TEACHER PREP REVIEW

Building Content Knowledge

Technical Manual

December 2022

National Council on Teacher Quality

CONTENTS

ABOUT THE STANDARD

Introduction

In 2013, the National Council on Teacher Quality (NCTQ) launched the *Teacher Prep Review*, which offers an assessment of elementary teacher preparation programs against seven key standards, to strengthen teacher preparation across the U.S. by analyzing how well programs prepare aspiring teachers in the most essential skills and knowledge needed to lead a classroom. These requisite skills are drawn from the research and evidence base on what is most needed to be effective with students. One of the seven standards is "Building Content Knowledge."

Why does NCTQ focus on "Building Content Knowledge" in teacher preparation?

The goal of the Building Content Knowledge standard is to ensure teacher preparation programs produce teachers who have the knowledge and skills needed to teach students to read.

Disturbingly, the most recent national data shows that 33% of 4th graders and 31% of 8th graders are reading proficiently. More alarming is that only 17% of Black 4th graders and 21% of Hispanic 4th graders and 11% of students with disabilities are reading at proficient levels[1]—not because of the students' characteristics, but because we have denied them access to the opportunity to learn to read.

Key to addressing this literacy crisis is ensuring both teachers and students have necessary content knowledge. Though sometimes overlooked in literacy improvement efforts, *content knowledge plays a vital role in producing successful readers.* Becoming a strong reader requires robust, cumulative exposure to rich content; readers with strong background knowledge across multiple disciplines and domains, including science and social studies, become stronger readers.[2] Elementary grades are an essential time for building this knowledge; for students to gain background knowledge and become successful readers, their teachers must gain it first. Teacher preparation is critical to providing aspiring teachers with the background content knowledge they will need.

As such, NCTQ explicitly reviews the opportunities provided by teacher preparation programs for aspiring teachers to build necessary content knowledge in two core subject areas: science and social studies. Specifically, the Building Content Knowledge standard evaluates preparation programs against the following claim:

CLAIM

Teacher preparation programs ensure elementary teacher candidates develop a firm foundation in the science and social studies topics they will need to teach their students and help them learn to read by requiring relevant coursework through the program's own requirements or the institution's general education requirements.

Two guiding principles inform this analysis:

1. To develop successful readers, all elementary teachers should enter the profession with a base of knowledge in the core subjects taught in elementary grades.
2. To support students in learning the content in science and social studies, teacher preparation programs have the responsibility to ensure candidates possess and/or acquire an established base of knowledge and demonstrate this knowledge through success in coursework or content knowledge tests.[3]

To evaluate programs against this standard, analysts review required coursework in science and social studies of aspiring elementary teachers. Analysts map coursework against the topics the field generally agrees that elementary teachers need for teaching science and social studies to determine whether aspiring teachers have access to the essential content.

To make this analysis actionable, NCTQ is providing programs with the **Building Content Knowledge: Content Coverage Tool** (or "Content Coverage Tool") to help programs identify which topics they adequately address by current program or university requirements and where gaps may exist in the program's effort to build candidates' base of content knowledge. The tool also identifies the existing available courses at the institution that, when taken together, provide elementary candidates with the most efficient and comprehensive coverage of social studies and science topics.

By ensuring teachers have the content knowledge necessary to help their students become strong readers, NCTQ aims to upend inequity and ensure that all students can read proficiently.

Process to Revise the Building Content Knowledge Standard

The *Teacher Prep Review* (TPR) was first published in 2013. Since then, the *Review* has continued to evolve, incorporating feedback from the research and teacher preparation field, requiring NCTQ to review and incorporate new research underpinning the standards, revisit the methodology, and examine how the *Review* can have the most impact. In 2021, NCTQ launched an effort to revise the Building Content Knowledge standard (formerly known as the Elementary Content standard) with deep engagement with teacher prep program faculty and staff, content experts, and measurement experts.

The purpose of the Building Content Knowledge standard revision process was fourfold:

1. Facilitate a transparent process more inclusive of feedback from external stakeholders than was the case for the original standard.
2. Clarify what we can claim about a program's preparation of teachers based on available evidence.
3. Ensure feedback is clear and actionable for teacher preparation programs.
4. Keep pace with changes in the field around what elementary teachers need to know.

Identifying content in social studies and science

To ensure the Building Content Knowledge standard aligns with what the field identifies as key concepts elementary teachers need to know in science and social studies, NCTQ completed a crosswalk of state elementary content standards[4] across all 50 states and the District of Columbia; elementary content licensure exams, such as the Praxis 5001 and Pearson exams; and the National Assessment of Educational Progress (NAEP).[5] Nearly all topics listed within state standards, excluding state-specific topics (e.g., the history of a specific state), fall under one of the topic branches identified by NCTQ (e.g., "civic and political institutions" falls under "structure and function of government"). NCTQ prioritized language for the "topic branches" aligning with widely implemented standards, such as the Next Generation Science Standards, adopted across 20 states and adapted by another 24 states. NCTQ used this crosswalk to develop a list of common themes and topics within science and social studies to ensure all topics align to the language found in the most commonly used standards or assessments. To validate the topics we identified, NCTQ then engaged deeply with the field—both content experts and practitioners.

Expert Advisory Panel

In revising the Building Content Knowledge standard, NCTQ was intentional in engaging content experts in science and social studies content, higher education, and measurement experts to define the vision for what teachers need to know and be able to do; and to advise us on how to fairly and accurately measure teacher preparation program performance. To do this, NCTQ established an Expert Advisory Panel, including two representatives from the NextGen Science Standards, two representatives from the National Curriculum Standards for Social Studies, three content experts in building background knowledge and its connection to reading, a district representative, and three representatives from higher education institutions. Expert Advisory Panel members assisted in the following areas:

- Verifying alignment of themes and topics to what the field agrees is important for each subject area (science and social studies).
- Suggesting additional themes/topics for inclusion.
- Reviewing and providing feedback on methodology and coding protocol.
- Providing suggestions to improve the capacity-building tool.

Based on feedback from content experts, NCTQ made a number of adjustments, including:

- Adding additional content themes, such as Engineering Practices and Pedagogy, which includes the Cross-Cutting Concepts and Scientific and Engineering Practices topics.
- Elevating the importance of integrating inclusive and diverse perspectives when considering courses across social studies course offerings, *as well as* the diverse perspectives topic.
- Providing additional context and rationale for the themes and topics chosen.

Inviting feedback from teacher preparation practitioners

Additionally, NCTQ held a focus group with eight representatives from teacher preparation programs to provide feedback on the Content Coverage Tool. Representatives were from a diverse set of institutions (50% from public universities; 50% from private universities; program enrollment ranging from 25 to 250; and each representing different states). During this session, NCTQ:

- Described the themes and topics chosen for the Building Content Knowledge standard, and methodology for analysis; and
- Presented a draft version of the Content Coverage Tool to gauge the tool's usability, presentation, and tone.

In a survey taken anonymously after the session, participants reported the following:

- 8 of 8 of surveyed participants reported the "Summary of Coverage" useful
- 3 of 4 surveyed participants reported the "Course Analysis" useful
- 8 of 8 of participants found the "Recommendations" useful
- 7 of 8 participants reported the themes and topics represent the content knowledge elementary teachers need

Based on feedback from this focus group, NCTQ made revisions to both the Content Coverage Tool and Building Content Knowledge standard, including:

- Revising the structure of the tool's design to make it easier to use; and
- Integrating additional text to explain purpose and use cases for the tool's recommendations.

Revised Standard Design

Sample

The sample of programs included in the analysis for the 2022 *Teacher Prep Review* Building Content Knowledge standard includes 437 undergraduate programs offering elementary teacher preparation leading to state licensure or certification across 44 states[6] and the District of Columbia. This analysis does not include non-traditional programs or graduate programs.

For this initial release of the Building Content Knowledge standard and the Content Coverage Tool, the sample includes institutions and programs with more specific or limited course options for completing science and social studies requirements and excludes institutions offering extensive menus of course options from multiple departments. The reason for this decision about the sample is that institutions with more extensive course offerings require extensive time to analyze available course offerings, compared to institutions with more limited requirements. For example, if all of an institution's general education requirements contained more than 25 options (often allowing candidates to select from multiple departments), we did not include them in the current sample because most content did not relate to elementary teachers. In future iterations of the standard, NCTQ aims to expand the sample to include the institutions omitted.

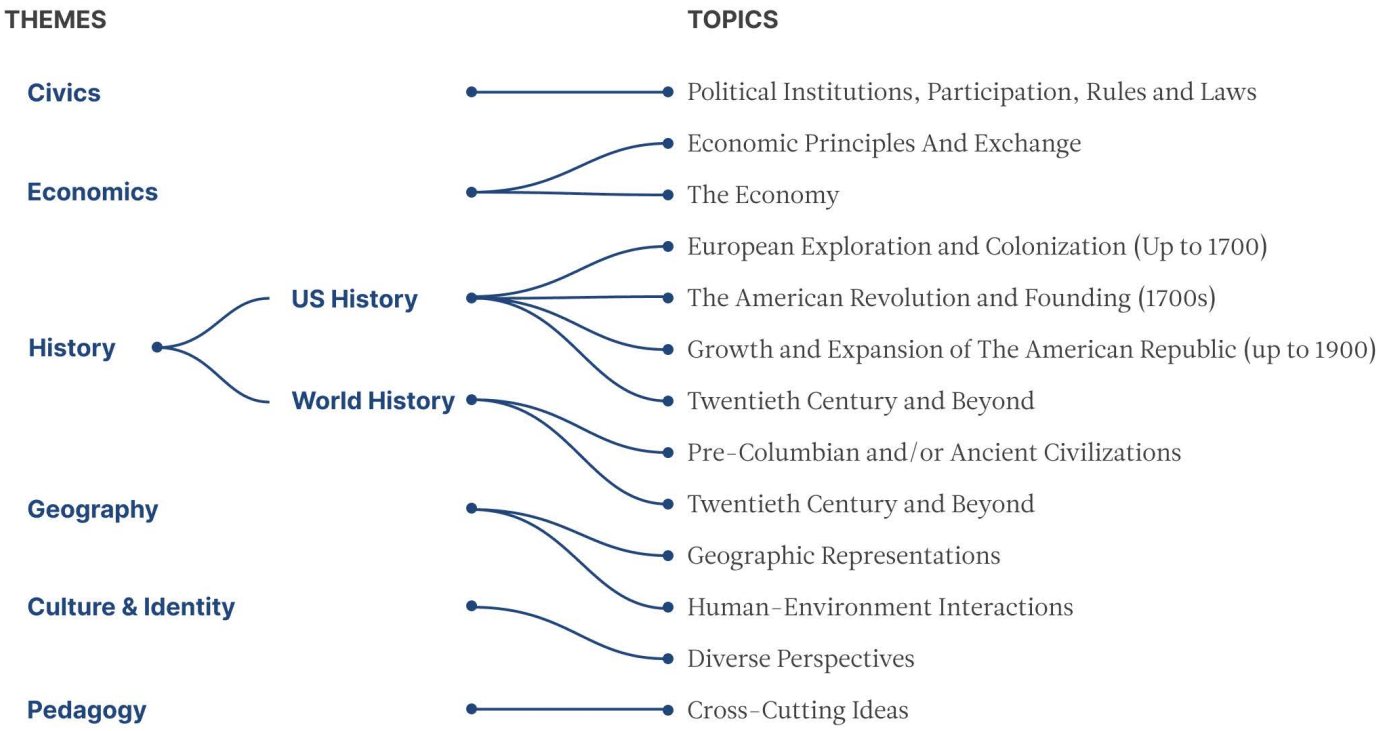
Required content topics under the 2022 Building Content Knowledge standard

The Building Content Knowledge standard explores two **subjects**: social studies and science. Subjects deconstruct into **themes**, or unifying ideas within the subject, and **topics**, groupings of key ideas.

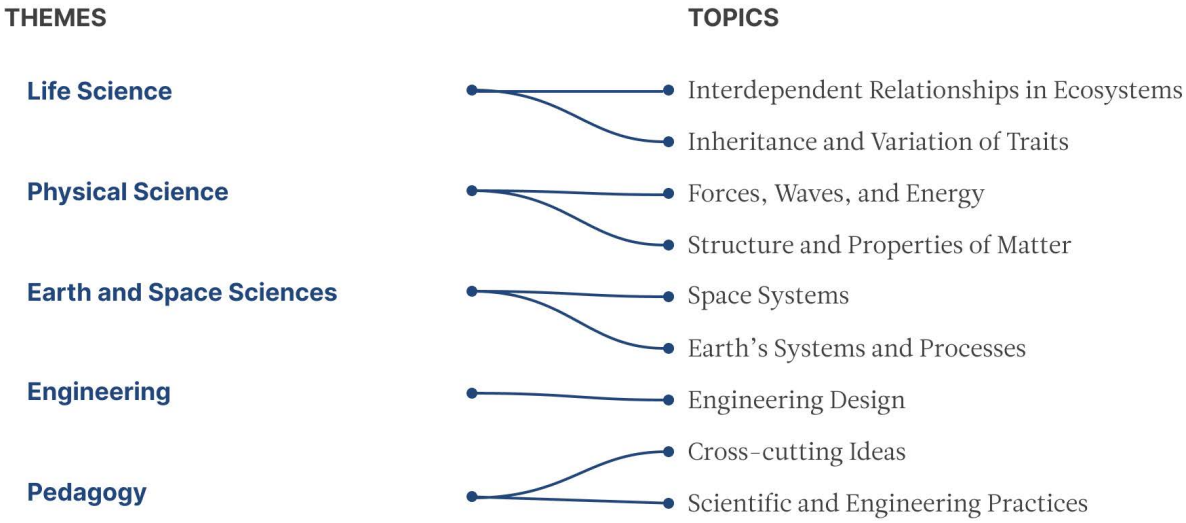
Term	Definition	Example
Subject	Broad swaths of required content knowledge all elementary teachers should have.	Science
Theme	A unifying or general idea within a subject.	Physical Sciences
Topic	Groupings of key ideas within a theme.	Forces, Waves, and Energy

The Building Content Knowledge standard explicitly seeks coverage of the following **subjects**, **themes**, and **topics**:

Social Studies



Science



Data collection and methodology

STEP 1

Identifying general or program-specific requirements at each institution

Determining how well institutions prepare candidates in science and social studies first requires analysts to identify the relevant courses aspiring teachers *can take* or are *required to take*.

At nearly every institution, information about the courses elementary teacher candidates are required to take is readily available online. Data sources for this information include course catalogs, degree plans, and required prerequisites identified during the admissions process. This analysis considers course options available to satisfy general education requirements, teacher preparation program requirements, or prerequisites to enter a teacher preparation program.

Analysts collected the following information for the institution and undergraduate elementary teacher preparation program:

- University requirement catalogs, course descriptions, and program requirement descriptions; and
- Concentration requirements.
  - If there is a choice in concentrations (i.e., an area within elementary education on which the candidate will focus more heavily), analysts privilege ELA concentrations or other concentrations not focused on one of the two primary subject areas, science or social studies. This ensures course recommendations are robust even for candidates who are not pursuing a concentration in science or social studies.

For any required, recommended, or optional course, analysts collect the course number, course title, and course description.

STEP 2

Identifying requirement categories and course options

Analysts use the information provided both within the general education requirements and those requirements specified by the teacher preparation program to identify which courses will likely provide social studies or science topic coverage. Using the institution's catalog or program information, analysts log each requirement as a separate "Requirement Category." The configurations for these vary widely across and within institutions. The chart below provides an explanation of the types of Requirement Categories.

Type of Requirement Category	Action	Example
Singular course	Treat as singular "group," no other course options can fulfill it.	All candidates must take CHEM 101.
Menu of course options (10 or fewer) to meet one Requirement Category	Treat as "group," each course listed as possible option for topic identification.	Candidates may take one course from the following options: BIO 102, BIO 103, ASTRO 102, CHEM 101.
Menu of course options (more than 10) to meet one Requirement Category	Treat as "group," include extensive list designator, and select some courses likely to provide coverage in topic coverage identification process.	Candidates must take one course with the prefix "BIO," "ASTRO" or "CHEM."

General education requirements: Institutions vary in how they present these requirements. Some provide specific, discrete lists for each requirement (e.g., all undergraduates must complete a science requirement and they have four courses from which to choose, or all elementary teacher candidates must take Introduction to Biology 101), while others allow undergraduates to choose from menus of course options to satisfy a requirement (e.g., a candidate can choose from among 20 courses to satisfy a science requirement, or from any course across several science disciplines). When a menu is extensive (i.e., includes more than ten options), analysts identify one or more courses (a) likely covering some of the science or social studies content prioritized in this analysis, and (b) are not addressed by other program or institution requirements being included in the analysis. In doing so, NCTQ seeks to provide programs with feedback on the set of courses providing the most topic coverage possible within the menu of course options.

Preparation program requirements: Teacher preparation programs will often require content coursework as part of their requirements for the education major or program. This can happen in multiple ways, such as:

- Option 1: The program may require an additional course (e.g., a specific American History course), in addition to required general education coursework.
- Option 2: A preparation program may set parameters around general education course options. For example, a program may specify which course candidates must take from the list of 20 science courses provided by the institution. When this occurs, the program requirement takes precedence, and analysts code the one required course rather than the full list of 20 courses.
- Option 3: Programs may also recommend, but not require, candidates take a specific course from the list of general education course options. If the program recommends a specific course from within a list of options, NCTQ analyzes both the course selected by the program and the other additional course options providing topic coverage. While the program's selected course is important, the goal of this tool is to determine the best possible combination of courses, which may not align with the selection made by the program.

STEP 3

Identifying topic coverage

After assigning courses to Requirement Categories for both the institution and program, analysts determine which topics each course covers. To identify coverage, analysts use the course title and description to determine whether the course likely covers the topics aligning with what elementary teachers need to know, based on an analysis of standards, licensure tests, and expert input. Guiding questions to determine if a course provides the topic content include:

- What is the focus of the course?
- Does language from the theme or topics appear in the course description?
- Would a group of experts in the field be able to predict it covers the topic(s)?

When courses do not address any of the topics, they are deemed irrelevant to the standard and not included in the analysis made available through the Building Content Knowledge data tool.

Course description and analysis example:

Course Title: Principles of Biology
Course D. A one semester survey of the major concepts of the biological sciences. Topics covered include biological chemistry; cell biology and cell reproduction; photosynthesis and respiration; Mendelian and molecular genetics; reproduction and development; origins; and ecology. This course should not be taken in addition to SCI 243. One laboratory per week.

Theme:	**Life Sciences**		**Physical Science**		**Earth and Space Sciences**		**Engineering**
Topic	Interdependent Relationships in Ecosystems	Inheritance and Variation of Traits	Forces, Waves, Energy	Structure and Properties of Matter	Space Systems	Earth's Systems and Processes	Engineering Practices
Coverage	Coverage	Coverage	No Coverage	No Coverage	No Coverage	No Coverage	No Coverage
Relevant Language	"Ecology"	"Reproduction and development"	N/A	N/A	N/A	N/A	N/A

STEP 4

Course selection recommendations

Using course topic coverage findings, analysts select courses to determine the most-aligned set of courses. Taken together, these courses accomplish two goals: 1) cover the broadest range of topics, while 2) meeting institution and program requirements. These are the set of courses NCTQ recommends teacher prep programs guide their aspiring candidates to complete, as they offer the greatest alignment with what elementary teachers need to know.

Program review of course coverage analysis: The Content Coverage Tool will be provided privately to programs within the sample for a review before the Tool is released publicly. During this period, programs are able to review the findings for their program and provide additional data (such as degree plans or other guidance documents). NCTQ analysts will use this data to adjust findings, and inform the program of any adjustments made.

Information provided through the Building Content Knowledge: Content Coverage Tool

The Content Coverage Tool provides three views showing the extent to which the program requirements align with the content knowledge elementary teachers need.

- **Summary of Coverage**, which provides an overview of the findings for your program in either social studies or science.
- **Course Analysis**, which displays whether courses that meet your program's or institution's requirements cover specific topics in either social studies or science.
- **Recommendations**, which identifies the best set of courses at your institution that, if taken by an aspiring elementary teacher, covers the most key content topics that elementary teachers need to be successful.

Summary of Coverage

Based on the analysis, the Content Coverage Tool reports on where the institution and teacher preparation program's requirements fall related to three overarching questions on the *Summary of Coverage* indicator:

- **Does the institution or program require any coursework in [science/social studies]?**
  - A program earns a "yes" here if candidates are required or recommended to take one or more courses in the relevant subject.
- **Does the institution or program require any coursework in all of the themes of [science/social studies]?**
  - A program earns a "yes" here if candidates are required or recommended to take at least one course in each theme within the subject.
  - If it is possible for a candidate to take a course in a theme, but not required (because the candidate could select other courses not including that theme), then this situation would not count as requiring coursework in that theme.

- **Does the institution or program require any coursework in all of the topics of [science/social studies]?**
  - A program earns a "yes" here if candidates are required or recommended to take at least one course in each topic within the subject.
  - If it is possible for a candidate to take a course in a topic, but not mandated (because the candidate could select other courses not including that topic), then this situation would not count as requiring coursework in that topic.

Course Analysis

In this section, the "Content Coverage Analysis" table in the Content Coverage Tool displays available course options to meet a Requirement Category:

- If a requirement mandates a specific course, it appears on the list.
- If the Requirement Category offers a menu of course options, all of those options (up to 10 courses) appear in the list.
- If the Requirement Category offers a menu of course options including more than 10 courses, a row appears titled "Extensive List" to indicate there is a long list of course options available, and a selection of courses offering the most aligned content from "extensive list" appear in the table.

The *Course Analysis* table indicates which topics each course addresses with a check mark.

Recommendations

Here NCTQ outlines 1) the set of courses providing candidates with the content most aligned with what elementary teachers need within current institution and program requirements, and 2) suggestions for courses to fill in gaps where candidates still lack coverage.

On this page of the Content Coverage Tool, the "Most Aligned" set of courses table lists all the courses NCTQ has identified, aligned with the current program and institutional requirements, offering the maximum attention to topics elementary teachers need to know. This table uses an orange bar to identify if the program *requires* or *recommends* any specific course. The Content Coverage Tool specifies whether each topic is addressed by this selection of courses, and what percentage of total topics within each subject are addressed by the identified course selections.

In the "How to improve content coverage" table, the Content Coverage Tool identifies which topics the "Most Aligned" set of courses does not address, and recommends additional courses available at the institution which candidates could take to round out their preparation in science and social studies.

How analysts identify missing topics

Requirements may not identify topics as covered for two reasons:

1. Requirement Categories may not include the topic. For example, Requirement Categories may not include any courses covering Geography (Geographic Representations or Human–Environment Interactions).
2. The Requirement Categories may include the topics in some courses, but not if the candidate follows the most aligned course sequence. For example, candidates may be required to take a history course, and can choose between a course addressing all of U.S. history (four topics), or all of World History (two topics). Thus, the Content Coverage Tool recommends candidates take the U.S. History course because it addresses *more* topics overall. However, this does not mean the current program and institution requirements do not include any World History courses, only that the "Most Aligned" set of courses does not include World History.

Access the Building Content Knowledge: Content Coverage Tool at: https://buildingcontentknowledge.nctq.org

Analyst Training, Pilot Testing, and Interrater Reliability

Analyst selection and training

NCTQ staff developed a protocol for analysis, including step-by-step instructions on how to collect requirements for each institution, determine coverage for courses, and determine the optimal set of courses aspiring teachers should take to receive the maximum amount of content coverage. An external psychometrician consultant established and reviewed the protocol process to ensure clear procedures whereby analysts consistently followed a process to establish strong inter-rater reliability. Once NCTQ established a protocol, the staff selected, trained, and conducted a pilot of the protocol with analysts. The pilot consisted of examining 14 programs and identified areas where protocol clarifications were needed to ensure strong inter-rater reliability. Analysts who worked on the Building Content Knowledge standard have worked across a host of NCTQ data projects and have a tenure with the organization of four to ten years.

Based on pilot results described below, analysts completed additional training and NCTQ made revisions to the protocol to strengthen results across the entire sample. Each program was reviewed and coded by two analysts for comparison, and staff monitored progress and calibrated consistency of results on a weekly basis.

Pilot testing

To determine the feasibility of the revised analysis process, NCTQ conducted two pilots: first, analysts evaluated 14 programs in Arkansas. Second, the team analyzed 10 additional programs from other states around the country. For these two pilots, NCTQ analyzed 768 total courses, with two analysts reviewing each course.

Courses analyzed

	Social studies	Science	Total
Total (24 programs)	460	308	768
Pilot #1 (14 programs)	165	129	294
Pilot #2 (10 programs)	295	179	474

The first phase of the pilot revealed discrepancies in how analysts were categorizing requirements, which led to a second pilot with a revised structure for logging requirements, which allowed us to capture a greater number of courses. Analysts also received more training and revised protocols on how to best categorize topic coverage in order to be better calibrated in making judgments and to facilitate greater agreement among analysts.

Topic coverage agreement average

	Social studies	Science
Pilot 1	88.4%	88.2%
Pilot 2	94.0%	93.0%

Within the pilot, average disagreements were low. After the second round of training, analysts hit the target of above 90% reliability across all courses. We define "topic coverage agreement" as whether the same course receives the same credit designation for each available topic.

Topic coverage identification

To determine inter-rater reliability for topic coverage for the full sample, we selected 96 programs (20% of the sample) to compare analysis of topics across courses. We assigned an additional analyst at random to complete topic coverage identification. We then compared rates of agreement between each version of analysis (e.g., whether both analysts indicated "Not Covered" or "Covered" for a topic). Overall, topic coverage agreement remained high—with 98.3% agreement in science courses, and 97.6% agreement in social studies courses.

Limitations

1. Analysts determine coverage based on course descriptions, which may not represent the full scope of any course. We consider this limitation reasonable because course descriptions are meant to provide college students with important information about the content of a course so they can make informed choices about whether to take the course; while these descriptions are not exhaustive, they are likely to provide sufficient information to identify content topics. Further, preparation programs have the opportunity to review our analysis and provide additional information in the event NCTQ overlooked or misinterpreted a topic addressed by a course.

2. The requirement lists for many institutions contain dozens of course options. For example, a university may have a Natural Sciences requirement allowing a candidate to select any course from the Biology department. We select one or two relevant courses for this requirement, and classify the requirement as an "Extensive List." While this approach does not provide feedback to a program on the full set of available courses, it does help programs identify which courses are potentially most relevant to the needs of future elementary teachers.

   Course options to fulfill a Requirement Category may include courses not falling within science or social studies. For example, a program may require a candidate to select one course out of ten to fulfill a humanities course. Of these ten options, five cover history and five cover literature topics. This Content Coverage Tool does not include course options falling entirely outside of the relevant subject area (in this case literature). As such, the course analysis tool alone may obfuscate the true amount of options teacher candidates are exposed to and therefore minimize the increased likelihood a candidate does not take an aligned course.

3. The coding of topic coverage addresses whether candidates are likely to learn about a specific topic, but does not address the quality of instruction on that topic. For example, the Building Content Knowledge standard does not evaluate whether candidates spend a single class session or an entire course on a topic, or whether candidates complete any assignments on that topic. However, this standard functions well as a high-level scan of whether elementary teacher candidates are required or likely to have the opportunity to learn about a topic, and provides valuable insight to preparation programs about where gaps in their candidates' preparation may lie.

4. This analysis and the corresponding recommendations privilege courses covering the most topics, which may encourage wide-ranging courses offering only shallow coverage. Programs should exercise judgment in recommending courses best fitting the needs of their candidates.

The Previous Elementary Content Standard (published in 2016)

In its prior construction, the Elementary Content standard was a review of thirteen categories of knowledge common to the standard elementary curriculum falling under English language arts, social studies, and science.[7] While there were some additional considerations, programs were primarily scored on the number of course categories based on an institution's general education requirements and preparation program requirements.

Course categories under the 2016 Elementary Content standard

Literature and composition	History and geography	Science
1. World literature 2. American literature 3. Writing, grammar, and composition 4. Children's literature	5. Early American history 6. Modern American history or government 7. World history—ancient 8. World history—modern 9. Geography	10. Biology 11. Chemistry 12. Physics/physical science 13. Earth science

Problems identified under the prior standard

While the Elementary Content standard provided previously unavailable insights into whether aspiring elementary teachers were required to take courses aligned with what they need to teach, it also had shortcomings. In some areas, misalignment occurred between course categories and what common licensure exams and state content standards expect elementary teachers to know. For example, Common Core literature standards for the elementary level are less focused on specific literature types, such as American Literature or World Literature. Requirements for courses to be eligible for credit (e.g., they should not be too narrow or too broad in scope, history courses not focus primarily on current events, science courses should not have a religious perspective) may have excluded some courses, including some relevant content. A summative grade met through different combinations of courses may have led to unclear feedback for stakeholders.

Addressing these shortcomings was the first step in revising the Building Content Knowledge standard. The revised standard aims to provide individualized feedback to programs on the extent to which their program and institution coursework provides the opportunity for candidates to learn about key topics aligning with what candidates need to know to teach state standards and pass their content licensing tests. To determine the key topics, NCTQ analyzed state student standards for social studies and science as well as content licensing exams, finding significant alignment of key topics across the country.[8]

Key changes to the standard

The key changes to the revised Building Content Knowledge standard are:

1) **Providing teacher preparation programs with a tool that directs their attention to important topics and which courses they should require, rather than a summative grade on content coverage.**

   The goal of this standard is to support teacher preparation programs in aligning their required content coursework more closely with what elementary teachers need to know and be able to teach their students. The former standard provided information about whether the program offered sufficient coverage in each subject, but did not provide further detail, nor did it help programs identify a readily available path to promote candidate content knowledge within their institution. The new Content Coverage Tool provides programs with specific information about what science and social studies topics their course requirements already address (including those set by General Education requirements), and identifies the courses available at the institution providing targeted content to aspiring teachers. This tool can offer leverage to preparation programs seeking to set parameters on general education courses available to their candidates, or to work with faculty from other departments to open up seats specifically for teacher candidates, among other uses.

2) **Moving from course categories to topics covered by required courses.**

   For example, instead of determining whether a course covers "early American history," analysts seek evidence of whether (or not) the course *likely* covers the topic. The topic was identified through a crosswalk between licensing tests and state standards (e.g., a topic might be The American Revolution or European Colonization).[9] In this approach, we evaluate courses based on if they *likely address* the content knowledge elementary teachers need to both become certified and teach students the elementary standards. This approach removes judgements about how much course time is sufficient to address topics.

3) **Removing analysis of Literature and Composition.**

   Based on feedback from external expert focus groups, we removed Literature and Composition from the analysis, as it did not clearly align to the purpose of building teachers' specific content knowledge within elementary subjects and aligned to expectations within state standards for students and licensure exams assessing content knowledge. Licensure exams and reading standards for students are less likely to specify genre-specific content knowledge in literature, instead emphasizing a split between informational text and literature and the usage of high-quality texts.

Composition in the original standard considered whether prospective teacher candidates were required to take a course explicitly teaching them how to write at the college-level (e.g., a required writing intensive seminar), rather than an expectation they learn how to teach writing to elementary-aged students. Instead of including composition in the Building Content Knowledge standard, NCTQ is considering how we can integrate how teachers *teach writing* in future iterations of the *Teacher Prep Review*.

4) **Expanding the approach to evaluating lists of course options, rather than only evaluating lists with seven or fewer courses.**

While institutions will sometimes specify candidates must take a specific course (e.g., American History 203), they will often also provide a menu of courses from which to choose (e.g., candidates must take an American History course, and can select from a range of courses offered by the university on topics from the Revolutionary War to Watergate). As the list of possible courses becomes longer, it takes more time for analysts to evaluate the possible options available, and also becomes less likely a candidate will select any individual course within the menu. Therefore, NCTQ does not evaluate the relevance of *all* courses when a menu exceeds a specified number of courses. In the earlier *Elementary Content standard*, we stopped analysis of courses when there were more than seven courses offered as choices—if a list exceeded seven course options, the protocol did not give credit for the relevant topic. In the revised Building Content Knowledge standard, that cutoff is set at 10 courses. However, analysts still review courses to identify which potentially offer relevant topic coverage, and include a small selection of courses *likely to provide coverage* within the Content Coverage Tool.

5) **Evaluating courses for their attention to specific topics, and no longer discounting courses focusing on current events, including religious perspective, covering a broad or narrow range, or teacher audience courses.**

While a course may teach some content not relevant to elementary teachers (e.g., a social studies course that focuses on current events that will no longer be current by the time the aspiring teacher reaches the classroom), these courses may also include some content relevant for aspiring teachers. Rather than discounting a course because some of the content is not relevant, or because it addresses too many topics, the revised standard credits any course based on the relevant topics it is likely to address. This includes teacher-audience courses, which were previously excluded from analysis.

6) **Focusing only on course requirements, and not content-focused admissions tests.**

In the former Elementary Content standard, programs could earn credit for requiring a test of content knowledge at admission to the preparation program. For example, a program might require all candidates to take and pass the Praxis Elementary Education: Multiple

Subjects (5001) test to gain entry into the program; this test serves as an adequate demonstration of content knowledge substitution for course requirements. This option was especially relevant for graduate and alternate route programs, which often do not have the course time available to address content knowledge and rely on candidates having a foundation in content knowledge when they enter into the program.

The new Building Content Knowledge standard does not include this option for two reasons. First, this standard only focuses on undergraduate elementary programs, not graduate or alternate route programs, so the admissions testing requirement is less relevant (and also quite rare in undergraduate programs, based on NCTQ's past analysis).[10] Second, this new standard focuses on providing *guidance* to preparation programs around course requirements to build the content knowledge candidates need, rather than on rating programs. Consequently, programs can use this information, in conjunction with other information they have on hand around admissions requirements, licensure test pass rates, feedback from candidates and their employers, and other sources, to determine which content topics need additional coverage in course requirements and to identify the most relevant courses.

7) **Integrating a "pedagogy" focused theme.**

In response to feedback from content experts in our focus groups, both analyses in science and social studies subjects now include indicators for an additional theme: pedagogy. For these courses, analysts look for courses intended to bridge the gap between content and pedagogy. Per recommendations from representatives of the Next Gen Science Standards, analysts now identify courses under two topics: **cross-cutting concepts** and **scientific and engineering practices**.[11] Cross-cutting concepts include language indicators such as, "systems," "interdisciplinary curriculum," or "integration," and language indicators of scientific and engineering practices include, "problem solving," "methods," and "designing or implementing (science concepts)." An example of a course description receiving coverage in both cross-cutting concepts and scientific and engineering practices:

> **STEAM Education for Young Children**
>
> This course includes research-based practices for designing, implementing, and assessing interdisciplinary curriculum including science, technology, engineering, arts, and math (STEAM). STEAM pedagogy, creativity and collaboration, and problem- and inquiry-based instruction in elementary classrooms are explored. Course includes a field experience.

In social studies, using a similar lens, analysts look for courses covering **cross-cutting concepts**—or bridging an understanding between content and pedagogy. Language indicators in a course providing coverage in cross-cutting concepts include: "methods," "skills" in the context of social science application, "curriculum across content areas," among others. An example of a course receiving coverage:

> **Social Studies Curriculum and Methods: Planning**
>
> Methods, materials, and resources for teaching social studies in grades K-6. Emphasis placed on the use of process skills of the social scientist. Long- and short-term planning including integration of curriculum across content areas, embedding Minnesota Graduation Standards.

Conclusion

In 2022, NCTQ revised the Building Content Knowledge standard to focus on the key content aspiring elementary teachers need to know in science and social studies. Research demonstrates that background knowledge underpins a student's ability to read and comprehend and prepares them for future success. Institutions play an invaluable role in strengthening teachers' content knowledge to improve outcomes for students. The Building Content Knowledge standard provides programs with a better understanding of the extent to which aspiring teachers have an opportunity to acquire this critical content knowledge.

Access the Building Content Knowledge: Content Coverage Tool at: https://buildingcontentknowledge.nctq.org

APPENDIX A

Research Rationale

Why is content knowledge important?

Content knowledge across an array of subjects and topics supports reading comprehension.

The full breadth of what teachers need to know and be able to do is expansive, and content knowledge is one of many critical requirements to be a successful elementary teacher, especially when teaching students to read. Much as learning phonics helps students decipher the sound of words, gaining background knowledge about a breadth of subject areas helps students draw meaning from what they read. A review of decades of research confirms:

> "higher levels of background knowledge enable children to better comprehend a text. Readers who have a strong knowledge of a particular topic, both in terms of quantity and quality of knowledge, are more able to comprehend a text than a similarly cohesive text for which they lack background knowledge."[12]

Tests of students' reading comprehension reveal their knowledge of the topic predicts their comprehension more accurately than their reading ability does.[13] Moreover, spending more class time on social studies is associated with improved reading ability, especially for students who are learning English and for those who are living in poverty.[14] Several studies of specific curricula or interventions have found building students' science and/or social studies content knowledge also supported their vocabulary and comprehension.[15]

A summary of research by Knowledge Matters highlights four ways in which background knowledge underpins reading comprehension:

> "First, vocabulary tends to grow along with knowledge, but when just 2% of the words in a passage are not known, comprehension begins to drop.[16] Second, the ability to process multiple details in a reading passage is severely restricted when readers aren't familiar with the topic(s) in the passage; cognitive scientist Daniel Willingham says that without adequate background knowledge, "chains of logic more than two or three steps long" can't be well comprehended.[17] Third, when we know a little about a topic (e.g., that Alaska is freezing cold), we use that bit to generate a picture in our mind that helps us make sense of a related passage (e.g., that animals without heavy coats or other means of staying warm will struggle to survive in Alaska). Fourth, when we already know much of what's in a passage, we don't have to focus on its basics, and we can think critically: Does this passage make sense? Do I

> agree with its argument? How do the different items and ideas in this or several passages relate to each other?"[18]

Disparities in access to a broad curriculum reinforces inequities for students of color and students living in poverty.

Learning core content builds the foundation for later grades and supports students' ability to enter postsecondary education. In a recent report on educational equity, the National Academies of Sciences identified "disparities in curricular breadth," and in particular "availability and enrollment in coursework in the arts, social sciences, sciences, and technology," as a key indicator of educational inequities.[19] Data from the National Assessment of Educational Progress and other sources confirms a sizable opportunity gap in core content areas for students of color and students living in poverty.[20]

Moreover, teachers with gaps in their content knowledge are more likely to work in more disadvantaged (and often lower-achieving) schools—those with higher rates of poverty and more students of color.[21] Similarly, classes of students with higher prior achievement in math or in science are more likely to be taught by teachers who report higher levels of preparedness in those subjects, compared with classes of students with lower prior achievement.[22]

Inequities in early access to core content knowledge are cited as a key reason for later inequities in access to jobs,[23] as disparities in jobs in the STEM field illustrate.[24] Not only do students deserve to attain an education preparing them to pursue a variety of fields, but those fields benefit from the perspectives and participation of people from a broad range of backgrounds and experiences.[25]

Content knowledge is important for its own sake.

Knowledge begets more knowledge. New research finds having prior knowledge of a subject makes it easier to acquire new knowledge on that subject.[26]

But learning about a new topic is an important and powerful experience in its own right. The National Academies of Sciences states,

> "Every child deserves to experience the wonder of science and the satisfaction of engineering. Children, even at very young ages, are deeply curious about the world around them and eager to investigate the many questions they have about their environment. Decades of research suggest that children are capable of learning sophisticated disciplinary concepts and can engage in scientific and engineering practices (National Research Council [NRC], 2007, 2012). Engaging them in learning science and

engineering takes advantage of this interest and helps them to answer their own authentic questions and solve real-world problems that are important to them."[27]

Early exposure to science, technology, engineering, and mathematics (STEM) may have lifelong implications for students. Children form attitudes about STEM subjects in the early grades.[28] Further, teaching children science concepts in the early grades establishes "the knowledge and skills they need to approach the more challenging science and engineering topics introduced in later grades."[29] Experts also anticipate early exposure to STEM subjects increases students' interest in pursuing those careers.[30]

Regarding social studies, there have been several perspectives over the years on why elementary students should learn history and social studies. These include that students should learn social studies to promote "civic competence and a disposition toward participatory citizenship," and students should learn a more rigorous history curriculum because "study rooted in the disciplines not only teaches content more effectively but makes for more thoughtful and cognitively sophisticated students."[31]

Why do aspiring elementary teachers need dedicated content coursework as part of their preparation?

There is widespread agreement among the education field—teachers cannot teach what they do not know. A 2020 NCTQ survey found 83% of teacher preparation program leaders and 95% of state education agency (SEA) leaders agreed with this sentiment.[32] The reasons these groups cited for the importance of content knowledge includes:

- Elementary teachers who have knowledge of a core content area can more efficiently plan lessons in that area (92% of teacher preparation program leaders and 93% of SEA leaders agree or strongly agree).
- Teachers cannot know how to deliver instruction in a content area (pedagogical content knowledge) without first having a clear understanding of that content area (84% of teacher preparation program leaders and 90% of SEA leaders agree or strongly agree).
- Elementary teachers need to have more advanced knowledge of content than what they teach their students (84% of teacher preparation program leaders and 95% of SEA leaders agree or strongly agree).
- Elementary teachers who have knowledge of a core content area are more likely to effectively teach that content (87% of teacher preparation program leaders and 98% of SEA leaders agree or strongly agree).

Even though they have earned bachelor's degrees and sometimes master's degrees, many teachers enter the classroom without a clear foundation in the content they will be expected to

teach. In a survey on behalf of the National Science Foundation, elementary teachers report they do not feel well prepared to teach science or social studies, and their reported rates of preparedness have declined in all subjects between 2012 and 2018.[33] Federal surveys of new teachers (not specific to elementary grades) find only 37% report feeling very well prepared to teach their subject matter in their first year, and 31% feel they were very well prepared to meet state content standards in their first year of teaching.[34] While teachers may not know everything they will be expected to teach before they set foot in the classroom, they will be far more effective if they enter with a foundation in most of the content knowledge.[35]

Further, this survey data is supported by a committee report from the National Academies, which concluded,

> "The available evidence suggests that many science teachers have not had sufficiently rich experiences with the content relevant to the science courses they currently teach, let alone a substantially redesigned science curriculum. Very few teachers have experience with the science and engineering practices described in the [Next Generation Science Standards]. This situation is especially pronounced both for elementary school teachers and in schools that serve high percentages of low-income students, where teachers are often newer and less qualified."[36]

While research on teachers' elementary content preparation and knowledge is limited, most available research confirms a common sense conclusion—students learn more when their teachers know more. This relationship between the courses teachers take during their pre-service preparation or in-service professional development and their students' achievement has been found in English language arts and in science.[37] Another study finds that when teachers learn more about an elementary mathematics topic during preparation, they address that topic more completely when teaching.[38]

Research generally finds the more a person knows about many different subject areas, the stronger his or her levels of literacy are, as measured by vocabulary and scores on tests of reading comprehension.[39] A body of robust research spanning many decades connects a teacher's level of literacy or verbal ability and the achievement of that teacher's students.[40]

Elementary teachers' insufficient content knowledge may also impede their ability to give their students appropriate assignments. A 2018 TNTP study found "few…assignments gave [students] the chance to demonstrate grade-level mastery." In data TNTP shared with NCTQ for assignments from kindergarten through grade 5, only a quarter of English language arts assignments (28%) and half of math assignments (48%) were based on grade-level content.[41] These results were particularly egregious for students of color: classrooms with mostly white students received 3.6 times more grade-appropriate lessons than classrooms with mostly

students of color, and classrooms with mostly higher-income students received 5.4 times more grade-level lessons than classrooms with mostly low-income students.[42]

An insufficient background in core subjects may also hinder teachers' efforts to identify additional resources to use in their classrooms, or to assess the quality of those resources.[43]

When teachers have strong content knowledge in science and social studies, they are better prepared to help their students succeed in meeting the standards in those subjects and simultaneously better prepared to boost students' reading levels and literacy skills.

APPENDIX B

Theme and Topic Descriptions

Social Studies

Theme	Topics	Keywords	Example State Standard
Civics	Political institutions, participation, rules and laws	Structure and function of government; relationship between the United States and the World; civic participation; roles and responsibilities of citizenship; processes, rules, and laws; statehood	Governmental institutions and practices in the United States and other countries. (Alabama)
Economics	Economic principles and exchanges	Economic decision making; basic economic principles such as scarcity, producers and consumers, goods and services	Economic concepts including income, goods and services, scarcity, producers and consumers, interdependence and voluntary exchange. (Georgia)
	The Economy	Economic systems; U.S. economy; world economy; macroeconomics	A student should understand the economies of the United States and the state and their relationships to the global economy. (Alaska)
History	US History: European exploration and colonization	1492 - 1700 Colonial America; early exploration of North America; colonization of North America; transatlantic slave trade	Explain the religious, political, and economic reasons for movement of people from Europe to the Americas, and analyze the multiple perspectives of the interactions between settlers and American Indians. (Oregon)
	US History: The American Revolution and founding	1700 - 1800 American Revolution - reasons, key battles, key historical figures; formation of US Government; transatlantic slave trade	Students will explain the causes, course, and key figures of the American Revolution. (Tennessee)
	US History: Growth and expansion of the republic	1800 - 1900 Civil War; westward expansion; regional growth; reconstruction; abolition movements; suffrage movements; immigration patterns	Trace the role of exploration and expansion in the development of the United States. (Idaho)
	US History: Twentieth century and beyond	1900 - Present World War I; World War II; Cold War; Civil Rights Movement; immigration; current events	Describe multiple causes and effects of contemporary global events and developments in relation to the United States. (North Dakota)

	World History: Pre-Columbian and/or ancient civilizations	Ancient civilizations of North America; indigenous nations and cultures of North America and other continents (e.g., Inca, Mayan, Aztec civilizations); technological innovations (e.g., agriculture, trade routes)	Between 1100 B.C.E. and 1500 C.E, complex societies and civilizations developed in the Western Hemisphere. Although these complex societies and civilizations have certain defining characteristics in common, each is also known for unique cultural achievements and contributions. (New York)
	World History: Twentieth century and beyond	Global innovations and technology; World War I; World War II; the Holocaust; current events	World History: Contributions from Individuals and Groups (World); Historical Documents, Artifacts and Sites (World); Impact of Continuity and Change (World); Conflict and Cooperation (World) (Pennsylvania)
Geography	Geographic representations	Describe the world in spatial terms; human and physical features of places and regions; use of geographic tools (e.g., maps)	Locate major landforms and bodies of water on a map or other representation. (Illinois)
	Human-environment interactions	Regions; human migration and movements; global patterns; geography of a specific place; natural forces and disasters; natural resources	Students examine how the physical environment influenced the cultural development of colonial America. (Louisiana)
Culture and Identity	Diverse perspectives	Diversity of human cultures; diversity of American culture; function of culture; human group interactions; role and characteristics of diversity; social justice movements; contributions by diverse peoples	Describe and explain how traditions and customs contribute to unity and diversity. (Mississippi)
Pedagogy	Cross-cutting Concepts	Historical inquiry (cause and effect, continuity and change, etc.); geographic inquiry (e.g., patterns and processes)	Analyze historical time periods and patterns of continuity and change, through multiple perspectives, within and among cultures and societies. (Colorado)

Science

Theme	Topics	Keywords	Example State Standard
Life Science	Interdependent relationships in ecosystems	Biology; structure and processes of organisms (e.g., the human body, plant cell structures); structure and function of living systems; ecosystems; ecology	Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms. (Arizona)
	Inheritance and variation of traits	Biology; heredity; variation of traits; biological evolution; diversity of life; reproduction	Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. (Oklahoma)
Physical Science	Forces, waves, and energy	Physics; motion; stability; forces; energy; waves; electricity; heat	Students use science and engineering practices, cross-cutting concepts, and an understanding of waves and their applications in technologies for information transfer to make sense of phenomena and solve problems. (Wisconsin)
	Structure and properties of matter	Chemistry; matter and its interactions	Obtain, evaluate, and communicate information to explain the differences between a physical change and a chemical change. (Georgia)
Earth and Space Science	Space systems	Astronomy; Earth's place in the universe; stars; planets; the universe; solar system	The student will investigate and understand that the planets have characteristics and a specific place in the solar system. (Virginia)
	Earth's systems and processes	Geology; Earth's systems; earth and human activity; Earth's geological history; Earth's physical and living systems; weather; natural resources	Characteristics and interactions of Earth's Systems. (Utah)
Engineering	Engineering design	Engineering design; defining engineering problems; developing solutions;	Engineering: Developing Possible Solutions. (North Dakota)
Pedagogy	Cross-cutting concepts	Linking ideas between different domains of science (e.g., patterns, cause and effect, systems and system models)	Students use science and engineering practices, cross-cutting concepts, and an understanding of structures and processes (on a scale from molecules to organisms) to make sense of phenomena and solve problems. (Wisconsin)
	Scientific and engineering practices	Practices describing behaviors that scientists engage in (e.g., asking questions, defining problems, carrying out investigations)	The student will demonstrate an understanding of scientific and engineering practices. (Virginia)

APPENDIX C

Standard and Assessment Crosswalks

STATE ELEMENTARY EDUCATION STANDARDS: TOPIC COVERAGE IN SCIENCE

	PHYSICAL SCIENCE: FORCES, WAVES, AND ENERGY			PHYSICAL SCIENCE: STRUCTURE AND PROPERTIES OF MATTER	PHYSICAL SCIENCE: OTHER		LIFE SCIENCES: INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS		LIFE SCIENCES: INHERITANCE AND VARIATION OF TRAITS	
	Motion and Stability: Forces and Interactions	Energy	Waves	Matter and Its Interactions	Light & Sound	Simple Machines	Molecules/ Organisms: Structures and Processes	Ecosystems	Heredity	Biological Evolution
•• Alabama	✓	✓	✓	✓			✓	✓	✓	✓
•• Alaska	✓	✓	✓	✓			✓	✓	✓	✓
•• Arizona	✓	✓		✓			✓	✓	✓	
• Arkansas	✓	✓	✓	✓			✓	✓	✓	
• California	✓	✓	✓	✓			✓	✓	✓	
•• Colorado	✓	✓	✓	✓			✓	✓	✓	✓
• Connecticut	✓	✓	✓	✓			✓	✓	✓	
• Delaware	✓	✓	✓	✓			✓	✓	✓	
• D.C.	✓	✓	✓	✓			✓	✓	✓	
Florida	✓	✓		✓			✓	✓	✓	✓
•• Georgia	✓	✓		✓	✓		✓	✓	✓	
• Hawaii	✓	✓	✓	✓			✓	✓	✓	
•• Idaho	✓	✓	✓	✓	✓		✓	✓	✓	✓
• Illinois	✓	✓	✓	✓			✓	✓	✓	
•• Indiana	✓	✓		✓	✓	✓	✓	✓	✓	
• Iowa	✓	✓	✓	✓			✓	✓	✓	
• Kansas	✓	✓	✓	✓			✓	✓	✓	
• Kentucky	✓	✓	✓	✓			✓	✓	✓	
•• Louisiana	✓	✓	✓	✓			✓	✓	✓	✓
• Maine	✓	✓	✓	✓			✓	✓	✓	
• Maryland	✓	✓	✓	✓			✓	✓	✓	
•• Massachusetts	✓	✓	✓	✓			✓	✓	✓	✓
• Michigan	✓	✓	✓	✓			✓	✓	✓	
•• Minnesota	✓	✓		✓			✓	✓	✓	
•• Mississippi	✓			✓				✓	✓	✓
•• Missouri	✓	✓	✓	✓			✓	✓	✓	
•• Montana	✓	✓	✓	✓			✓	✓	✓	✓
•• Nebraska	✓	✓	✓	✓			✓	✓	✓	✓
• Nevada	✓	✓	✓	✓			✓	✓	✓	
• New Hampshire	✓	✓	✓	✓			✓	✓	✓	
• New Jersey	✓	✓	✓	✓			✓	✓	✓	
• New Mexico	✓	✓	✓	✓			✓	✓	✓	
•• New York	✓	✓	✓	✓			✓	✓	✓	✓
North Carolina	✓			✓			✓	✓		✓
•• North Dakota	✓	✓	✓	✓			✓	✓	✓	✓
Ohio	✓	✓	✓	✓			✓	✓	✓	
•• Oklahoma	✓	✓	✓	✓	✓		✓	✓	✓	✓
• Oregon	✓	✓	✓	✓			✓	✓	✓	
Pennsylvania	✓	✓	✓	✓			✓	✓	✓	✓
• Rhode Island	✓	✓	✓	✓			✓	✓	✓	
•• South Carolina	✓	✓		✓	✓		✓	✓	✓	
•• South Dakota	✓	✓	✓	✓			✓	✓	✓	✓
•• Tennessee	✓	✓	✓	✓			✓	✓	✓	✓
Texas	✓	✓		✓			✓	✓	✓	
•• Utah	✓	✓	✓	✓	✓		✓	✓	✓	
• Vermont	✓	✓	✓	✓			✓	✓	✓	
Virginia	✓	✓		✓	✓		✓	✓	✓	
• Washington	✓	✓	✓	✓			✓	✓	✓	
•• West Virginia	✓	✓	✓	✓			✓	✓	✓	✓
•• Wisconsin	✓	✓	✓	✓				✓	✓	✓
•• Wyoming	✓	✓	✓	✓			✓	✓	✓	✓

• **State adopted NGSS**
•• **Standards based on NGSS**

Download the full details of topic coverage under these standards

STATE ELEMENTARY EDUCATION STANDARDS: TOPIC COVERAGE IN SCIENCE

	EARTH AND SPACE SCIENCES: SPACE SYSTEMS		EARTH AND SPACE SCIENCES: EARTH'S SYSTEMS AND PROCESSES		ENGINEERING DESIGN	PEDAGOGY
	Earth's Place in the Universe	Stars & Planets	Earth's Systems	Earth and Human Activity	Engineering Design	Scientific Processes, Inquiry, etc.
•• Alabama	✓		✓	✓	✓	
•• Alaska	✓		✓	✓	✓	
•• Arizona	✓		✓			
• Arkansas		✓	✓		✓	✓
• California		✓	✓		✓	✓
•• Colorado	✓		✓	✓		
• Connecticut		✓	✓		✓	✓
• Delaware		✓	✓		✓	✓
• D.C.		✓	✓		✓	✓
Florida	✓		✓			✓
•• Georgia	✓	✓	✓	✓		
• Hawaii		✓	✓		✓	✓
•• Idaho	✓	✓	✓	✓	✓	
• Illinois		✓	✓		✓	✓
•• Indiana	✓		✓	✓	✓	✓
• Iowa		✓	✓		✓	✓
• Kansas		✓	✓		✓	✓
• Kentucky		✓	✓		✓	✓
•• Louisiana	✓		✓	✓	✓	✓
• Maine		✓	✓		✓	✓
• Maryland		✓	✓		✓	✓
•• Massachusetts	✓		✓	✓	✓	✓
• Michigan		✓	✓		✓	✓
•• Minnesota		✓	✓	✓	✓	
•• Mississippi	✓		✓			
•• Missouri	✓		✓	✓	✓	
•• Montana		✓	✓	✓		
•• Nebraska	✓		✓	✓	✓	
• Nevada		✓	✓		✓	✓
• New Hampshire		✓	✓		✓	✓
• New Jersey		✓	✓		✓	✓
• New Mexico		✓	✓		✓	✓
•• New York	✓		✓	✓	✓	
North Carolina	✓		✓			
•• North Dakota	✓	✓	✓	✓	✓	✓
Ohio		✓	✓			
•• Oklahoma	✓	✓	✓	✓		✓
• Oregon		✓	✓		✓	✓
Pennsylvania	✓		✓	✓	✓	✓
• Rhode Island		✓	✓		✓	✓
•• South Carolina		✓	✓			
•• South Dakota	✓		✓	✓		
•• Tennessee	✓		✓	✓		
Texas	✓		✓		✓	✓
•• Utah	✓	✓	✓		✓	
• Vermont		✓	✓		✓	✓
Virginia	✓	✓	✓	✓	✓	
• Washington		✓	✓		✓	✓
•• West Virginia	✓		✓	✓	✓	
•• Wisconsin	✓		✓	✓	✓	✓
•• Wyoming	✓		✓	✓	✓	

• **State adopted NGSS**
•• **Standards based on NGSS**

STATE ELEMENTARY EDUCATION STANDARDS: TOPIC COVERAGE IN SOCIAL STUDIES

	CIVICS: POLITICAL INSTITUTIONS, PARTICIPATIONS, RULES, AND LAWS					ECONOMICS: ECONOMIC PRINCIPLES AND EXCHANGES		ECONOMICS: THE ECONOMY			ECONOMICS: OTHER
	Structure/ Function of Government	Statehood	US + The World	Participation, Rights, Roles, and Responsibilities	Processes, Rules, and Laws	Economic Decision Making	Basic Economic Principles	Economic Systems	US Economy	World Economy	Personal Financial Literacy
Alabama	✓		✓	✓			✓		✓	✓	✓
Alaska	✓		✓	✓	✓	✓			✓		
Arizona	✓			✓	✓	✓		✓	✓	✓	✓
Arkansas	✓			✓	✓	✓	✓			✓	
California	✓			✓		✓	✓		✓		
Colorado	✓			✓			✓				✓
• Connecticut	✓			✓	✓	✓	✓		✓	✓	
Delaware	✓			✓			✓	✓		✓	
D.C.	✓				✓			✓			
Florida	✓			✓			✓	✓		✓	✓
Georgia	✓			✓	✓		✓		✓		✓
Hawaii	✓		✓	✓	✓	✓	✓		✓		✓
Idaho	✓			✓			✓		✓		✓
Illinois	✓				✓		✓		✓	✓	
Indiana	✓		✓	✓	✓		✓				
Iowa	✓			✓	✓	✓	✓		✓		✓
Kansas				✓							
Kentucky		✓		✓	✓	✓		✓	✓	✓	
Louisiana	✓			✓					✓		
Maine				✓			✓				✓
Maryland				✓			✓				
Massachusetts	✓			✓	✓						
Michigan	✓			✓	✓		✓		✓	✓	
Minnesota	✓		✓	✓	✓	✓	✓	✓			✓
Mississippi	✓	✓		✓	✓		✓		✓		
Missouri	✓				✓		✓				
Montana	✓			✓	✓	✓	✓		✓		
Nebraska	✓			✓		✓	✓		✓	✓	✓
Nevada	✓			✓	✓		✓		✓	✓	✓
New Hampshire	✓		✓	✓		✓	✓	✓	✓	✓	
New Jersey	✓				✓	✓					
New Mexico	✓			✓		✓		✓	✓		
New York	✓		✓	✓			✓		✓	✓	
North Carolina	✓			✓	✓	✓			✓		
North Dakota	✓			✓	✓	✓	✓		✓		
Ohio	✓			✓	✓		✓		✓		✓
Oklahoma	✓						✓		✓		
Oregon	✓	✓		✓	✓		✓		✓	✓	✓
Pennsylvania	✓		✓	✓	✓	✓	✓		✓	✓	
Rhode Island	✓		✓	✓		✓	✓				
South Carolina				✓			✓				
South Dakota	✓				✓		✓		✓		
Tennessee					✓				✓		
Texas	✓			✓	✓		✓		✓		
Utah				✓	✓				✓		
• Vermont	✓			✓	✓	✓	✓		✓	✓	
Virginia	✓			✓		✓	✓		✓		✓
Washington	✓		✓	✓	✓	✓	✓		✓		
West Virginia	✓			✓	✓		✓		✓	✓	
Wisconsin				✓		✓	✓		✓		
Wyoming	✓		✓	✓	✓	✓	✓		✓		✓

• **Adopted C3 Framework**

STATE ELEMENTARY EDUCATION STANDARDS: TOPIC COVERAGE IN SOCIAL STUDIES

	HISTORY: COMPREHENSIVE	HISTORY: EUROPEAN EXPLORATION AND COLONIZATION	HISTORY: THE AMERICAN REVOLUTION AND FOUNDING	HISTORY: GROWTH AND EXPANSION OF THE REPUBLIC	HISTORY: TWENTIETH CENTURY DEVELOPMENTS AND TRANSFORMATIONS; CONTEMPORARY EVENTS	HISTORY: OTHER		
	Intended to cover all or most time periods	1492-1700	1700 - 1800	1800 - 1900	1900 - Present	Arts & Music	Role of Technology	Symbols of US/State
Alabama					✓			
Alaska								
Arizona	✓							
Arkansas		✓	✓					
California	✓	✓	✓	✓				
Colorado								
• Connecticut								
Delaware		✓	✓	✓	✓			
D.C.							✓	
Florida	✓	✓	✓	✓				
Georgia		✓	✓	✓	✓			✓
Hawaii		✓	✓		✓			
Idaho		✓		✓	✓			
Illinois								
Indiana			✓		✓			
Iowa		✓						
Kansas	✓							
Kentucky	✓							
Louisiana		✓						
Maine	✓							
Maryland	✓							
Massachusetts		✓	✓	✓				
Michigan	✓							
Minnesota		✓	✓					
Mississippi		✓	✓	✓	✓	✓		✓
Missouri	✓							
Montana								
Nebraska								
Nevada	✓							
New Hampshire						✓		
New Jersey							✓	
New Mexico	✓							
New York		✓						
North Carolina	✓							✓
North Dakota	✓				✓			✓
Ohio		✓	✓	✓				
Oklahoma	✓	✓	✓					
Oregon		✓	✓		✓			
Pennsylvania	✓							
Rhode Island								
South Carolina		✓	✓	✓	✓			
South Dakota								
Tennessee	✓	✓	✓	✓	✓			
Texas		✓	✓	✓	✓	✓	✓	
Utah	✓							
• Vermont								
Virginia	✓							
Washington					✓			
West Virginia								
Wisconsin							✓	
Wyoming	✓				✓			

• Adopted C3 Framework

STATE ELEMENTARY EDUCATION STANDARDS: TOPIC COVERAGE IN SOCIAL STUDIES

	HISTORY: PRE-COLUMBIAN AND/OR ANCIENT CIVILIZATIONS		HISTORY: WORLD HISTORY	GEOGRAPHY: GEOGRAPHIC REPRESENTATIONS	GEOGRAPHY: HUMAN-ENVIRONMENT INTERACTIONS						
	Pre-Columbian and/or Pre-Colonization Contact	Ancient/Classic Civilizations	World History	Geographic Representations & Spatial Terms	Human-Environment Interactions	Regions	Human Migration/ Movements	Global Patterns	Geography of US/ State	Natural Forces/ Disasters	Natural Resources
Alabama				✓	✓	✓					
Alaska				✓	✓		✓			✓	
Arizona				✓	✓		✓	✓			
Arkansas	✓			✓	✓		✓	✓			
California				✓	✓				✓		
Colorado					✓		✓				
• Connecticut				✓	✓		✓	✓			
Delaware	✓			✓	✓	✓					
D.C.		✓	✓		✓						
Florida	✓			✓	✓	✓					
Georgia	✓			✓	✓						
Hawaii	✓			✓	✓		✓		✓	✓	
Idaho	✓	✓			✓	✓	✓				
Illinois				✓	✓				✓	✓	
Indiana				✓		✓					
Iowa				✓	✓		✓	✓			
Kansas					✓						
Kentucky				✓	✓		✓		✓		
Louisiana				✓					✓		
Maine					✓						
Maryland											
Massachusetts	✓			✓	✓	✓			✓		
Michigan				✓	✓	✓					
Minnesota	✓	✓	✓	✓	✓	✓	✓	✓			✓
Mississippi	✓			✓	✓					✓	✓
Missouri				✓							
Montana	✓			✓	✓		✓				
Nebraska				✓	✓	✓	✓				
Nevada			✓	✓	✓		✓	✓			
New Hampshire			✓	✓	✓	✓					
New Jersey					✓						
New Mexico				✓	✓						✓
New York	✓			✓	✓						
North Carolina					✓				✓		
North Dakota				✓	✓		✓				
Ohio		✓	✓	✓		✓	✓				
Oklahoma				✓					✓		
Oregon	✓			✓			✓		✓	✓	
Pennsylvania			✓	✓	✓	✓					
Rhode Island				✓	✓	✓	✓				
South Carolina		✓	✓	✓	✓		✓			✓	
South Dakota				✓	✓	✓					
Tennessee	✓			✓					✓		
Texas	✓			✓	✓		✓				
Utah		✓	✓		✓				✓		
• Vermont				✓	✓		✓	✓			
Virginia				✓		✓	✓		✓		
Washington				✓	✓			✓			
West Virginia					✓		✓				✓
Wisconsin				✓	✓		✓	✓			
Wyoming				✓	✓	✓	✓		✓		✓

• **Adopted C3 Framework**

STATE ELEMENTARY EDUCATION STANDARDS: TOPIC COVERAGE IN SOCIAL STUDIES

	CULTURE/IDENTITY: DIVERSE PERSPECTIVES							PEDAGOGY: THINKING AND INQUIRY		
	Function of Culture	Diversity of Human Cultures	Diversity of American Cultures	Human Group Interactions	Role and Characteristics of Diversity	Social Justice	Contributions by Diverse Peoples	Historical Inquiry	Geographic Inquiry	Behavioral Science
Alabama								✓		
Alaska								✓		
Arizona								✓		
Arkansas										
California										
Colorado								✓		
• Connecticut	✓									
Delaware		✓						✓		
D.C.		✓				✓				
Florida								✓		
Georgia			✓							
Hawaii	✓		✓					✓		
Idaho		✓								
Illinois								✓		
Indiana	✓							✓		
Iowa	✓			✓				✓		✓
Kansas				✓						
Kentucky								✓		
Louisiana										
Maine										
Maryland	✓		✓							
Massachusetts			✓							
Michigan										
Minnesota		✓						✓	✓	
Mississippi		✓	✓		✓	✓		✓		
Missouri				✓						
Montana			✓					✓		
Nebraska								✓		
Nevada					✓	✓	✓	✓		
New Hampshire	✓									
New Jersey		✓						✓		
New Mexico								✓		
New York	✓	✓							✓	
North Carolina			✓		✓					
North Dakota		✓						✓		
Ohio								✓		
Oklahoma										
Oregon			✓			✓				
Pennsylvania								✓		
Rhode Island								✓		
South Carolina								✓		
South Dakota								✓		
Tennessee										
Texas			✓							
Utah	✓									
• Vermont	✓									
Virginia										
Washington								✓		
West Virginia								✓		
Wisconsin	✓	✓		✓				✓		✓
Wyoming	✓		✓							

• **Adopted C3 Framework**

Download the full details of topic coverage on these assessments and standard frameworks.

STANDARD FRAMEWORKS AND ASSESSMENTS: TOPIC COVERAGE IN SCIENCE

	PHYSICAL SCIENCE: FORCES, WAVES, AND ENERGY			PHYSICAL SCIENCE: STRUCTURE AND PROPERTIES OF MATTER	PHYSICAL SCIENCE: OTHER		LIFE SCIENCES: INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS		LIFE SCIENCES: INHERITANCE AND VARIATION OF TRAITS	
	Motion and Stability: Forces and Interactions	Energy	Waves	Matter and Its Interactions	Light & Sound	Simple Machines	Molecules/ Organisms: Structures and Processes	Ecosystems	Heredity	Biological Evolution
NGSS	✓	✓	✓	✓			✓	✓	✓	
Core Knowledge Foundation	✓	✓		✓	✓	✓	✓	✓	✓	✓
MEGA	✓	✓		✓			✓	✓	✓	✓
NAEP	✓	✓		✓			✓	✓	✓	✓
Pearson California	✓			✓			✓	✓	✓	
Pearson Florida	✓	✓		✓			✓	✓	✓	✓
Pearson New York	✓	✓		✓			✓	✓	✓	✓
Pearson Ohio	✓	✓		✓				✓	✓	✓
Pearson Texas	✓	✓		✓			✓	✓	✓	✓
Praxis 5001	✓	✓		✓			✓	✓	✓	✓

	EARTH AND SPACE SCIENCES: SPACE SYSTEMS	EARTH AND SPACE SCIENCES: EARTH'S SYSTEMS AND PROCESSES	ENGINEERING DESIGN	PEDAGOGY
	Stars & Planets	Earth's Systems	Engineering Design	Scientific Processes, Inquiry, etc.
NGSS	✓	✓	✓	✓
Core Knowledge Foundation	✓	✓	✓	
MEGA	✓	✓		✓
NAEP	✓	✓	✓	
Pearson California	✓	✓		
Pearson Florida	✓	✓		
Pearson New York	✓	✓		✓
Pearson Ohio	✓	✓		
Pearson Texas	✓	✓		
Praxis 5001	✓	✓		✓

Download the full details of topic coverage on these assessments and standard frameworks.

STANDARD FRAMEWORKS AND ASSESSMENTS: TOPIC COVERAGE IN SOCIAL STUDIES

	CIVICS: POLITICAL INSTITUTIONS, PARTICIPATIONS, RULES, AND LAWS				ECONOMICS: ECONOMIC PRINCIPLES AND EXCHANGES		ECONOMICS: THE ECONOMY		
	Structure/ Function of Government	US + The World	Participation, Rights, Roles, and Responsibilities	Processes, Rules, and Laws	Economic Decision Making	Basic Economic Principles	Economic Systems	US Economy	World Economy
C3 Framework	✓		✓	✓	✓	✓		✓	✓
Core Knowledge Foundation			✓	✓					
MEGA	✓		✓		✓	✓		✓	✓
NAEP	✓	✓	✓	✓		✓		✓	✓
Pearson California	✓					✓			✓
Pearson Florida						✓			
Pearson New York	✓							✓	
Pearson Ohio	✓	✓	✓			✓	✓	✓	
Pearson Texas	✓		✓		✓		✓		
Praxis 5001	✓		✓			✓		✓	

	HISTORY: COMPREHENSIVE	HISTORY: EUROPEAN EXPLORATION AND COLONIZATION	HISTORY: THE AMERICAN REVOLUTION AND FOUNDING	HISTORY: GROWTH AND EXPANSION OF THE REPUBLIC	HISTORY: TWENTIETH CENTURY DEVELOPMENTS AND TRANSFORMATIONS; CONTEMPORARY EVENTS	HISTORY: OTHER	HISTORY: PRE-COLUMBIAN AND/OR ANCIENT CIVILIZATIONS	
	Comprehensive	1492-1700	1700 - 1800	1800 - 1900	1900 - Present	Role of Technology	Pre-Columbian and/or Pre-Colonization Contact	Ancient/ Classic/ Medieval Civilizations
C3 Framework								
Core Knowledge Foundation		✓	✓	✓	✓		✓	✓
MEGA	✓							
NAEP		✓	✓	✓	✓			
Pearson California		✓	✓	✓	✓		✓	✓
Pearson Florida	✓							
Pearson New York	✓							
Pearson Ohio	✓							
Pearson Texas	✓	✓		✓	✓	✓	✓	✓
Praxis 5001	✓	✓	✓		✓			✓

Download the full details of topic coverage on these assessments and standard frameworks.

STANDARD FRAMEWORKS AND ASSESSMENTS: TOPIC COVERAGE IN SOCIAL STUDIES

	HISTORY: WORLD HISTORY	GEOGRAPHY: GEOGRAPHIC REPRESENTATIONS	GEOGRAPHY: HUMAN-ENVIRONMENT INTERACTIONS				CULTURE/IDENTITY:	PEDAGOGY: THINKING AND INQUIRY	
	World History	Geographic Representations & Spatial Terms	Human-Environment Interactions	Regions	Human Migration/ Movements	Global Patterns	Function of Culture	Historical Inquiry	Geographic Inquiry
C3 Framework		✓	✓		✓	✓	✓		
Core Knowledge Foundation	✓	✓						✓	
MEGA		✓	✓				✓		✓
NAEP		✓	✓						
Pearson California	✓	✓	✓		✓		✓		
Pearson Florida	✓		✓					✓	
Pearson New York			✓				✓	✓	
Pearson Ohio	✓	✓	✓	✓	✓			✓	✓
Pearson Texas			✓				✓		
Praxis 5001	✓	✓	✓				✓	✓	

Endnotes

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[2] Smith, R., Snow, P., Serry, T., & Hammond, L. (2021). The role of background knowledge in reading comprehension: A critical review. *Reading Psychology, 42*(2), 1-27; Connor, C. M., Dombek, J., Crowe, E. C., Spencer, M., Tighe, E. L., Coffinger, S., ... & Petscher, Y. (2017). Acquiring science and social studies knowledge in kindergarten through fourth grade: Conceptualization, design, implementation, and efficacy testing of content-area literacy instruction (CALI). *Journal of Educational Psychology*, *109*(3), 301; Kim, J. S., Burkhauser, M. A., Mesite, L. M., Asher, C. A., Relyea, J. E., Fitzgerald, J., & Elmore, J. (2021). Improving reading comprehension, science domain knowledge, and reading engagement through a first-grade content literacy intervention. *Journal of Educational Psychology*, *113*(1), 3.

[3] Aligned to a crosswalk between Praxis Elementary Education: Multiple Subjects (5001), Pearson products from five states, common standard frameworks, and the NAEP assessment by subject area: Literature/Writing: Common Core State Standards; Science: Next Generation Science Standards; Social Studies: The College, Career, and Civic Life Framework for Social Studies. **Download the full crosswalk results for state standards**. Download the full crosswalk results for standard frameworks and assessments.

[4] Including state standards for grades K-5 (with slight variations based on state definition of elementary grades), the Next Generation Science Standards, CORE Foundation standards, and National Council on Social Studies C3 Framework.

[5] Including Science, Technology and Engineering, US History, Geography, Economics, and Civics.

[6] States not represented: Alaska, Connecticut, Maine, New Hampshire, New Mexico, and Rhode Island.

[7] Math is considered under the NCTQ Elementary Mathematics standard.

[8] See Appendix C. **Download the full crosswalk results for state standards. Download the full crosswalk results for standard frameworks and assessments.**

[9] Findings from this crosswalk between licensure tests and state standards are presented in more detail in Appendix C of this Technical Report. **Download the full crosswalk results for state standards. Download the full crosswalk results for standard frameworks and assessments.**

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[11] To see NGSS' definitions of cross-cutting concepts, see **here**. To see their definition of scientific and engineering practices, see here.

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[20] For example, 2015 science assessment data finds 51% of white students were proficient or advanced, compared with 15% of Black students and 21% of Hispanic students. This same year, 55% of students who were not eligible for the National School Lunch Program (NSLP) scored proficient or advanced, compared with only 22% who were eligible for the NSLP. National Center for Education Statistics. (2015). *National Assessment of Educational Progress: 2015 Science Assessment.* Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Dept. of Education. Retrieved from https://www.nationsreportcard.gov/science_2015/#acl?grade=4.

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[37] Research on teacher preparation programs (both traditional and alternative) in New York City found the amount of English language arts (ELA) coursework completed by teacher candidates correlated with increased ELA student achievement in the second year of teaching (Boyd, D. J., Grossman, P. L., Lankford, H., Loeb, S., & Wyckoff, J. [2009]. Teacher preparation and student achievement. *Education Evaluation and Policy Analysis, 31*(4), 416-440.) Another study found no correlation between teachers' content courses and students' achievement (Harris, D. N., & Sass, T. R. [2011]. Teacher training, teacher quality and student achievement. *Journal of Public Economics, 95*, 798-812.) Note: this study's findings run contrary to the conclusions of most strong research in the field. Research conducted in another large urban district also revealed a positive relationship between teachers' science knowledge and student achievement (Diamond, B. S., Maerten-Rivera, J., Rohrer, R. E., & Lee, O. [2014]. Effectiveness of a curricular and professional development intervention at improving elementary teachers' science content knowledge and student achievement outcomes: Year 1 results. *Journal of Research in Science Teaching, 51*[5], 635-658.) Another study in which teachers completed coursework aimed at improving their content knowledge also found improvement in student performance relative to a control group. This study relied on professional development coursework designed for teachers, rather than the general population. However, it provides supporting evidence that teachers' content knowledge influences student learning (Heller, J. I., Daehler, K. R., Wong, N., Shinohara, M., & Miratrix, L. W. [2012]. Differential effects of three professional development models on teacher knowledge and student achievement in elementary science. *Journal of Research in Science Training, 49*[3], 333-362.)

[38] A study of teachers' preparation in elementary mathematics found their lesson plans give more attention and address topics more fully when they learned about those topics in their teacher preparation coursework (Morris, A. K., & Hiebert, J. [2017]. Effects of teacher preparation courses: Do graduates use what they learned to plan mathematics lessons? *American Educational Research Journal, 54*[3])

[39] Numerous research studies have established the strong relationship between teachers' vocabulary (a proxy for being broadly educated) and student achievement. For example, see Ehrenberg, R., & Brewer, D. (1995). Did teachers' verbal ability and race matter in the 1960s? Coleman Revisited. *Economics of Education Review, 14*, 1-21.

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