council on Education n.d.; PARCC 2012; AMATYC 1995; College Board 2011).

Rationales for Selecting the Standards for Mathematical Practice

Panelists selected all eight of the Standards for Mathematical Practice. Stakeholders agreed strongly with the emphasis on the Standards for Mathematical Practice and, in fact, encouraged including more detail about each one—a recommendation accepted by panelists.

Rationales for Selecting Number Sense and Operations Standards

Panelists heeded the message of the *ACT National Curriculum Survey* that put rational number calculations as a top priority in K–12 education. Therefore, standards emphasizing number sense and operations comprise the largest majority (41 percent) of standards selected for adult education. They span the five levels (A–E) with increasing number, intensity, and complexity as they progress from Level A to Level D. In addition to the many number sense standards (NBT for grades 1–5 and NS for grades 6–8), fractions (NF for grades 3–5), and ratio/proportion (RP for grades 6–7) standards selected, 10 additional standards were selected in Operations and Algebraic Thinking (OA for grades 1–5). They provide the basis for deep understanding of the properties of numbers and operations performed with them, in addition to fluency with most of those operations.

Examples of these operations standards include 1.OS.4 (Understand subtraction as an unknown-addend problem); 2.AO.2 (Fluently add and subtract within 20 using mental strategies); 3.OA.5 (Apply properties of operations as strategies to multiply and divide); and 5.OA.1 (Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols). Proficiency in the requirements of Level D ensures that students will have the ability to compute with all four operations using all forms of rational numbers, fractions, decimals, and percentages, as well as being able to engage in extensive proportional reasoning. Specifically, the writers recommended adding 7.NS.3 since “arithmetic with rational numbers was the #1 top-rated skill in the *ACT National Curriculum Survey*.” Panelists agreed. In addition, proficient numerical reasoning is important for success in algebraic operations with expressions and solving basic equations and application problems in Levels C and D.

The panel selected only a few Number and Quantity standards from high school (Level E), since at that level the focus moves away from operating with rational numbers. Most of those number standards emphasize operations with radicals and irrational numbers (N.RN.1 to N.RN.3), quantities used in descriptive modeling (N.Q.2), complex numbers (N.CN.1 to N.CN.9), and numbers represented as vectors or matrices (N.VM.1 to N.VM.12). Many of those are Science, Technology, Engineering, and Mathematics (STEM) related content and go beyond what is needed for college and career preparation for all students. In fact, there are more

STEM-related standards (23) identified in Number and Quantity than in any other conceptual category.

Rationales for Selecting Algebra and Functions Standards

In response to data from college faculty and employers, panelists emphasized algebraic thinking, the second largest number of selected standards. In fact, algebraic thinking is found throughout the domains, beginning with a conceptual understanding of the variable in Level A to assumed use of expressions, equations, inequalities, formulas, graphs, tables, and distributions in Levels C, D, and E. The panel selected nearly all CCSS related to algebra and functions for grades 1 through 8 for core adult education requirements. Those few not selected were considered either too specific (e.g., 8.EE.6, describing a specific strategy for deriving slope) or were subsumed by a standard at a higher level. For example, 8.F.2 is redundant to F.IF.9. Both include a key idea, i.e., comparing functions represented in different ways. Both relate well to Mathematical Practices 2 and 4 and are identified in assessment targets for the new GED®, making the content important to include. The requirements of this standard, however, are more appropriately addressed at Level E.

In considering which content should be selected, understanding and representing solutions to systems of equations rather than systems of inequalities was emphasized. Most of the non-selected algebra and functions standards were identified as STEM in the CCSS[26] and thus beyond the scope of core requirements for adult learners.

In other cases, suggestions from the principal writers for the CCSS mathematics standards and data from postsecondary instructors were pivotal. Standards identified as a low priority in the survey of postsecondary instructors usually were not selected. For example, A.SSE.1 and A.SSE.1a, which require interpretation of expressions and their parts, were rated as “more or most important” as prerequisite knowledge by 83 and 79 percent respectively of respondents. These were selected as part of the core standards for adult learners. On the other hand, only 42 and 50 percent of postsecondary faculty rated A.APR.4 (Prove polynomial identities…) and A.APR.5 (Know and apply the Binomial Theorem…) as important, and neither was selected by the panel.

Occasionally when a standard had two or more sub-parts, not every part was selected. Sometimes just the stem standard was selected, and at other times just one or more of

[26] These include such topics as binomial expansion (A.APR.5), operations with rational expressions (A.APR.6), matrices (A.APR.8 and A.APR.9), rational function graphs (F.IF.7d), function composition (F.BF.1c, F.BF.4b), inverse functions (F.BF.4c, F.BF.4d, and F.BF.5), trigonometric functions (F.TF.1 to F.TF.9, G.SRT.9 to G.SRT.11), advanced constructions (G.C.4), conic sections (G.GPE.3), Cavalieri’s proof of volume (G.GMD.2), and advanced statistical analysis (S.CP.8, S.CP.9, S.MD.1 to S.MD.5a, S.MD.6, and S.MD.7).

sub-standards was selected, but not the stem. The rationale always was based on the best choice for adult learners and their specific needs. Following are some examples and the reasoning:

- F.LE.1, 1b, and 1c were selected (distinguishing between linear and exponential functions). However, F.LE.1a (Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals) was not selected because panelists determined that requiring formal proofs of these factors was not judged to be essential to college and career readiness; it will not be included on the new GED® and does not appear on typical college placement tests.

- F.IF.7 was selected because graphs are an important way to represent function solutions (Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases).The very specific sub-standard (F.IF.7a) was not selected, however, since it could be seen as limiting the graphing requirement to only linear and quadratic and is covered by the more general F.IF.7. In addition, in the case of F.IF.7b through F.IF.7d, not all functions listed were considered necessary and appropriate for adult learners, and some are time consuming to teach. While it was agreed that, at minimum, all students should have a deep understanding of linear, quadratic, and exponential functions, panelists' opinions differed with respect to which of the other functions should be addressed. They agreed that adult educators should select the appropriate functions from the following list to meet the needs of their individual students: square root, cube root, step, piecewise, absolute value, higher-order polynomial, rational, and logarithmic.

- A.SSE.1 and A.SSE.1a both were selected (interpreting expressions and the meaning of their parts in a context), but A.SSE.1b (Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)^n as the product of P and a factor not depending on P) was not. Panelists agreed that the requirement in 1b was more specific than necessary and that the concept was already well covered by Standard 1 and 1a.

Rationales for Selecting Geometry and Measurement Standards

Selections from the Geometry domains and related Measurement and Data domains addressing spatial reasoning and measurement using figures in two and three dimensions span the five levels. While panelists agreed that adult learners must be required both to know and use formulas for area and linear measures (e.g., 7.G.4, area and circumference of a circle), they did not consider memorization of volume formulas to be imperative. Panelists agreed, however, that being able to apply volume formulas was important, as demonstrated in their selection of 5.MD.3 through 5.MD.5. Both address an understanding of volume and applications using volume formulas for right rectangular prisms. Continuing with that line of reasoning, G.GMD.3 was selected (Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems) in lieu of 8.G.9 (Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems). The high school standard subsumes 8.G.9, as it requires understanding and using volume formulas for pyramids in addition to cones, cylinders, and spheres, whereas 8.G.9 implies only memorization of the mathematical formulas.

Several standards requiring transformations (translations, reflections, rotations, dilations) were also selected, with a focus on important concepts of congruence and similarity (8.G.2 and 8.G.4). However, 8.G.1 (requiring transformation experimentation) and 8.G.3 (requiring that students describe the effect of transformations) were not considered central enough to the concepts of congruence and similarity.

Rather than requiring formal proof (e.g., G.CO.9 through G.CO.11), panelists agreed that more informal reasoning—constructing viable arguments and evaluating the reasoning of others—was more important as a core requirement for adult learners. For this reason, 8.G.5 (Use informal arguments to establish facts about…) and G.SRT.5 (Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures) both were selected.

Formal construction also was downplayed in the selected standards, since it takes time and specialized tools, with little pay-off for most adult students. For this reason, neither G.CO.12 (Make formal geometric constructions with a variety of tools and methods…) nor G.CO.13 (Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle) were selected. This content is picked up in more expert training for professional drafters or industrial or architectural engineering. Standards requiring students more informally to "draw" a geometric figure—particularly on a coordinate plane, such as 4.G.1 (Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines…) and 6.G.3 (Draw polygons in the coordinate plane…) were selected.

Based on suggestions from the CCSS mathematics writers and the postsecondary faculty survey, G.MG.2 (Apply concepts of density based on area and volume in modeling situations…) was added to the selections in the final round. While panelists did not originally select this standard, they agreed that this concept would provide adult learners with relevant opportunities to apply ratio and proportional reasoning.

Rationales for Selecting Data, Statistics and Probability Standards

The national trend emphasizing data-driven mathematics in K–12 education is reflected in the selection of nearly all CCSS standards in Measurement and Data (MD) for grades 1 through 5 that are related to the collection, organization, display, and interpretation of data. These complement and progress to the CCSS requirements in Statistics and Probability (SP) for grades 6 through 12. While some MD standards overlap with geometry, there is at least one in each grade level (grades 1–5) relating to the collection, organization, display, and interpretation of data. Panelists selected all of those standards except one (4.MD.4, which is subsumed by the Level C standard 5.MD.2). In the selected CCSS, the number of Statistics and Probability standards gradually increases with the progression from Level A to D, with more than half of all selected data-related standards falling in Level D.

Panelists considered some conflicting recommendations from the postsecondary survey and the CCSS writers, such as those received about S.ID.5 (Summarize categorical data for two categories in two-way frequency tables…) and S.ID.9 (Distinguish between correlation and causation). While multiple stakeholders suggested that S.ID.5 be deleted from the selections, describing it as "not essential to understanding needed statistical concepts that follow," 64 percent of postsecondary survey respondents indicated the content of S.ID.5 was a prerequisite to their course, and the PARCC Frameworks have this as a first priority. In addition, this high school standard shows a progression from concepts in selected standards from grades 7 and 8 that address an understanding of frequency and two-way tables (7.SP.6, 7.SP.7, 7.SP.7b, and 8.SP.4). For these reasons panelists selected this standard. With regard to S.ID.9, while only 3.4 percent of faculty believed that students must be able to distinguish correlation from causation, the CCSS writers believed (and panelists agreed) that this concept was crucially important in our data-driven world.

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APPENDIX D

UNDERSTANDING TEXT COMPLEXITY

The notion of text complexity is central for understanding and implementing the changes called for in the Common Core State Standards (CCSS). Once the standards are adopted, educators must grasp the importance of students being able to read complex text. For that reason, panelists and stakeholders asked for a full explanation of text complexity. The *Supplemental Information for Appendix A of the Common Core State Standards for English Language Arts and Literacy: New Research on Text Complexity* (NGA n.d.) addresses new research and resources supporting text complexity. Much of the information on text complexity found below—what it is, why it is important, and how to determine it—was drawn from this report.

In 2006, ACT, Inc., released research called *Reading Between the Lines* that demonstrated that the greatest predictor of success in college and careers is not a graduate's SAT scores, GPA, or even their critical thinking skills, but rather the ability to read complex text. A growing body of similar research also supports this theory of text complexity as an important indicator of reading success.[27] Yet the alarming fact is that, over the past 50 years, the complexity of texts students read in their classes has eroded significantly—whereas the reading demands of college, careers, and citizenship have not. The average student graduates roughly four grade levels behind where they need to be to succeed in the 21st century knowledge economy, which puts a premium on the ability to read complex text (Williamson 2006).

The standards address this challenge by insisting that students be exposed regularly to appropriately complex literary and informational text, both in the classroom and on assessments. This finds expression in Reading Standard 10, which specifies a staircase of increasing text complexity for students to master from beginning through adult secondary levels. Standard 10 is to be used together with level-specific standards (Reading Standards 1–9) requiring increasing sophistication in students' reading comprehension ability.

Choosing rich text worthy of reading and rereading is an important first step in CCSS-aligned instruction. The process of determining text complexity is illuminating

[27] Much of the work by the CCSS writers in text complexity was heavily influenced by Marilyn Jager Adams's painstaking review of the relevant literature (Adams 2009).

for instructors, as it replaces intuition with concrete data and a systematic investigation of the text.

The CCSS defines a three-part model—embraced by the panel—for determining how easy or difficult a particular text is to read, as well as specifications for increasing text complexity as students move up the levels:

1. **Quantitative dimensions of text complexity.** The terms *quantitative dimensions* and *quantitative factors* refer to those aspects of text complexity, such as word length or frequency, sentence length, and text cohesion, that are difficult if not impossible for a human reader to evaluate efficiently, especially in long texts, and are thus typically measured by computer software.

2. **Qualitative dimensions of text complexity.** The terms *qualitative dimension*s and *qualitative factors* refer to those aspects of text complexity best measured or only measurable by an attentive human reader, such as levels of meaning or purpose, structure, language conventionality and clarity, and knowledge demands.

3. **Reader and task considerations.** While the quantitative and qualitative measures focus on the inherent complexity of the text, the CCSS model expects educators to use professional judgment to identify texts that are well-matched to specific tasks or students, such as skilled readers or those with high interest in the content of the text.

Each tool described above—quantitative and qualitative—has its limitations, and none is completely accurate. However, in the following instances of selecting texts at specific grade levels, qualitative and quantitative measures can be used together, complementing one another:

1. It is recommended that educators first use *quantitative measures* to locate a text within a band level because they measure dimensions of text complexity that are challenging for individuals to evaluate when reviewing a text.

2. Once a text is located within a band by using quantitative measures, educators should use *qualitative measures* to determine other important aspects of texts and position a text at the high, middle, or low end of a grade band.

Certain measures are less valid or not applicable for specific kinds of texts. Until quantitative tools for capturing the difficulty of poetry and drama are developed, determining whether a poem or play is appropriately complex for a given grade or grade band necessarily will be a matter of professional judgment using only the qualitative characteristics of texts.

APPENDIX E

PREPARING STUDENTS FOR SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS

The high school Common Core State Standards (CCSS) specify the mathematics all students should study to be ready for college and career. While the CCSS do not attempt to define a complete advanced mathematics curriculum, they offer a complement of standards that go beyond the typical core mathematics curriculum for high school and are related to Science, Technology, Engineering, and Mathematics (STEM) fields. Specifically, these standards outline mathematics knowledge needed to be successful in advanced courses such as calculus, advanced statistics, or discrete mathematics. They are identified in the CCSS by a (+) symbol. While panelists did not select any of the 54 STEM standards (as they are beyond the core requirements for K–12 students and likewise for adult learners), adult educators preparing students for college studies or careers with a high need for advanced mathematics ability should have a clear picture of students' goals when preparing their curriculum.

A wide variety of jobs requires the use of scientific and mathematical thinking, including work in laboratory settings and the social sciences and jobs requiring a high level of precision. STEM occupations include:

- Laboratory scientist – Biologist, Geologist, Physicist, Chemist, Ecologist, etc.
- Mathematician – Actuary, Research Analyst, Statistician, etc.
- Engineer – Civil, Industrial/Architectural, Agricultural, Bio-Chemical, Electronic, Aerospace, Environmental, Draftsman, Cartographer, etc.
- Technician – Computer/Technology, Software Designer, Support Specialist, etc.

Workers in STEM occupations rely on science and math and use technology in the workplace to engineer solutions to complex problems. While the educational requirements for STEM occupations range from a high school diploma to on-the-job training to higher degrees, all require the ability to think logically (Terrell 2007).

Although none of the STEM-related standards (identified by a +) was selected for the core adult learning standards, they will be appropriate for students with high interest in STEM studies or careers. For example, actuaries would need extensive study in probability and statistical analysis (e.g., S.CP.8-9 and S.MD.1-7); an aerospace engineer would need to be familiar with conic sections (e.g., G.GPE.3); an architectural engineer would need more study of trigonometry (e.g., F.TF.3-9); a physicist must grasp vectors (e.g., N.VM.1-12); and an industrial draftsman would need more knowledge of advanced geometric constructions (e.g., G.C.4).

The following table shows the 54 CCSS identified as STEM-related by conceptual category and domain:

Number and Quantity
The Complex Number System
N.CN.3 (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.
N.CN.4 (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.
N.CN.5 (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. *For example,* $(-1 + \sqrt{3}\, i)^3 = 8$ *because* $(-1 + \sqrt{3}\, i)$ *has modulus* 2 *and argument* 120°.
N.CN.6 (+) Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.
N.CN.8 (+) Extend polynomial identities to the complex numbers. *For example, rewrite* $x^2 + 4$ *as* $(x + 2i)(x - 2i)$.
N.CN.9 (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
Vector and Matrix Quantities
N.VM.1 (+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., $\boldsymbol{v}$, $\lvert\boldsymbol{v}\rvert$, $\lVert\boldsymbol{v}\rVert$, v).
N.VM.2 (+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.
N.VM.3 (+) Solve problems involving velocity and other quantities that can be represented by vectors.
N.VM.4 (+) Add and subtract vectors.
N.VM.4a (+) Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.
N.VM.4b (+) Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.
N.VM.4c (+) Understand vector subtraction $\boldsymbol{v} - \boldsymbol{w}$ as $\boldsymbol{v} + (-\boldsymbol{w})$, where $-\boldsymbol{w}$ is the additive inverse of $\boldsymbol{w}$, with the same magnitude as $\boldsymbol{w}$ and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.

N.VM.5 (+) Multiply a vector by a scalar.
N.VM.5a (+) Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(v_x, v_y) = (cv_x, cv_y)$.
N.VM.5b (+) Compute the magnitude of a scalar multiple $c\mathbf{v}$ using $\|c\mathbf{v}\| = \|c\|v$. Compute the direction of $c\mathbf{v}$ knowing that when $\|c\|v \neq 0$, the direction of $c\mathbf{v}$ is either along $\mathbf{v}$ (for $c > 0$) or against $\mathbf{v}$ (for $c < 0$).
N.VM.6 (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.
N.VM.7 (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.
N.VM.8 (+) Add, subtract, and multiply matrices of appropriate dimensions.
N.VM.9 (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.
N.VM.10 (+) Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.
N.VM.11 (+) Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors.
N.VM.12 (+) Work with 2 × 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.
Algebra
Arithmetic with Polynomials and Rational Expressions
A.APR.5 (+) Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.
A.APR.7 (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.
Reasoning with Equations and Inequalities
A.REI.8 (+) Represent a system of linear equations as a single matrix equation in a vector variable.
A.REI.9 (+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater).
Functions
Interpreting Functions
F.IF.7d (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
Building Functions
F.BF.1c (+) Compose functions. *For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.*

F.BF.4b (+) Verify by composition that one function is the inverse of another.
F.BF.4c (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.
F.BF.4d (+) Produce an invertible function from a non-invertible function by restricting the domain.
F.BF.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
Trigonometric Functions
F.TF.3 (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi-x$, $\pi+x$, and $2\pi-x$ in terms of their values for x, where x is any real number.
F.TF.4 (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
F.TF.6 (+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.
F.TF.7 (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.
F.TF.9 (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.
Geometry
Similarity, Right Triangles, and Trigonometry
G.SRT.9 (+) Derive the formula $A = 1/2\ ab \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
G.SRT.10 (+) Prove the Laws of Sines and Cosines and use them to solve problems.
G.SRT.11 (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).
Circles
G.C.4 (+) Construct a tangent line from a point outside a given circle to the circle.
Expressing Geometric Properties with Equations
G.GPE.3 (+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.
Geometric Measurement and Dimension
G.GMD.2 (+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.
Statistics and Probability
Conditional Probability and the Rules of Probability
S.CP.8 (+) Apply the general Multiplication Rule in a uniform probability model, $P(A \text{ and } B) = P(A)P(B\|A) = P(B)P(A\|B)$, and interpret the answer in terms of the model.

S.CP.9 (+) Use permutations and combinations to compute probabilities of compound events and solve problems.
Using Probability to Make Decisions
S.MD.1 (+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.
S.MD.2 (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
S.MD.3 (+) Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. *For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.*
S.MD.4 (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. *For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?*
S.MD.5 (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.
S.MD.5a (+) Find the expected payoff for a game of chance. *For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.*
S.MD.6 (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
S.MD.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

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APPENDIX F BIOGRAPHICAL SUMMARIES

Project Lead and Author, *College and Career Readiness Standards for Adult Education*

Susan Pimentel
President, Susan Pimentel, Inc., Hanover, NH

Susan Pimentel is president of Susan Pimentel, Inc. and a founding partner of Student Achievement Partners, a nonprofit devoted to accelerating student achievement of all students by supporting effective and innovative implementation of the Common Core State Standards (CCSS). Before her work as the lead writer of the Common Core for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects (ELA/literacy), Ms. Pimentel was a chief architect of the American Diploma Project Benchmarks designed to close the gap between high school demands and postsecondary expectations. She has more than 30 years of experience in working on standards-based education reform. Ms. Pimentel recently guided a 14-state working group in creating curriculum, improving instruction, and enhancing learner outcomes for the U.S. Department of Education's (ED's) Adult Education Content Standards Warehouse project. As lead content developer, coach, and trainer for ED's *Standards-In-Action* initiative, she developed a series of standards-based education innovations for adult education that have been implemented by 15 state teams. Since 2007, Ms. Pimentel has served on the National Assessment Governing Board, an independent, bipartisan board that sets policy for the national assessment of education progress, and she currently serves as the Board's vice-chairman. She holds a J.D. and a B.S. in early childhood education, both from Cornell University.

Mathematics Facilitators

Melanie (Mimi) Alkire
Educational Consultant and Principal, Alkire Consulting, Bend, OR

Melanie Alkire is an educational consultant and principal at Alkire Consulting in Bend, OR. Currently she is working with Achieve, Inc. on the alignment of standards for states and districts with the American Diploma Project Benchmarks and the CCSS. She serves as assistant examiner for Higher Level Mathematics with International Baccalaureate Americas. Ms. Alkire was a secondary math teacher with the Portland Public Schools for more than 30 years. She holds an A.B. in mathematics/education from Northwest Nazarene University and an M.A.T. from Lewis and Clark College.

Francis (Skip) Fennell
L. Stanley Bowlsbey Professor of Education and Graduate and Professional Studies and Project Director, Elementary Mathematics Specialists and Teacher Leaders Project, McDaniel College, Westminster, MD

Francis Fennell is a mathematics educator with experience as a classroom teacher, school principal, and supervisor of instruction. Dr. Fennell is presently the L. Stanley Bowlsbey Professor of Education and Graduate and Professional Studies at McDaniel College in Westminster, MD, where he directs the Brookhill Foundation supported Elementary Mathematics Specialists and Teacher Leaders project. He is a recent past president of the National Council of Teachers of Mathematics (NCTM). Dr. Fennell is widely published in professional journals and textbooks related to elementary and middle-grade mathematics education, and he has authored chapters in yearbooks and resource books published by NCTM. He was a member of the writing teams for NCTM's Principles and Standards for School Mathematics (2000) and Curriculum Focal Points (2006) and the Common Core State Standards (2010). Dr. Fennell also served as a member of the National Mathematics Advisory Panel from May 2006–April 2008 and has received numerous awards in the areas of mathematics and teacher education, including NCTM's Lifetime Achievement Award (2012). He holds a Ph.D. in mathematics education from the Pennsylvania State University.

ELA/Literacy Panel Members

Robert Curry
Associate Professor and Chair of English and Humanities, Alfred State, State University of New York (SUNY) College of Technology, Alfred, NY

Robert Curry is associate professor and chair of English and Humanities at Alfred State, SUNY College of Technology, where he directs the freshman writing program, overseeing course and program development and assessment; instructor hiring, training, and mentoring; and student writing placement and exit assessments. In 2011, Dr. Curry was selected by the New York State Education Department to serve as the state's higher education representative for the 22-state Partnership for Assessment of Readiness for College and Careers (PARCC) consortium's work to develop new K–12 English language arts (ELA) assessments based on the CCSS, work he continues as a member of PARCC's ELA Core Leadership Item Review Team. He serves in a similar role for the New York State Regents' work in developing assessments and instructional support for the CCSS. He also served as a consultant to the GED® Testing Service, assisting its efforts to redesign the GED® to reflect CCSS priorities. Dr. Curry holds a Ph.D. in English from the University of Connecticut.

Mary Beth Curtis
Director, Center for Special Education, Lesley University, Cambridge, MA

Mary Beth Curtis is professor of education and founding director of the Center for Special Education at Lesley University. Dr. Curtis is also founding director of the Boys Town Reading Center in Nebraska. Before joining Boys Town USA in 1990, she was associate professor of education at the Harvard Graduate School of Education and associate director of the Harvard Reading Laboratory. Dr. Curtis is the lead author of the U.S. Department of Education, Office of Vocational and Adult Education's (OVAE's) STAR (Student Achievement in Reading) Tool Kit, and she leads program evaluation activities for the National STAR Training Network. She served as a subject matter expert for another OVAE teacher quality initiative, *Teaching Excellence in Adult Literacy (TEAL)*. Dr. Curtis earned her Ph.D. in psychology at the University of Pittsburgh and completed postdoctoral work at the Learning Research and Development Center in Pittsburgh, PA.

Margo Gottlieb
Lead Developer, World-Class Instructional Design and Assessment Consortium, Wisconsin Center for Education Research, University of Wisconsin-Madison and Director, Assessment and Evaluation, Illinois Resource Center, Arlington Heights, IL

Margo Gottlieb is a national expert in assessment design for English language learners and has spearheaded the creation of language development standards in pre-K–12 educational settings. For the past several decades, Dr. Gottlieb has consulted for and provided technical assistance to governments, states, school districts, publishers, universities, and professional organizations. She is currently co-editing a series of six books on *Academic Language in Diverse Classrooms* (2013) for English language arts and mathematics. Her latest books include *Common Language Assessment for English Learners* (2012), *Paper to Practice: Using the TESOL English Language Proficiency Standards in PreK–12 Classrooms* (2009, with A. Katz & G. Ernst-Slavit), *Assessment and Accountability in Language Education Programs* (2007, with D. Nguyen) and *Assessing English Language Learners: Bridges from Language Proficiency to Academic Achievement* (2006). Dr. Gottlieb holds an M.A. in applied linguistics and a Ph.D. in public policy analysis, evaluation research and program design.

Lisa Hertzog
Executive Director of Academic Support, New York City Department of Education, District 79 Alternative Schools and Programs, New York, NY

Lisa Hertzog is the executive director of academic support for the New York City Department of Education District 79 Alternative Schools and Programs. Dr. Hertzog has led district initiatives on establishing standards for teaching performance, developed curriculum for over-age and under-credited students in secondary school settings, and led professional development for instructional leaders. In collaboration with the American Council on Education and MDRC, her current work involves piloting an accelerated learning program to prepare New York City GED® students for the Next Generation GED®. Before joining District 79, Dr. Hertzog worked as a National Board Certified Spanish bilingual and ESL elementary teacher, adult English as a Second Language (ESL) instructor, and instructor at Teachers College, Columbia University. She holds an Ed.D. in curriculum and teaching in urban education from Teachers College.

Lorretta Holloway
Program Advisor and Associate Professor, Department of English, Framingham State University, Framingham, MA

Lorretta Holloway is associate professor of composition and Victorian literature at Framingham State University. Dr. Holloway serves as advisor to both undergraduate students in English and graduate students in the Master in Education, English concentration, program. She teaches a variety of English courses. After serving as an official reviewer of the CCSS for the Massachusetts Board of Education, Dr. Holloway was selected to represent the state's higher education community for the PARCC consortium's work on developing high school ELA assessments to measure college and career readiness. She lectures often in the community about college readiness, skills students should develop in middle and high school to be successful in college, expectations of college professors, and strategies parents can use to help their children become college and career ready. She also serves as an instructor to local high school students attending the College Tomorrow summer program. Dr. Holloway holds a Ph.D. in literature from the University of Kansas.

Meredith Liben
English Language Arts and Literacy Team Director, Student Achievement Partners, Liben Education Consulting, Hartland, VT

Meredith Liben is an educator with wide-ranging classroom and curricular experience in K–college. She provides a variety of consulting services related to teaching reading and standards-based education. Ms. Liben taught reading in the content areas to teachers in technical and career centers at Vermont Technical College and English to students at the regional high school career and technical education center until recently. Currently, she directs ELA and literacy activities at Student Achievement Partners, a group founded by the authors of the CCSS to offer support and guidance in implementing the CCSS. She also offers curriculum support, teacher training, and school start-up services to various school networks and education groups. Ms. Liben was a member of the CCSS ELA Working Group. She has degrees from Oberlin College, University of Massachusetts and City University of New York.

Jane Meyer
Coordinator, Canton City Schools, Adult Basic and Literacy Education, Canton, OH

Jane Meyer began her work at Adult Basic and Literacy Education (ABLE) in 1990 as a volunteer tutor and served as a family literacy teacher and Even Start facilitator. She is currently the ABLE coordinator for Canton City Schools. Under her direction, the Canton ABLE program has earned several state and national awards. Ms. Meyer was a member of the National Institute for Literacy (NIFL) Reading Research Working Group. She participated on NIFL's design team to develop reading training for family literacy programs based on scientifically-based reading research and Equipped for the Future. Ms. Meyer has served the STAR project in many roles, including as a member of the national STAR planning team, STAR Tool Kit developer, trainer, and technical assistance coach, and administrator of a local STAR pilot program. She is currently a reviewer for the Literacy Information and Communication System (LINCS) Resource Collection and a LINCS National Trainer. Ms. Meyer has a master's degree in curriculum and supervision from Miami University in Ohio.

Jane Roy
Adjunct Instructor, South Dakota State University, Brookings, SD

Jane Roy is an instructor at South Dakota State University where she teaches a graduate course on applied linguistics for teaching ESL and undergraduate courses on basic writing and advanced composition. Ms. Roy has eighteen years of experience in education working with low-income adults, non-native speakers of English, and first-generation college students. This experience includes program management, curriculum development, teacher training and support, and teaching ESL in the U.S. and overseas. Ms. Roy has developed and facilitated professional development workshops for state and national initiatives and served various organizations including the National Institute for Literacy. She has also contributed to the development of a number of language tests, including the *Best Plus* oral English proficiency assessment, for the Center for Applied Linguistics in Washington, DC. Ms. Roy holds a master's degree in teaching ESL from Georgetown University.

Barbara Van Horn
Co-Director, Institute for the Study of Adult Literacy and the Goodling Institute for Research in Family Literacy, College of Education, The Pennsylvania State University, University Park, PA

Barbara Van Horn is co-director of the Institute for the Study of Adult Literacy and the Goodling Institute for Research in Family Literacy. Her work focuses on adult learning and literacy in work and family contexts. In these areas, Ms. Van Horn has experience in designing and evaluating programs, curricula, and instructional materials for adult learners. Through the Institute for the Study of Adult Literacy, she and her staff have directed numerous state leadership initiatives for the Pennsylvania Department of Education's Division of Adult Education in the Bureau of Postsecondary Education. Currently, these projects provide assistance to the Division in developing career pathway programs for adults participating in adult basic education, managing and providing training on the use of the Division's online data management systems, and promoting teacher quality and standards-based instruction in partnership with Workforce Investment Act (WIA), Title II partners to achieve positive student outcomes. In 2011, the Institute was awarded direct service grants and has established Title II services in two WIA one-stop centers in an effort to build and integrate career pathway programs with other WIA services in these centers. From 2006–11, she directed the LINCS Workforce Competitiveness Resource Collection. She also works with the National Center for Family Literacy on research, professional development, and policy activities related to family literacy through the Goodling Institute. Early in her career, Ms. Van Horn taught high school English and reading, developmental reading and GED® preparation at a community college, and Adult Basic Education and GED® preparation at a community education center. She also developed and managed a library-based literacy program. Ms. Van Horn holds an M.Ed. in reading education.

Mathematics Panel Members

Gayle Box
Associate, Strategic Initiatives, Kentucky Adult Education, Kentucky Council on Postsecondary Education, Frankfort, KY

Gayle Box is an associate on the strategic initiatives team for Kentucky Adult Education. Before joining Kentucky Adult Education in 2007, she spent five years as the lead adult education instructor in Perry County. Ms. Box worked on the Kentucky Adult Education Standards for mathematics and was one of two state leads for Kentucky on the *Standards-in-Action* project. She served on the Council for Postsecondary Education Mathematics Committee, which was charged with reviewing drafts of the CCSS as they were presented to states for input. She is the adult education representative to the state Committee for Mathematics Achievement, which promotes coordination of professional development related to the CCSS for K–12, postsecondary, and adult education. Her current responsibilities include professional development and college readiness initiatives. Ms. Box holds degrees in education from Texas State University, and she spent 24 years teaching general music and choir in Texas public schools.

Donna Curry
Senior Professional Development Specialist, Tech Education Research Center (TERC), Cambridge, MA

Donna Curry has more than 30 years of experience in adult education as a teacher, program coordinator, and curriculum specialist. She has professional development expertise in the areas of adult numeracy, adult education standards, and workplace education integrating academic and interpersonal skills. Ms. Curry has participated in four national projects: *Standards-in-Action*, the *Equipped for the Future* standards initiative, the *Adult Numeracy Instruction Project*, and *Teachers Investigating Adult Numeracy*. For *Standards-in-Action*, she served as a coach, providing technical assistance to states on implementing adult education math standards in the classroom. Ms. Curry holds an M.Ed. in education from Augusta College (now Augusta State University).

Arthur Heinricher
Dean of Undergraduate Studies and Professor of Mathematical Sciences, Worcester Polytechnic Institute (WPI), Worcester, MA

Arthur Heinricher joined the faculty of WPI in 1992, and he teaches first- and second-year students. Dr. Heinricher has extensive experience in the pre-college area, including the "Mathematics in Industry Institutes for Teachers" and the "Focus on Mathematics Partnership" programs. He served as principal investigator for the Research Experiences for Undergraduates program in Industrial Mathematics and Statistics, which has brought college math students from across the nation to WPI in the summers. Dr. Heinricher holds a B.S. in applied mathematics from the University of Missouri-St. Louis and a Ph.D. in mathematics from Carnegie Mellon University.

Steve Hinds
Mathematics Curriculum Developer, City Colleges of Chicago, Chicago, IL

Steve Hinds has focused his work on teaching math, devising curricula, and conducting professional development projects, especially for programs that serve adults and students who have struggled to learn mathematics. Mr. Hinds recently began work developing curricula in the Adult Education Department at the City Colleges of Chicago. Prior to this, he was a curriculum developer at the Center for Elementary Mathematics and Science Education at the University of Chicago. Before moving to Chicago, Mr. Hinds spent seven years at The City University of New York where he led curriculum and professional development projects in a range of programs serving adult literacy, high school, and community college developmental math students. He began his career in education as a 9th-grade math teacher in New Haven, CT. Mr. Hinds has given talks and conducted workshops on mathematics education at conferences and professional development events across the country, and serves as a subject matter expert on various federally-sponsored panels devoted to improving adult numeracy teaching and learning. Mr. Hinds holds a B.A. in economics from the University of Illinois at Urbana-Champaign and an M.A. in sociology from the University of Warwick in England.

M. Joanne Kantner
Dean, Adult Education and Transition Programs, Kishwaukee College, Malta, IL

Joanne Kantner is dean of Adult Education and Transition Programs at Kishwaukee College. Previously, she was director of developmental education at Joliet Junior College (JJC). Before joining JJC, Dr. Kantner taught developmental mathematics for six years and coordinated special projects for Kishwaukee College. She has been involved in several organizational boards and working groups, including the U.S. Department of Education *Adult Education Partnership*, American Association for Adult and Continuing Education, Adults Learning Mathematics: International Research Forum, Adult Numeracy Network, NIFL, Association of Adult Literacy Professional Developers, Illinois Community College Board, Developmental Education Advisory Council for College and Career Readiness Standards, and Illinois Community College Board ABE-ASE Mathematics Standards. She has published widely and serves on the editorial boards of Adult Education Quarterly, Adult Learning, American Educational Research Journal, and Education Evaluation and Policy Analysis. Dr. Kantner holds a B.S. in theoretical mathematics and both an M.S.Ed. and Ed.D. in adult and higher education, with a focus on mathematics education.

Karen King
Former Director of Research, National Council of Teachers of Mathematics (NCTM) Reston, VA

Karen King is the former Director of Research for NCTM, the largest professional association of mathematics teachers in the world. Dr. King's research focused on urban mathematics reform, the mathematics preparation of elementary and secondary teachers, and policy related to mathematics teacher professional development. She has been principal investigator or co-principal investigator for grants from the National Science Foundation totaling more than $2 million. Dr. King has published numerous articles and book chapters and recently co-edited a book titled *Disrupting Tradition: Research and Practice Pathways in Mathematics Education*. She is a member of the writing team for the revision of The Mathematical Education of Teachers, which describes the mathematics teachers need to know and be able to do to adhere successfully to the CCSS in math. Dr. King has served as associate editor of the Journal for Research in Mathematics Education and was a member of the RAND Mathematics Study Panel, which made recommendations to the U.S. Department of Education about future research funding in mathematics education. She also serves on numerous committees focusing on research in mathematics education and teacher education with national organizations, including the Association of Mathematics Teacher Educators, the Benjamin Banneker Association, and the National Board for Professional Teaching Standards. Dr. King holds a Ph.D. from the University of Maryland.

Henry Kranendonk
Mathematics Specialist, Educational Opportunity Program, Marquette University; Retired Mathematics Curriculum Specialist, Milwaukee Public Schools, Milwaukee, WI

Henry Kranendonk was the Mathematics Curriculum Specialist for the Milwaukee Public Schools from 2002 to 2008. He is currently the Mathematics Specialist for the Marquette University Educational Opportunity Program. Mr. Kranendonk also is a supervising teacher for student teachers in mathematics and science at Marquette University and the University of Wisconsin-Milwaukee. He is involved in curriculum writing projects for various companies, including Texas Instruments. Mr. Kranendonk is co-principal investigator for the Milwaukee Mathematics Partnership, a project funded by the National Science Foundation. He has spent more than 37 years working with Milwaukee Public School students and teachers, initially as a mathematics and computer science teacher. Mr. Kranendonk's publications include high school mathematics textbooks, statistics books for professional development, and mathematics journal articles. He has served for more than 20 years as a computer science teacher leader and assistant examiner for the International Baccalaureate (IB) Program, having conducted IB workshops in the United States, Europe, and Africa. Mr. Kranendonk holds a B.A. in mathematics, physics, and education from Carroll College and an M.A. in mathematics from Marquette University.

Miriam Leiva
B. Cone Distinguished Professor Emerita, Professor of Mathematics Emerita, University of North Carolina Charlotte, Charlotte, NC

Miriam Leiva has been a teacher of mathematics at all levels for more than 35 years. Dr. Leiva is founding president of TODOS: Mathematics for ALL, a national organization committed to equity in mathematics education for all students. Currently she is editor of *Teaching for Excellence and Equity in Mathematics*, a TODOS journal that bridges research and practice. Dr. Leiva served as president of the North Carolina Council of Teachers of Mathematics and Director of Teacher Preparation at the National Science Foundation. Her work in mathematics education focuses on problem solving and communicating in the mathematics classroom and barriers presented by culture, language, and context. Much of her professional work reflects her experiences as an English Language Learner. Dr. Leiva has published in journals and books, edited and co-authored 11 NCTM books for teachers and is senior author for mathematics textbooks in secondary and elementary mathematics. She holds a Ph.D. in mathematics and mathematics education from Union Graduate School in consortium with the University of North Carolina.

Virginia (Ginny) Seltenright
Academic Support and Compliance Manager, Adult Education Services, Arizona Department of Education, Phoenix, AZ

Virginia (Ginny) Seltenright works in Adult Education at the Arizona Department of Education. Ms. Seltenright is the Academic Support and Compliance Manager and works with state funded adult education programs, providing technical assistance and monitoring contract compliance. She also helps design and facilitates teacher professional development. Ms. Seltenright serves on a team that is aligning the Arizona Adult Education Mathematics Standards to the CCSS. In 2010, Ms. Seltenright served on a team charged with revising the Arizona Adult Education Civics Standards; she led a pilot project that involved several adult education programs infusing civic learning and engagement into ESL and Adult Basic Education (ABE)/Adult Secondary Education (ASE) classes. She has also been a facilitator for Teachers Investigating Adult Numeracy in Arizona, training ABE/ASE teachers. Ms. Seltenright holds a B.A. in anthropology and an M.A. in Teaching English to Speakers of Other Languages (TESOL).

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APPENDIX G

STAKEHOLDERS AND THE COMMON CORE WRITERS

Stakeholders

Paul Baggett
Assistant Professor of English
South Dakota State University
Brookings, SD

Sue Barauski
Director
Adult Learning Resource Center/The Center: Resources for Teaching and Learning
Arlington Heights, IL

Meryl Becker-Prezocki
Educational Consultant
M. Becker-Prezocki
Louisville, KY

D.J. Begley
Associate, Program Administration Area 3
Kentucky Adult Education, Council on Postsecondary Education
Frankfort, KY

Bridget Blixt
Program Manager
Native Workforce Services/ Adult Literacy
Phoenix Indian Center, Inc.
Phoenix, AZ

Barbara Bowen
Reading Specialist
Rhode Island Adult Education Professional Development Center
Warwick, RI

David Bressoud
DeWitt Wallace Professor
Macalester College
St. Paul, MN

Sara Brown
High School Mathematics Teacher
Brown Deer High School
Brown Deer, WI

Sue Cain
Senior Policy Advisor, College Readiness and Student Success
Kentucky Council on Postsecondary Education
Frankfort, KY

Andree Rose Catalfamo
Associate Professor of Developmental Education Manager
Tidewater Community College
Chesapeake, VA

Nicole Chilla
Director of Literacy
Corrections and Youth Justice Programs
New York City Department of Education, District 79
New York, NY

Debra Cloud
Mathematics Instructional Coordinator
Rio Salado College
Tempe, AZ

Cris Crowley
Director of Adult Education
Madisonville Community College
Madisonville, KY

Frederick De Naples
Professor of English
Bronx Community College
Bronx, NY

Judith Diamond
Professional Development Specialist
Adult Learning Resource Center
Arlington Heights, IL

Stephen Dolainski
Adult Literacy Consultant
Los Angeles, CA

Brian Durham
Senior Director for Academic Affairs and Career and Technical Education
Illinois Community College Board
Springfield, IL

Ruth Durkee
Assistant Director for Adult Education
Randolph Technical Career Center
Randolph, VT

Sarah Fearnow
Math Instructor, ABE/GED
Pima Community College Adult Education
Tucson, AZ

Anthony Fernandes
Assistant Professor of Mathematics Education
University of North Carolina Charlotte
Charlotte, NC

Lori Forlizzi
Adult Reading and Assessment Specialist
Institute for the Study of Adult Literacy
The Pennsylvania State University
University Park, PA

Judy Franks
Literacy Projects Coordinator
Ohio Literacy Resource Center
Kent State University
Kent, OH

Janice Gallagher
Adult Education Instructor
Pima Community College Adult Education
Tucson, AZ

Lynda Ginsburg
Senior Researcher, Associate Director
The Center for Mathematics, Science and Computer Education
Rutgers, The State University of New Jersey
Piscataway, NJ

Steven Hansen
Chief of Institutional Research
The Air University
Maxwell Air Force Base, AL

Cindy Heimbach
Director
Grenada Adult Education Center
Grenada, MS

Patrick Hopfensperger
Adjunct Professor
University of Wisconsin-Milwaukee
Milwaukee, WI

Lynn M. Hublou
Instructor and Basic Writing Coordinator
Department of English
South Dakota State University
Brookings, SD

Marlisa R. Johnson
Founder and Director
Mathtopian Preparation, Inc.
Los Angeles, CA

Mark Kearns
Basic Education Instructor (Retired)
Wisconsin Indianhead Technical College
New Richmond, WI

Michael Keller
Professor of English
South Dakota State University
Brookings, SD

Susan Kidd
Program Administrator
State Board for Community and Technical Colleges
Olympia, WA

Kathi King
Mathematics Teacher
Messalonskee High School
Oakland, ME

Jennifer Lacher-Starace
Instructor
Teaching, Learning and Leadership and English Departments
South Dakota State University
Brookings, SD

Connie Laughlin
Instructor
University of Wisconsin
Milwaukee, WI

Becki Lemke
Education Coordinator
Cornerstones Career Learning Center, Inc.
Huron, SD

Betty B. Long
Professor of Mathematical Sciences
Appalachian State University
Boone, NC

Carol Lorenz
English Instructor
Veterans Upward Bound
Arizona State University
Phoenix, AZ

Claire Ludovico
ABE/GED Math Instructor (retired)
Rio Salado College
Tempe, AZ

Laurie Martin
Professional Development Specialist
Adult Learning Resource Center
Arlington Heights, IL

Monica Mitchell
President and CEO
MERAssociates, LLC
Vienna, VA

Amber Najmi-Shadid
Director of Literacy
New York City Department of Education, District 79
Alternative Programs and Schools
New York, NY

Lisa Otterson
Instructor of Philosophy
South Dakota State University
Brookings, SD

Tami Ozegovich
Director of Education
Private Industry Council of Westmoreland/Fayette, Inc.
Greensburg, PA

Jennifer Palmgren
Vice President for Academic Affairs
Saint Paul's College
Lawrenceville, VA

Donna Parrish
Adult Basic Skills/GED Instructor
Redwood Learning Center
Rogue Community College
Grants Pass, OR

Josephine Pirrone
Lecturer
Department of English
The Pennsylvania State University
University Park, PA

Brian Quinn
Assistant Professor of English and Humanities
Alfred State College
Alfred, NY

Lynn Reese
Director
Southwest Ohio ABLE Resource Center
Dayton, OH

George Reese
Director
Office for Mathematics, Science, and Technology Education
College of Education
University of Illinois at Urbana-Champaign
Champaign, IL

Harold Reiter
Professor of Mathematics
University of North Carolina Charlotte
Charlotte, NC

Valerie Roberson
Vice President, Academic Affairs
Joliet Junior College
Joliet, IL

Chyleigh Rose
KDE Educational Recovery Specialist/Mathematics
Newport High School
Newport, KY

David Royster
Professor of Mathematics
University of Kentucky
Lexington, KY

Elizabeth Zachry Rustschow
Project Director
Achieving the Dream Evaluation, MDRC
New York, NY

Katherine Safford-Ramus
Professor of Mathematics
St. Peter's University
Jersey City, NJ

Susan Sheehan
Supervisor
Adult Education Services
Parma City School District
Parma, OH

Wanda Sherman
ABE/GED Faculty Coordinator
Rogue Community College
Grants Pass, OR

Jane Schwerdtfeger
Curriculum and Assessment Development Specialist
Massachusetts Department of Elementary and Secondary Education, Adult and Community Learning Services Unit
Malden, MA

John Strucker
Researcher and Consultant
Adult Literacy and Teacher Education
Boston, MA

Marcia Taylor
Coordinator
Bernard Kleiman JobLink Learning Center
East Chicago, IL

Tony Trujillo
ABE/GED Instructor
Tempe Adult Education Program
Tempe, AZ

Mark Trushkowsky
Mathematics Professional Development Coordinator
City University of New York Adult Literacy and GED Program
New York, NY

Melissa Viscovich
Assistant Principal
School of Cooperative Technical Education
New York, NY

CCSS Writers

David Coleman
President
College Board
New York, NY

William McCallum
University Distinguished Professor of Mathematics and Head of the Department of Mathematics
University of Arizona
Tucson, AZ

Jason Zimba
Founding Partner
Student Achievement Partners
Bennington, VT