Maryland College and Career Readiness Empirical Study

Final Report

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Executive Summary

The *Blueprint for Maryland's Future*, passed by the 2021 Maryland General Assembly, requires that a college and career readiness (CCR) standard be set for Maryland public school students that "certifies that by the end of 10th grade, and not later than the end of 12th grade, a student has the requisite literacy in English and math to be successful in first-year, credit-bearing coursework at a Maryland community college or open enrollment postsecondary institution" (Blueprint for Maryland's Future Act, 2021, p. 9). The Maryland State Department of Education (MSDE) contracted with the American Institutes for Research® (AIR®) to conduct the empirical study required by the *Blueprint* and to explore additional possible measures of student readiness for college and career success.

This report addresses the study's four objectives:

- **Objective 1.** Identify knowledge and skills required to be college and career ready.
- **Objective 2.** Assess the alignment between Maryland's College and Career Ready Academic Content Standards and postsecondary expectations.
- **Objective 3.** Assess how well the interim CCR standard and alternative specifications of the standard predict postsecondary progress.
- **Objective 4.** Identify potential areas of bias within assessments used to determine CCR.

Key Takeaways

Findings from the predictive validity analysis and content and standards alignment analysis support the following key takeaways for each study objective.

Study Approach

The study includes two components: (a) a predictive validity analysis and (b) a content and standards alignment analysis.

The **predictive validity analysis** was based on administrative data for Maryland public high school students who were in the expected high school graduation classes of 2017–2021 and focused on students who enrolled in a Maryland college the fall after their fourth year of high school.

To assess the quality of different high school measures of CCR, we examined how well the interim CCR standard and alternative definitions of the standard predicted students' progress toward postsecondary success, particularly college course credits earned in a student's first semester in college.

The **content and standards alignment analysis** included four main activities:

- Inventory college course requirements to identify expectations for first-year credit-bearing and developmental courses at Maryland community colleges.
- Collect stakeholder perceptions via focus groups with Maryland postsecondary faculty, workforce representatives, and K–12 leaders.
- Conduct a landscape analysis and literature review to explore how top-performing education systems approach CCR.
- Conduct an alignment analysis to identify areas of alignment and misalignment between Maryland high school content standards and first-year college course expectations.

Objective 1. Identify Knowledge and Skills Required to Be College and Career Ready

Content knowledge considered important for college readiness is covered in the Maryland K–12 content standards. Postsecondary stakeholders identified reading comprehension and writing as foundational English content knowledge; algebra and functions as foundational math content knowledge; and critical reasoning and writing, scientific thought, and basic math skills as foundational science content knowledge. These foundational content knowledge areas are similar to content covered in the Maryland K–12 content standards. However, postsecondary stakeholders raised concerns that many incoming college students struggle with reading, writing, precalculus, and scientific thought.

Skills for success, including collaboration and healthy work habits, are critical for CCR. Postsecondary and workforce stakeholders mentioned time management, critical thinking, workplace knowledge, and social-emotional competencies as important skills for students to master for college and career success.

Top-performing education systems provide formal CCR counseling early in students' journeys and clear options for college and career pathways. Top-performing U.S. states provide formal CCR counseling to students before Grade 10 and an easily accessible CCR plan. In addition, the top-performing states have multiple ways for students to demonstrate CCR or content knowledge for high school graduation, including individualized options (e.g., capstone project, appeals process) in lieu of passing a standardized test for high school graduation. None of the three top-performing states in our analysis use CCR assessments to determine which students can access certain courses or postsecondary pathways in high school. Top-performing international education systems offer multiple rigorous tracks; vocational or technical tracks are among several options for upper secondary school leading to a postsecondary career, with specific sets of requirements for completing each secondary track so that it feeds directly into the corresponding career pathway.

Objective 2. Assess the Alignment Between Maryland's College and Career Ready Academic Content Standards and Postsecondary Expectations

In general, the high school English language arts (ELA), math, and science content standards align to the content expectations of college course content in developmental and first-year credit-bearing courses. The Maryland high school content standards cover the relevant content expectations in college developmental and first-year credit-bearing courses. We found that all content expectations in the developmental and first-year credit-bearing college courses are addressed by the high school content standards. The Writing and Language strands of the high school ELA standards had the highest level of alignment with the college developmental and first-year credit-bearing English course content expectations. The high school math standards classified within the Algebra and Functions domains had the highest level of alignment with the college developmental and first-year credit-bearing math course content expectations. There was content alignment between the concepts within science disciplinary core ideas, life science college course content and physical science college course content.

Maryland's high school ELA and math standards align to content knowledge expectations for certificate-granting programs using two national frameworks that articulate workforce skills. Using national frameworks as an alternative source for content expectations, we found that Maryland's high school ELA and math content standards do cover the ELA and math expectations in common frameworks for workforce skills. While academic content standards are aligned, postsecondary expectations shared through the course syllabi, focus groups, and national workforce frameworks emphasize skills for success (e.g., communication, critical thinking, self-regulation), which are not as present or explicit within Maryland's CCR standards.

Alignment of Maryland's High School Content Standards With College Course Content

Summary of the content alignment ratings for the Maryland high school content standards: ELA content strands and math content domains

High school ELA content standards alignment with college English course content	Dev:	FY:
Language	●	●
Reading Informational Text	◐	◐
Reading Literature	○	○
Speaking and Listening	○	◐
Writing	●	●

High school math content standards alignment with college math course content	Dev:	FY:
Algebra	●	●
Functions	●	●
Geometry	○	◐
Number and Quantity	◐	●
Statistics	◐	●

● High school content is aligned with college course content expectations

◐ High school content is partially aligned with college course content expectations

○ High school content is not addressed in college course content expectations

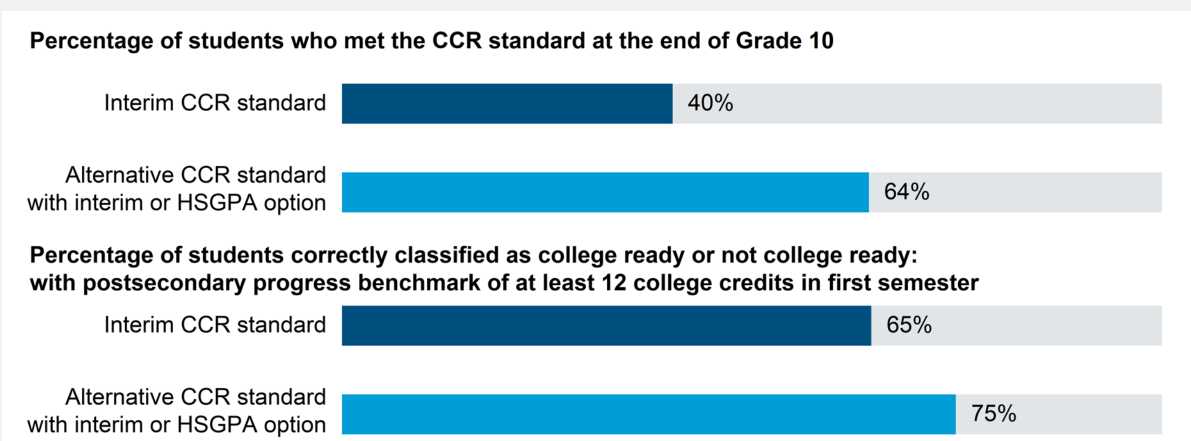
Note. ELA = English language arts; Dev = developmental college course; FY = first-year credit-bearing college course

Objective 3. Assess How Well the Interim CCR Standard and Alternative Specifications of the Standard Predict Postsecondary Progress

The interim CCR standard, utilizing state assessments, correctly classified about half to two-thirds of students as college ready or not college ready at the end of Grade 10. Overall, 40% of students who enrolled in a Maryland college the fall after their fourth year of high school met the interim CCR standard by the end of Grade 10. The interim CCR standard correctly classified 47%–65% of students as college ready or not college ready, depending on the college credits earned postsecondary progress benchmark used to validate readiness. This means that the interim CCR standard could misclassify 35%–53% of students, and especially misclassify many students as not college and career ready when they are likely to be ready. Accuracy rates were lower for some student groups than others. In particular, for Black students, Hispanic students, current English learners, students with disabilities, and students eligible for free and reduced-price meal services, the interim CCR standard had average accuracy rates that were less than 60%. Using a more inclusive threshold on the state assessments (i.e., a score of 725 instead of the 750-threshold used for the interim CCR standard) classifies more students as college and career ready and provides a more accurate prediction of readiness.

Comparison of the Interim CCR Standard to an Alternative CCR Standard With HSGPA

Among students who enrolled in a Maryland college the fall after their fourth year of high school



Note. A student can meet the interim CCR standard by meeting or exceeding performance expectations on the English 10 state assessment and a high school math assessment (Algebra 1, Algebra 2, Geometry, or the SAT math test). A student can meet the alternative CCR standard by meeting the interim CCR standard requirements or having an overall HSGPA ≥ 3.0. *N* = 121,002 for the percentage of students who met the CCR standard at the end of Grade 10. *N* = 117,819 for the percentage of students correctly classified as college ready or not college ready based on a postsecondary progress benchmark in the first fall semester after a student's fourth year of high school. CCR = college and career readiness; HSGPA = high school grade point average.

Adding an alternative way to meet the CCR standard with high school grade point average (HSGPA) increased the percentage of students who meet the CCR standard and improved accuracy rates for predicting first-year college credits earned. Adding an option that allows students to meet the CCR standard based on the interim CCR standard criteria or with an overall HSGPA of at least 3.0 at the end of Grade 10 increased the percentage of students who met the CCR standard from 40% to 64% (among students who enrolled in a Maryland college). In addition, an alternative CCR standard with HSGPA as an option correctly classified 67%–77% of students as college ready or not college ready, depending on the college credits earned postsecondary progress benchmark used to validate readiness. Adding HSGPA into the CCR standard improved accuracy rates more for students who attended a Maryland public 4-year college (75%–82% with HSGPA compared to 52%–64% without HSGPA) than for students who attended a Maryland community college (61%–71% compared to 44%–67%).

Objective 4. Identify Potential Areas of Bias Within Assessments Used to Determine CCR

Standardized assessments are frequently subject to cultural bias. Cultural bias in standardized tests is well-documented and mostly attributed to language used on the tests, which is normed to background knowledge often held by White, middle-class students. Some studies raise equity concerns about the reliance on college admissions tests to determine CCR. Citing equity, access, and relevance concerns, many colleges across the country have moved toward test-optional admissions policies.

Inequities exist in students' opportunities to prepare for assessments. Postsecondary stakeholders raised concerns about inequities in preparation for college entrance assessments and noted the opportunity gap for students in less resourced districts, as well as concerns about limited information and guidance about college preparation and pathways.

Policy Recommendations

The findings presented in this report support the following policy recommendations. These recommendations are intended to guide and foster further discussion among decision makers and stakeholders and should be interpreted within the context of the study's scope and limitations.

Revise the Maryland CCR Standard to Assess CCR More Accurately and Equitably

Postsecondary stakeholders pointed to the importance of using multiple measures to assess CCR. The utility of multiple measures is further supported in the literature review on bias in assessments, the broader research literature, and the predictive validity analysis we conducted for this study.

Relying solely on the test-based measures in the interim CCR standard likely will result in misclassifying many students, and disproportionately, students from historically marginalized groups. The Maryland CCR standard should be flexible enough to support decisions that are tailored to individual student needs and aspirations. In particular, we recommend MSDE consider the following options for revising the CCR standard.

- **Provide at least two options for students to meet the CCR standard: one option based on the state assessments in the interim CCR standard, and another option based on having an HSGPA of at least 3.0.** Including options to meet the CCR standard based on (1) the state assessments in the interim CCR standard or (2) an overall HSGPA of at least 3.0 will provide a more accurate indicator of whether students will succeed in first-year credit-bearing college courses or not (compared to using the interim CCR standard alone) and reduce the number of students who are misclassified as not ready when they are, in fact, on track to be college and career ready.
- **If an HSGPA option is included in the CCR standard, provide guidance and support to local education agencies (LEAs) and schools to better standardize and align grading practices across the state.** In our study, we found that overall HSGPA is a strong predictor of future postsecondary progress in all regions of the state. However, there is variability in the predictive utility of HSGPA across LEAs and schools that requires further investigation into how measures like HSGPA are operationalized across the state.
- **Incorporate flexibility into the CCR standard that allows students individualized ways to demonstrate mastery of the foundational skills needed for a particular postsecondary pathway.** Regardless of the high school measures included in the CCR standard, some students will be misclassified as not college and career ready when they will, in fact, be ready for a postsecondary pathway. This misclassification could be especially problematic if the CCR standard is used as a gatekeeper for future educational opportunities. Policymakers should consider additional ways for students to demonstrate readiness for specific pathways to better reflect the diversity of individual students' lived experiences and needs. For example, the CCR standard could include an option that allows LEAs to establish alternative mastery- or competency-based assessments (e.g., capstone projects) that, with MSDE approval, would give students whose individual circumstances do not align with the measures in the CCR standard another opportunity to meet the CCR standard.

Strengthen Learning Opportunities and Supports for Content Mastery, Along With CCR Counseling Early in Students' Educational Journeys

Findings from the alignment analysis indicate that Maryland's high school content standards are generally aligned with the English, math, and science content expected for students to succeed in entry-level college courses. But many students are not ready at college or workforce entry. Given the breadth of the high school content standards, more guidance and supports may be needed to help LEAs and schools prioritize the standards most aligned with college readiness and for students to engage in career pathway planning. However, revising or reorganizing content expectations for high school students will not address the underlying barriers to student learning and mastery of foundational content needed for college and career success. Rather, students are likely to succeed if provided with more engaging learning opportunities, individualized learning strategies, and wraparound services in middle and high school. In addition, beginning postsecondary planning earlier than high school could help teachers and counselors intervene if students are not on track to gain the skills necessary to be college and career ready.

Consider Integrating Skills for Success Into CCR Standards Alongside the Provision of Supports That Develop These Skills

Beyond concerns of academic readiness, postsecondary stakeholders consistently emphasized the importance of critical thinking, self-direction, and other skills for success that are not part of formal course content standards or expectations, though many college course syllabi indicated opportunities to develop such skills. In addition, workforce stakeholders noted that workforce readiness is built through experience, like internships and work-based learning. The comparison of top-performing education systems, nationally and internationally, also underscores the importance of social skills and work habits as a part of CCR. Establishing more explicit standards and measures of skills for success may result in more accurate and equitable application of a CCR standard.

Skills for success are already a focus of the Maryland Career Development Framework for College and Career Readiness and service-learning hours are already part of Maryland's graduation requirements, but the career development framework and service-learning requirements are not formally part of the Maryland College and Career Ready Standards and may not address all of the skills for success identified as important for CCR. In addition, Maryland institutions of higher education may benefit from developing a common framework for their workforce training programs, which emphasize skills for success and can be used by MSDE to better align skills for success opportunities at the K–12 level.

Provide Clear Guidance on How the CCR Standard Should and Should Not Be Used

Findings from the predictive validity analysis indicate that the interim CCR standard could misclassify up to half of the state's students in Grade 10: an error rate generally considered too high for high-stakes decisions for individuals. In particular, the interim CCR standard would likely misclassify many students as not ready who, in fact, will be college and career ready. Using the interim CCR standard as a gatekeeper for educational opportunities (e.g., access to advanced courses or dual enrollment programs) could adversely affect educational outcomes for many students. In addition, relying solely on state assessments, which research indicates can include cultural biases, may structurally disadvantage students with a diverse range of lived experiences.

Revising the interim CCR standard to include additional measures such as HSGPA or to use a more inclusive test score threshold can help, but the overall accuracy rates may still be too low (i.e., less than 75%) for high-stakes placement decisions. Students from historically marginalized groups may be disproportionately harmed if the CCR standard is misused for high-stakes decisions about individual student opportunities. Use of the CCR standard should be balanced with individualized guidance for each student and not prevent students from pursuing educational opportunities that support their college and career goals. It may be more appropriate to use the CCR standard to monitor system-level progress toward CCR and support school-level decisions related to college and career counseling and identify students who need additional CCR supports.

Continue to Monitor How Well the CCR Standard Accurately Predicts Student Preparation for College and Career Success

Empirically validating measures of CCR should not be a one-time process. Instead, key stakeholders should routinely monitor how well established CCR measures are aligned with and accurately predict college and career success. In particular, we have the following recommendations for future research.

- **Revisit how well state assessment performance levels are aligned with CCR expectations.** Findings from the predictive validity analysis indicate that adjusting the PARCC threshold from the meets expectations performance level to the approaching expectations performance level increased the CCR standard's accuracy rates. It is unclear whether the misalignment of performance level benchmarks for the PARCC applies to the current MCAP performance levels. As more data from the MCAP assessments become available, MSDE should examine how well the MCAP performance levels are calibrated with CCR expectations and monitor the relationship over time.
- **Provide further insight into predictors of career success as more data become available.** For the student cohorts included in our study, important information regarding CTE program completion, as well as completion of apprenticeship programs and non-credit certifications, were incomplete because these data collection efforts are relatively new. As a result, our analysis of how well measures of CCR predict career readiness was not as robust as our analysis of college readiness. As more career-related data become available, future studies can address this gap in the research.

- **Include student voice, more K–12 and workforce representation in future research.** For this study, we gathered input from a wide range of stakeholders across the state of Maryland, including college faculty, K–12 curriculum leaders, and workforce representatives. In addition, we examined a great deal of administrative student data. Given the scope of the study, however, we did not hear directly from the students and a large number of K–12 educators who have the most firsthand experience with what is required for students to be college and career ready. Gathering additional perspectives from these groups would provide a deeper understanding of CCR needs and expectations across Maryland.

A. Introduction

A central goal of the *Blueprint for Maryland's Future*, passed by the 2021 Maryland General Assembly, is to ensure that all Maryland public school students are college and career ready before graduating from high school, signifying an ability to transition successfully to postsecondary coursework at a 2- or 4-year postsecondary institution or to the workforce. To reach this goal, the *Blueprint* requires that a college and career readiness (CCR) standard be set for Maryland public school students that "certifies that by the end of 10th grade, and not later than the end of 12th grade, a student has the requisite literacy in English and math to be successful in first-year, credit-bearing coursework at a Maryland community college or open enrollment postsecondary institution" (Blueprint for Maryland's Future Act, 2021, p. 9). Further, the *Blueprint* requires that the Maryland State Department of Education (MSDE) contract with a public or private entity to conduct an empirical study of the interim CCR standard set by MSDE to determine whether that standard reflects and/or predicts whether a student will be successful in entry-level credit-bearing courses or postsecondary education at a state community college.

Maryland's Interim CCR Standard

In February 2022, the Maryland State Board of Education set an interim CCR standard. The standard states that students are considered college and career ready when they meet or exceed a metric in both English and math, as defined by the following criteria:

- **English**: Score at or above the proficient (or met expectations) performance level on the English 10 state assessment
- **Math**: Score at or above the proficient (or met expectations) performance level on the Algebra 1, Algebra 2, or Geometry state assessment or score at least 520 on the SAT Math Test

In August 2022, MSDE released an implementation roadmap for the CCR policy established in the *Blueprint* (MSDE, 2022). In the roadmap, MSDE highlighted the importance of establishing a CCR standard that reflects the skills and knowledge necessary to succeed in the first year at a community college, as well as what it means to be equipped to thrive in any postsecondary or career environment. The roadmap also outlined the call for an empirical study that (a) not only meets the requirements of the *Blueprint* but also examines alternative indicators of readiness, (b) further studies the alignment between the Maryland interim CCR standard and current content standards required by postsecondary institutions and industry, and (c) considers potential sources of bias in any proposed CCR standard. In its conclusion, the roadmap stipulated that the empirical study should inform adoption of a CCR standard that best predicts whether a student is ready for college and career, without a disproportionate impact on any student group.

MSDE contracted with the American Institutes for Research® (AIR®) to conduct the empirical study required by the *Blueprint* and to explore additional possible measures of student readiness for college and career success. The empirical study includes two components:

1. A **predictive validity analysis** to determine whether the interim CCR standard predicts whether a student is ready to progress toward postsecondary success.
2. A **content and standards alignment analysis** to determine the levels and types of literacy in English language arts (ELA) and math needed for postsecondary success.

This final report integrates these two components to present key findings and recommendations. We start with a summary of prior research related to measuring and supporting CCR. Next, we provide an overview of our approach for this study and then present the overall findings. We conclude the report with a discussion of recommendations.

B. Summary of Existing Practices and Prior Research

To inform our approach to the predictive validity and the content and standards alignment analyses, and help situate the analyses within a larger CCR knowledge base, this section summarizes prior research on frameworks for CCR and its relationship to postsecondary progress.

B.1. Framework for CCR

A commonly cited definition of college readiness offered by Conley (2010) describes college readiness as "the level of participation a student needs in order to enroll and succeed—without remediation—in a credit-bearing course at a postsecondary institution" (p. 21). Conley (2012) furthered his definition of college readiness by establishing a four-dimension framework for readiness that includes career-ready skills needed for students to be prepared for both higher education and the workforce. This four-dimension framework includes:

- **Dimension 1** - Content knowledge demonstrated through the understanding of the key ideas, concepts, and vocabulary in core academic subjects such as ELA, math, science, and social studies (e.g., performance on state content assessments)
- **Dimension 2** - Cognitive strategies such as problem solving, reasoning, analysis, and interpretation skills necessary for success on the job and in college-level coursework
- **Dimension 3** - Academic behaviors that promote student ownership of learning (e.g., self-awareness, self-monitoring, study skills) and transcend content-area knowledge

- **Dimension 4** - Contextual skills and awareness about the informal and formal systems and culture of the institution that enable the transition to life beyond high school (e.g., knowledge of postsecondary admissions requirements, understanding workforce norms)

A framework developed by the College and Career Readiness and Success Center at AIR (Balestreri et al., 2019) advances Conley's framework for readiness by situating CCR within a comprehensive system for success that organizes CCR components into four strands:

- **Strand 1.** Learners have clear **goals and expectations** about what they should know and be able to do to achieve CCR.
- **Strand 2.** Learners know the **outcomes and measures** used to identify whether they are meeting expectations for CCR and success.
- **Strand 3.** Institutions provide **pathways and supports** that enable learners to achieve college and career success.
- **Strand 4.** Institutions have the robust **resources and structures** needed to enable learner readiness for college and careers**.**

An important feature of the framework offered by Balestreri et al. (2019) is that defining and measuring a CCR standard happens within the context of institutional supports, resources, and structures. A CCR standard can set clear goals and expectations (Strand 1) and establish CCR outcomes and measures (Strand 2), but the quality of the standard may depend on how well existing institutional systems develop CCR (Strands 3 and 4). Thus, a CCR standard should be seen as not only a tool to gauge individual student readiness but also as a way to inform institutional and system-level change.

B.2. Existing Practice

Since the enactment of the Every Student Succeeds Act (ESSA) of 2015 and its policy mandate for states to establish more explicit CCR requirements in their K–12 academic standards, states have responded with varied approaches to measure, monitor, and report on their students' CCR. A review of state definitions of CCR shortly after the enactment of ESSA (English et al., 2016) found that the following were commonly included in state definitions of CCR: academic knowledge (19 states' definitions), critical thinking and/or problem-solving skills (14 states), social and emotional traits (14 states), intrapersonal skills (eight states), citizenship and/or community involvement (eight states), and other employability skills (six states). In many cases, states use standardized tests, such as their own state assessments, the SAT, or the ACT, to measure CCR among their high school students. Some states also use high school coursework, including dual enrollment and CTE coursework, and grades to determine readiness (Hackmann et al., 2019).

Although some states determine their students' college readiness based on a single standardized test (e.g., ACT, PSAT/SAT), others use multiple measures to determine readiness. California, for example, established multiple criteria to determine whether a high school graduate is "prepared" or "approaching prepared" for college based on whether a student meets at least one of the criteria based on state assessment scores, scores on Advanced Placement (AP) or International Baccalaureate (IB) examinations, passing college-level courses, or completing certain course requirements with a grade of C or better.

In parallel to changes among K–12 education systems, there has been a growing movement in the past decade for broad and open access postsecondary institutions (e.g., community colleges, 4-year colleges with high acceptance rates) to adopt a multiple measures assessment approach when determining incoming students' appropriate placement in either developmental education or credit-bearing college-level courses. Under this approach, institutions do not rely on only one traditional placement examination (e.g., ACCUPLACER) to determine placement but rather consider a range of academic measures that allow students greater opportunity to demonstrate their readiness for college-level coursework. For example, in Maryland, all community colleges and a majority of the public 4-year and independent colleges use more than one assessment tool to determine students' course placement (Maryland Higher Education Commission, 2021). The most common academic measures include SAT/ACT, AP, and high school grade point average (HSGPA), among others.

Although theoretically distinct from college readiness, career readiness often is defined by the same metrics as college readiness. The number of states with career-focused measures in their CCR indicators has more than doubled since 2014 (Advance CTE et al., 2019), but these indicators often do not isolate career readiness as a separate metric with its own distinct requirements. A career readiness metric often included in measures of CCR is participation in career and technical education (CTE) programs designed to prepare students with technical skills and knowledge for specific occupations (Hirschy et al., 2011). As of 2019, 23 states included participation or completion in a CTE pathway or course as a component of CCR (Advance CTE et al., 2019). Moreover, 10 states incorporated experiential, work-based learning into a measure of career readiness, yet challenges exist in how to measure and standardize what counts as acceptable work-based learning (Advance CTE et al., 2019).

B.3. Measures of CCR

Although research cites the potential for using multiple and novel measures of CCR, in practice, most attention has focused on individual measures that are readily available in K–12 education data systems (e.g., state-specific standardized assessment scores, SAT/ACT scores, HSGPA) or used for college placement or college coursework decisions. These measures often are defined by threshold scores or benchmarks intended to signal readiness. In this section, we briefly highlight findings from recent research on various CCR measures and their associations with subsequent postsecondary outcomes. (For a full discussion of the relevant literature, see Appendix A.)

College Readiness

College Admissions and Placement Test Scores. Norm-referenced standardized tests used for college admissions decisions (e.g., SAT, ACT) and college-level course placement decisions (e.g., COMPASS, ACCUPLACER) often are the focus of research on CCR measures as predictors of postsecondary student success. For example, studies found positive associations between students' SAT scores (e.g., Marini et al., 2019) and ACT scores (e.g., Westrick et al., 2015) and their first-year college GPA (FYGPA). Other studies, however, found that relative to other potential CCR measures, particularly HSGPA, the predictive validity of SAT and ACT test scores alone may be limited in predicting college outcomes such as FYGPA (Rothstein, 2004) and college completion (Allensworth & Clark, 2020).

Similarly, studies on the predictive validity of college-level course placement tests such as COMPASS and ACCUPLACER find positive but weak associations between test scores and college outcomes such as course grades, college GPA, and college credits earned (Bahr, 2016; Belfield & Crosta, 2012; Scott-Clayton, 2012).

State-Specific Standardized Assessment Scores. Studies within different states found positive associations between content-aligned assessments administered to high school students and college GPA (Cimetta et al., 2010; Coelen & Berger, 2006; McGhee, 2003). Additional research found that scores on state content assessments were comparable to other CCR measures, particularly ACT/SAT test scores, in terms of their ability to predict college outcomes such as FYGPA (Fina et al., 2018; Koretz et al., 2016; Nichols-Barrer et al., 2015).

HSGPA. Several studies on college readiness examined how well HSGPA predicts college outcomes, even as researchers acknowledge potential limitations of HSGPA because of the subjective nature of grading (Brackett et al., 2013; Kunnath, 2017; Lipnevich et al., 2020) and evidence of grade inflation (Camara et al., 2004; Sanchez & Moore, 2022). Despite these concerns, many studies provide evidence for HSGPA as a strong and reliable predictor of various college outcomes, including initial college enrollment and sustained enrollment for more than one term (Hester et al., 2021), overall college GPA and college credits earned (Belfield & Crosta, 2012), and college completion (Allensworth & Clark, 2020). Compared with other test-based measures, studies found that HSGPA was a stronger predictor of college completion than SAT/ACT scores (Allensworth & Clark, 2020; Galla et al., 2019; Koretz et al., 2016).

A recent study conducted by the Maryland Assessment Research Center (MARC, 2023) compared how well HSGPA predicted FYGPA compared with college admissions tests (SAT and ACT) and state assessment scores for Maryland public high school graduates who attended a Maryland public institution of higher education. The study found that the relationships between the different high school measures and college FYGPA were stronger among 4-year college attendees (correlations between 0.42 and 0.44) than 2-year college attendees (correlations between 0.25 and 0.36). However, at both 4-year and 2-year colleges, HSGPA was a better predictor of which students earned a FYGPA of at least 3.0 than the Partnership for Assessment of Readiness for College and Career (PARCC), SAT, or ACT.

High School Course-Taking. High school course-taking is another potential measure of CCR commonly examined by researchers. Though defined differently across studies, measures of "curricular intensity" (e.g., highest math course completed) had strong positive associations with postsecondary persistence and bachelor's degree completion (Adelman, 1999, 2006; Austin, 2020). Similarly, Hester et al. (2021) found that among Arkansas high school students, taking at least one advanced course—defined as AP, IB, or advanced career education—was the strongest predictor of college enrollment and persistence among the CCR measures examined.

Multiple Measures for College Readiness. Although much of the research on college readiness focuses on specific measures, studies highlighted the strengths of using multiple measures to predict college readiness, including the combination of ninth-grade GPA, completion of advanced coursework (i.e., AP, IB, dual enrollment), and participation in CTE coursework (e.g., Education Strategy Group, 2020). Similarly, research on college course placement decisions points to the benefits of using multiple measures. Several recently published studies consistently found that using multiple measures for placement in community college developmental courses resulted in better student outcomes (e.g., college credits earned) than using a single measure such as a placement test score (Bergman et al., 2023; Cullinan & Biedzio, 2021; Cullinan & Kopko, 2022).

Career Readiness

Measures of career readiness are less standardized and less often viewed as separate from measures of college readiness. Despite this lack of a clear distinction between CCR measures in the research literature, one relatively common measure associated with career readiness is student participation in CTE. Growing evidence shows that increased exposure to CTE, by attending a dedicated CTE high school or being a CTE "concentrator" in high school, is positively associated with increased employment and higher earnings (Ecton & Dougherty, 2023; Lindsay et al., 2021).

C. Approach to the College and Career Readiness Study

We designed the CCR empirical study to address four main objectives:

- **Objective 1.** Identify knowledge and skills required to be college and career ready. Identify how top-performing educational systems define students as college and career ready and explore the extent to which those expectations align to Maryland's expectations.
- **Objective 2.** Assess the extent to which Maryland's College and Career Ready Academic Content Standards align with postsecondary expectations in (a) entry-level credit-bearing ELA, math, and science courses, (b) developmental ELA and math courses, and (c) certificate-granting workforce training programs.
- **Objective 3.** Assess how well the interim CCR standard and alternative specifications of the standard predict postsecondary progress.
- **Objective 4.** Identify potential areas of bias within assessments used to determine CCR.

Exhibit 1 shows how these objectives align with the research questions that guided this study.

In the following sections, we describe the methods and data sources comprising our approaches to addressing each of the four main objectives.

Exhibit 1. CCR Study Objectives and Guiding Research Questions

Objective	Guiding research questions
Objective 1. Identify knowledge and skills required to be college and career ready. Identify how top-performing educational systems define students as college and career ready and explore the extent to which those expectations align to Maryland's expectations.	• **Research Question 1:** How are college- and career-ready knowledge and skills identified and defined in Maryland? How do these definitions compare with those of top performing states and countries? • **Research Question 2:** What are the knowledge and skills students in top performing education systems should have if they are identified as "college and career ready"? • **Research Question 3:** How is "college and career ready" defined in those systems?
Objective 2. Assess the extent to which Maryland's College and Career Ready Academic Content Standards align with postsecondary expectations in (a) entry-level credit-bearing ELA, math, and science courses, (b) developmental ELA and math courses, and (c) certificate-granting workforce training programs.	• **Research Question 4:** To what degree are the Maryland College and Career Ready Standards aligned to the content of entry-level credit-bearing postsecondary courses and certificate-granting postsecondary training programs at state community colleges? • **Research Question 5:** To what degree are the Maryland College and Career Ready Standards aligned to the content of developmental postsecondary courses? • **Research Question 6:** To what degree are the Maryland College and Career Ready Standards aligned to the tests/measures named in the standard set by MSDE to indicate readiness for success in entry-level credit-bearing postsecondary courses and postsecondary training programs? • **Research Question 7:** To what degree are the Maryland College and Career Ready Standards aligned to the tests/measures used by postsecondary institutions to place students in entry-level credit-bearing postsecondary courses and certificate-granting postsecondary training programs?
Objective 3. Assess how well the interim CCR standard and alternative specifications of the standard predict postsecondary progress.	• **Research Question 8:** How well does Maryland's interim CCR standard predict student success in entry-level credit-bearing coursework? • **Research Question 9:** How well do alternative CCR standards predict student success in entry-level credit-bearing coursework?
Objective 4. Identify potential areas of bias within assessments used to determine CCR.	• **Research Question 10:** In any assessments used to determine CCR, what sources of bias are present?

BOX 1. DEFINITION OF KEY TERMS

Throughout this report, we use the following operational definitions for key terms:

- **Benchmarks of postsecondary progress** refer to a minimum threshold on a measure of postsecondary progress that signals that a person is making adequate progress toward college and/or career success.
- **CCR standard** refers to a set of conditions or decision rules to determine whether a student (or high school graduate) meets the minimum expectations for CCR, based on benchmarks for one or more high school measures of CCR.
- **High school measures of CCR** (i.e., readiness measures) refer to measures of a student's performance or achievement during their K–12 academic career that could be an indicator of readiness to successfully progress through a postsecondary pathway.
- **Initial postsecondary pathway** refers to the postsecondary pathway a person starts in the fall after their fourth year of high school, regardless of whether they graduate from high school on time.
- **Measures of postsecondary progress** refer to post-high school measures of positive progress toward college and/or career success.
- **Postsecondary retention** is defined as continuous enrollment at the same postsecondary institution as a student's initial postsecondary pathway from one enrollment period to another.
- **Postsecondary pathways** refer to different sequences of college enrollment and/or workforce participation a person makes after exiting from formal K–12 schooling.
- **Postsecondary persistence** is defined as continuous enrollment at any postsecondary institution from one enrollment period to another.
- **Skills for success** encompass learning skills, thinking skills, communication skills, technology skills, and interpersonal skills that apply across content areas. Examples include collaboration, creativity, problem solving, and time management.[1] In the report, we use this term broadly to also capture related skills that are often referred to as employability skills, nonacademic skills, noncognitive skills, social and emotional skills, or interpersonal and intrapersonal skills.

C.1. Analysis Approach for Identifying CCR Knowledge and Skills (Objective 1)

To identify CCR knowledge and skills for Maryland students as well as those from top performing national and international education systems, we took a holistic approach that involved collecting, analyzing, and triangulating multiple forms of data. Key activities in this objective, which informed the content alignment analysis (section C.2), included:

- **An inventory of course requirements** to identify expectations for first-year credit-bearing English, math, and science courses and developmental courses at each Maryland community college, followed by **a programmatic survey** administered to college faculty and administrators to collect syllabi and related course materials (e.g., assessments, grading

[1] The term "Skills for Success" is used by MSDE's Career Development Office: https://marylandpublicschools.org/programs/Pages/CTE/careerdevelopment.aspx

rubrics) for the first-year courses, as well as additional details about learning objectives, course expectations, and perceptions of college readiness.

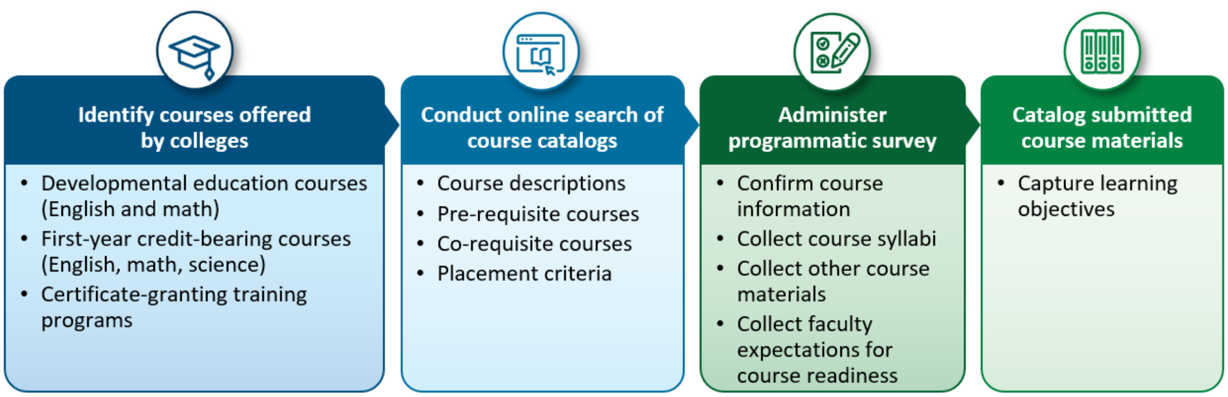
- **Stakeholder engagement via focus groups** with Maryland postsecondary faculty, workforce representatives, and K–12 leaders to provide important context to the information collected through the programmatic survey and to collect information on perceptions about potential sources of bias in assessments.
- **A landscape analysis** to explore how top-performing education systems approach assessing CCR.

In this section, we describe our methodological approach to each of these activities.

Course Inventory and Programmatic Survey

To inventory course requirements for entry-level and developmental courses, we collected and analyzed extant data on entry-level and developmental courses (Exhibit 2) and administered a programmatic survey to faculty and administrators at each community college.

Exhibit 2. Course Inventory Process



First, we identified first-year credit-bearing English, math, and science courses and developmental courses at each community college using information publicly available on college websites. This search provided initial insights into key themes in course descriptions. Common information collected includes course descriptions, ACCUPLACER score requirements, and prerequisites/corequisites. In total, the course inventory contains 241 courses across the 16 community colleges. Criteria for inclusion in the course inventory were:

- **Developmental English:** Non-credit-bearing English courses that served as prerequisites for 100-level English courses
- **First-Year Credit-Bearing English**: 100-level English courses that had no other 100-level English courses as prerequisites

- **Developmental Math:** Non-credit-bearing math courses that served as prerequisites for 100-level math courses
- **First-Year Credit-Bearing Math**: 100-level math courses that had no other 100-level math courses as prerequisites
- **Science**: Biology and physical science 100-level courses, grounded in the definition of the required science courses for general education; classes designed for general education students (non-biology majors); and/or classes with no other science prerequisites

Programmatic Survey. Based on the information collected and analyzed for the initial course inventory, we developed a programmatic survey to request faculty and administrators at community colleges to: (a) review the course information to confirm or correct what was collected and (b) submit course syllabi, learning objectives, assessments, and grading rubrics. We worked with the Maryland Higher Education Commission (MHEC) to distribute the survey invitation to the presidents of all 16 community colleges, who then shared the survey with the appropriate stakeholders at their institutions. Responses were provided most often by faculty (43%) followed by administrators (32%) and department chairs (24%). Division directors accounted for 6%, and course coordinators accounted for 3% of the respondents. Deans accounted for 2%, and other roles accounted for 2%.[2] In total, we received responses from 11 community colleges and syllabi for 144 of the 241 (60%) unique courses identified in the course inventory. In addition, we received supplemental information other than syllabi for 6 courses. Exhibit 3 details the number of courses identified, and number of syllabi collected per subject area.

Exhibit 3. Number of Courses Identified and Syllabi Collected per Subject Area

Subject area	Number of courses	Number of syllabi
Developmental math	73	41
First-year credit-bearing math	60	42
Developmental English	43	25
First-year credit-bearing English	34	18
Science	31	18
Total	**241**	**144**

The programmatic survey also included several questions related to CCR that asked respondents to offer their perception of the share of their students who are college-ready in a

[2] Survey respondents could select more than role/position, so the percentages by respondent type do not sum to 100%.

range of content areas (e.g., reading literature, algebra, scientific thought). Additional open-ended questions provided opportunities for respondents to share their perspectives on how learning objectives are set and revised and offer any other reflections on their expectations for and experiences with students' CCR (e.g., "Is there anything else you would like to share regarding expectations for college and career readiness for students in your courses?"). Appendix B includes the programmatic survey, and Appendix C provides a list of English, math, and science courses included in the course inventory.

Limitations. There are several limitations to the course inventory and programmatic survey. First, the course inventory was limited to information about courses that was publicly available via community college websites. Course information is not always presented consistently across colleges, and some courses that appear on websites may not be currently offered or fully up to date. Second, responses to the programmatic survey covered approximately 60% of courses in the course inventory. Although this represents nearly two-thirds of the courses we inventoried, findings from the survey and other analysis activities based on this information are limited to those courses for which we received survey responses. Finally, the course inventory and programmatic survey focus solely on Maryland community colleges. This is an appropriate starting point for this research, given the focus on entry-level and developmental course expectations; however, it is important to consider that there may be additional expectations in entry-level courses at other postsecondary institutions.

Stakeholder Input

To supplement and provide nuance to the information collected through the course and syllabi inventory, we engaged key stakeholders from postsecondary education; additionally, we included stakeholders from workforce and K–12 education to gather additional input to inform a common understanding of postsecondary readiness expectations from multiple perspectives. AIR conducted eight focus groups with a total of 41 participants. Exhibit 4 lists the focus groups, the number of participants, and who we collaborated with for outreach.

Focus Group Data Collection. To better understand the expectations that Maryland's postsecondary institutions have for students entering postsecondary education, we conducted five virtual focus groups with a total of 30 faculty and staff from postsecondary institutions in the state. To recruit participants, we worked with MHEC to share information about the focus groups with representatives from each of the postsecondary sectors, who then shared the invitation with stakeholders at their institutions. Of the postsecondary focus group participants, 16 were from community colleges, 12 were from public 4-year institutions, and two were from state-aided independent institutions. Participants represented institutions from different geographic regions in the state. The postsecondary focus groups were conducted separately by subject area: six participants for English, six participants for math, seven participants for science, five participants for career and technical education, and six participants for developmental education. Our sample size was consistent with best practices in qualitative research for facilitating focus groups and reaching "saturation," or the point at which no new insights are gained by increasing the sample size (Hennink & Kaiser, 2022). To provide additional perspectives to the data collected through the course inventory and programmatic survey (focused solely on community colleges), the focus groups and associated stakeholder engagement efforts allowed us to deepen our understanding of expectations for CCR across all institution types. See Appendix D.1 for more details about the participant distribution by subject area and institution type in the focus groups.

Exhibit 4. Focus Group Participation and Collaborators

Focus groups (8)	Number of participants	Outreach collaborators
Postsecondary (five focus groups) - English, math, developmental education, science, CTE	30	MHEC facilitated introductions with Maryland postsecondary sectoral representatives; those representatives received the focus group invitations and distributed to their institutions.
Workforce (two focus groups) - Trade, non-trade	4	MSDE's Office of College and Career Pathways distributed the focus group invitation to employers.
K–12 Education (one focus group) - ELA, math, science, CTE	7	Maryland's K–12 Content Collaboratives distributed the focus group invitation to K–12 teachers, instructional leaders, and administrators.
Total	**41**	

Note. ELA = English language arts; CTE = Career and technical education; MHEC = Maryland Higher Education Commission; MSDE = Maryland State Department of Education.

We aligned the focus group protocol with the guiding research questions related to the postsecondary perspective on CCR. The protocol focuses on questions about course readiness (e.g., the knowledge, skills, and abilities postsecondary stakeholders expect students to have entering college) and course design (e.g., approaches to teaching and learning). It also includes questions about potential bias in CCR expectations. Appendix D.2 provides the protocol used for the postsecondary education focus group.

In addition to the focus groups, the AIR team also sought input from the University System of Maryland (USM) provosts. We presented an overview of the Content and Standards Alignment Study to the USM provosts on February 28, 2023, and facilitated a discussion about their perspectives on CCR. Following the meeting, we distributed a short feedback form with open-ended questions for the provosts to provide additional feedback. We received six responses, providing additional context to the data collected through the five postsecondary focus groups and optional feedback form.

Additional Stakeholder Engagement. Although this study's primary focus was on understanding postsecondary content and expectations, AIR also invited workforce and K–12 stakeholders to participate in virtual focus groups to complement the insights gathered from the postsecondary stakeholders and provide additional context. To recruit workforce stakeholders, we worked in partnership with the leadership of MSDE's Office of College and Career Pathways to recruit participants. Our outreach targeted individuals in Maryland working in roles that were most connected with hiring and interfacing with incoming employees (e.g., hiring managers) in both the trade and nontrade fields.[3] In total, five individuals representing trade or nontrade fields participated in a focus group. To recruit participants for the K–12 focus group, we worked with Maryland's K–12 Content Collaboratives to distribute a request for participation to teachers, instructional leaders, and other K–12 staff across content areas. In collaboration with MSDE, we conducted one focus group with seven instructional leaders from ELA, math, science, and CTE content areas.

Consistent with our approach to the postsecondary focus group protocol, we aligned the protocols for these additional focus groups with guiding research questions related to expectations for CCR. Appendix D.2 provides the protocols used for both focus groups.

Focus Group Data Analysis. On average, focus groups lasted 60 minutes, and we audio recorded all focus groups for later transcription. To identify key themes and emerging insights related to guiding research questions, we conducted a thematic analysis. Thematic analysis is a qualitative analysis method that is designed to identify key themes and patterns in data; in a thematic analysis, researchers look for meaning across a data set and for shared meaning and themes related to identified research questions (Braun & Clarke, 2012).

Limitations. Our approach to gathering feedback through focus groups involved primarily postsecondary stakeholders, per the goals and design of this study. Although we were able to capture some additional, complementary perspectives from workforce and K–12 stakeholders,

[3] "Trade" fields refer to those that involve specialized skills and advanced training but do not always require a 4-year degree (e.g., construction, electric).

additional input from these groups might provide a more robust picture of stakeholder perceptions of CCR expectations in Maryland.

Landscape Analysis and Literature Review

To identify the knowledge and skills that top-performing education systems consider necessary for students to be college and career ready, we conducted a landscape scan and analysis of top-performing education systems, both national and international. In collaboration with MSDE, we identified three U.S. states and four countries on which to focus the landscape analysis. For each of these systems, we examined the design of their K–12 and higher education systems, definitions of CCR, expectations for CCR, and assessments that measure students' level of readiness (e.g., performance tasks, standardized tests).[4]

Identification and Selection of Education Systems for Analysis. To identify the national top-performing education systems for the landscape analysis, we considered factors like ACT and SAT benchmarks, K–12 performance, and postsecondary attainment by state. We identified the top-performing states on each of these factors, and then narrowed the options to those states that perform highly across all factors. In consultation with MSDE, we identified Colorado, Connecticut, and Massachusetts for in-depth analysis, with an eye toward comparability with Maryland and availability of data.

To identify top-performing education systems internationally, we collaborated with MSDE to develop an initial list of top-performing countries using the most recent data available from two international educational assessments: the 2018 Programme for International Student Assessment (PISA)[5] and the 2019 Trends in International Mathematics and Science Study (TIMSS)[6] (see Appendix E.1 for details). This list is based on countries that performed well on one or both assessments (above the OECD average on PISA and/or above the center point on TIMSS) as well as countries of particular interest to MSDE. In looking at both academic performance and structural components of the education system, we selected four countries for the in-depth landscape analysis that represent different features of the top-performing international education systems: Estonia, Germany, Japan, and Singapore. While we focused on these four countries, we considered other countries with top-performing education systems as

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[4] The landscape analysis and literature review were led by CALCO Consulting Group.
[5] Launched in 2000, the Programme for International Student Assessment (PISA) is a standardized test initially developed by experts across the Organisation for Economic Co-operation and Development (OECD) countries. PISA assesses reading, math, and science knowledge, and how to apply that knowledge, among 15-year-old students across multiple nations. See: https://ncee.org/top-performing-countries/
[6] Since 1995, the Trends in International Mathematics and Science Study (TIMSS) has assessed students in math and science in Grades 4 and 8 every 4 years and is sponsored by the International Association for the Evaluation of Educational Achievement (IEA). In 2019, TIMSS was administered across 64 countries and 8 benchmarking systems. See: https://timss2019.org/reports/achievement/

we developed recommendations as well. A summary of information for all countries reviewed can be found in Appendix E.2.

Landscape Analysis. The landscape analysis consisted of online searches and reviews of existing research literature to collect information on a set of key components, including the following:

- Design components of K–12 and higher education system (e.g., access, supports)
- Definitions of CCR
- Level of integration of expectations for CCR
- Assessments of CCR (e.g., performance tasks)
- Academic standards and skills for success important for CCR

We synthesized the information collected on these key components to provide an analysis of the focal states and countries. First, we gathered literature and relevant information for each state and country, and coded each document based on themes of interest, such as: "CCR definitions," "types of higher education (post-secondary) programs," "requirements for entry to such programs," "assessments," and "contextual factors." Based on this information, we conducted a comparative analysis to explore commonalities and differences across states and countries, generating findings that may inform Maryland's CCR efforts.

Limitations. We identified top-performing education systems based on available and commonly used data, along with collaboration with MSDE. One should not assume, however, that these educational systems are top performing because of their approach to CCR nor infer that the CCR approaches used by these education systems are models of "best practices." Drawing comparisons with international education systems is particularly challenging due to fundamental differences between these countries and the United States. For future studies, additional in-depth analyses of CCR expectations and education systems within the United States beyond those conducted in this study may provide more useful comparisons with Maryland and yield more feasible recommendations.

Conceptual Frameworks for Postsecondary Expectations

We developed conceptual frameworks to synthesize key information about what is expected of students and what they will need to know to succeed in the following Maryland college programs: developmental ELA and math courses and first-year credit-bearing ELA, math, and science courses. The information contained within the conceptual frameworks is aggregated from the course inventory, syllabi submitted through the programmatic survey conducted with the community colleges, and focus groups with postsecondary, workforce development, and K–12 stakeholders (as described above).

Our process of building conceptual frameworks for postsecondary expectations was based on our learning from the course and program inventory and stakeholder input. Our analysis followed an iterative process in which evidence from multiple sources of data continually inform each other to present a coherent picture of what students need to be prepared for postsecondary education (Miles & Huberman, 1984).

C.2. Analysis Approach for Content Alignment (Objective 2)

We examined alignment between high school content standards for Maryland students at the end of Grade 10 with content found within developmental English and first-year credit-bearing English courses, developmental math and first-year credit-bearing math courses, first-year credit-bearing science courses, and certificate-granting programs at the community college level. Exhibit 5 shows the postsecondary courses included in the analysis.

Exhibit 5. Postsecondary Courses Included in Content Alignment Analysis

Topic	Course type	Courses included
English	Developmental English	Developmental course focused on both reading and writing
	First-year credit-bearing English	100-level English composition courses without prerequisites
Math	Developmental math	Developmental course focused on foundations and fundamentals and pre-algebra
	First-year credit-bearing math	100-level math courses focused on foundations, algebra, statistics, and precalculus without prerequisites
Science	First-year credit-bearing science	100-level science courses focused on biological and physical science without prerequisites
Workforce training	Certificate-granting training programs	Top certificate-granting programs based on MACC Workforce Training Dashboard

AIR content experts (English, math, science, and CTE) used the information collected from the course and program inventory and the stakeholder engagement, along with the draft conceptual frameworks for postsecondary expectations where available, to complete an alignment analysis of the Maryland CCR standards and postsecondary content expectations. The analysis included four major steps, which are described in the following sub-sections. More information about the alignment analysis is provided in Appendices F and G.

Step 1. Compile Review Materials

AIR used the information collected through the course inventory and stakeholder input processes to develop a suite of materials that were used to ground the alignment review. These materials included: the conceptual frameworks for postsecondary education; output from researcher coding of college course syllabi along with the full college syllabi; college course descriptions and objectives from the college course inventory; the O*NET Content Model[7], Employability Skills Framework[8] and the Maryland high school standards (ELA Grade 9/10 standards, Disciplinary Literacy Grade 9/10 standards, math standards for Algebra I, Algebra II, Geometry, and Statistics, and the Next Generation Science Standards).[9]

Step 2. Develop Qualitative Alignment Index

AIR created a qualitative index of alignment for content teams to use to summarize the degree to which the Maryland high school standards align with postsecondary content expectations (Exhibit 6). Postsecondary readiness expectations are reflected in the conceptual frameworks for postsecondary expectations in Appendix H.

Step 3. Code Alignment of Standards

Content experts reviewed materials regarding content expectations, identified topics within academic standards, and coded the content alignment using the alignment index. The ELA and math teams conducted their alignment in small teams that provided opportunities for real-time discussion and calibration. In addition to coding, reviewers provided narrative justifications for their coding that referenced evidence of alignment or misalignment from data collected (i.e., course inventory, programmatic survey, focus groups). The AIR analysis team then aggregated the individual reviewer codes and summarized the rationales across high school standards to determine a single, more parsimonious, content alignment rating and rigor alignment rating for each high school standard (Exhibit 7). We aggregated the individual codes from each reviewer separately for both content alignment and rigor alignment using the median rating across reviewers.

Illustrative examples of the final ratings and rationale for specific high school standards and college course content are provided in Box 2. Additional information about the process for coding and analyzing alignment ratings is provided in Appendices F and G.

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[7] O*NET is managed and maintained by the U.S. Department of Labor and provides occupational information such as "standardized and occupation-specific descriptors on almost 1,000 occupations covering the entire U.S. economy" (https://www.onetcenter.org/overview.html).

[8] The Employability Skills Framework was developed by the U.S. Department of Education to support the work of the Office of Career and Technical Education (https://cte.ed.gov/initiatives/employability-skills-framework).

[9] The findings from the ELA and math alignment reviews were key inputs for the science alignment review since specific ELA and math connections are outlined within the Next Generation Science Standards (NGSS) and the majority of first-year credit-bearing science courses have prerequisite ELA and math knowledge expectations.

Exhibit 6. Qualitative Index for Content and Rigor Alignment Review

Content ratings	Rigor ratings
(5) Very Strong: Course content includes clear and sufficient language to suggest that the college courses cover the same content described in the high school standard.	**(5) Much Higher:** The language in the college course content describes a much higher level of cognitive demand than the high school standard.
(4) Strong: Course content includes clear and sufficient language to suggest that the college courses cover similar content as described in the high school standard. For example, the overall topics may be the same while the specific content varies slightly.	**(4) Higher:** The language in the college course content describes a somewhat higher level of cognitive demand than the high school standard.
(3) Weak: Course content includes clear and sufficient language to suggest that the college courses cover some of the same content as described in the high school standard. For example, the overall topics may be the same while the specific content varies considerably.	**(3) Similar:** The language in the college course content describes a similar level of cognitive demand than the high school standard.
(2) Very Weak: Course content includes clear and sufficient language to suggest that the college courses cover little of the same content described in the high school standard.	**(2) Lower:** The language in the college course content describes a lower level of cognitive demand than the high school standard.
(1) Not Addressed in college course: Course content does not include any language suggesting the college courses cover the same or similar content described in the high school standard.	
(0) Unable to Determine: Reviewers were unable to determine a rating due to lack of information.	

Exhibit 7. Qualitative Rating of Content and Rigor Alignment for Reporting

Content ratings	Rigor ratings
(4–5) Aligned: Course content includes clear and sufficient language to suggest that the college courses cover the same or similar content described in the high school standard. For example, the overall topics may be the same while the specific content varies slightly.	**(4–5) Higher in college course:** The language in the college course content describes a higher level of cognitive demand than the high school standard.
(2–3) Partially Aligned: Course content includes clear and sufficient language to suggest that the college courses cover some or little of the same content described in the high school standard. For example, the overall topics may be the same while the specific content varies considerably.	**(3) Similar to college course:** The language in the college course content describes a similar level of cognitive demand than the high school standard.
(1) Not Addressed in college course: Course content does not include any language suggesting the college courses cover the same content described in the high school standard.	**(2) Lower in college course:** The language in the college course content describes a lower level of cognitive demand than the high school standard.
	(1) Not Addressed in college course: Course content does not include any language suggesting the college courses cover the same content described in the high school standard.

BOX 2. EXAMPLES OF HOW THE ALIGNMENT BETWEEN HIGH SCHOOL ELA WRITING STANDARDS AND DEVELOPMENTAL COLLEGE ENGLISH COURSE CONTENT EXPECTATIONS WERE RATED

- **High School ELA Standard W.9–10.5.** 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.
  - **Content Alignment Rating**: Aligned with college course content expectations

    Rationale: Reviewers noted that college course content had an explicit emphasis on rhetorical knowledge and the writing and revision process.
  - **Rigor Rating**: Similar to college course content expectations

    Rationale: Reviewers viewed the level of the high school writing content as similar to that of the developmental college course content.
- **High School ELA Standard W.9–10.6.** 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.
  - **Content Alignment Rating**: Partially aligned with college course content expectations

    Rationale: Reviewers found minimal mentions of technology in college course content and most often when mentioned it was in the context of technology use for the course rather than for writing. Use of technology for writing was implied but not explicit.
  - **Rigor Rating:** Not addressed in college course

    Rationale: Because content regarding use of technology for writing was limited in college courses, rigor could not be assessed.
- **High School ELA Standard W.9–10.3.** Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
  - **Content Alignment Rating**: Not addressed in college course

    Rationale: Reviewers did not find mentions of writing narrative texts in the college English developmental course syllabi. The focus of the courses was on expository and academic writing.
  - **Rigor Rating**: Not addressed in college course

    Rationale: Because content was not found in college courses, rigor could not be assessed.

Step 4. Analyze Alignment Ratings and Justifications

Following the completion of alignment coding, we developed content maps to provide an easily understandable visual representation of alignment between Maryland high school content standards and postsecondary content expectations. As part of the content mapping, we summarized the content alignment and rigor alignment ratings for each content standard at the standard cluster level and standard strand/domain level. To summarize the alignment ratings at these more aggregate levels, we used the median content alignment and rigor alignment ratings for content standards within a given cluster or strand/domain.

There was no expectation that all of Maryland's high school standards should align with the postsecondary content expectations of developmental or first-year credit-bearing college courses. In fact, the underlying assumption is that not all high school standards should be fully aligned, given the breadth and depth of the high school standards and the specific focus areas found on which postsecondary course content is grounded. In addition, the postsecondary content expectations for first-year college courses should not perfectly overlap with the high school standards because the college coursework should build upon the foundational knowledge students acquire in high school rather than repeating high school content. A lack of alignment should not be interpreted as a negative finding.

In addition to the content maps, AIR conducted a qualitative analysis of the narrative justification reviewers provided for the ratings to identify themes related to alignment and misalignment to inform actionable recommendations.

Limitations

Findings from the content and standards alignment analysis should be interpreted with the following limitations and considerations in mind:

- The math content alignment analysis focused solely on Maryland's high school math standards and content from a selected set of community college math courses. The same is true of high school ELA standards and community college English courses. Therefore, the findings may not be generalizable to other types of educational institutions in the state.
- The analysis relied on document review (e.g., course syllabi, focus group transcripts). These documents do not encompass all classes categorized as developmental or first-year credit-bearing at the college level, and not all colleges submitted syllabi. Reviewers relied on documents that varied in terms of specificity and depth. The summation of syllabus information from differing and decentralized institutions required reviewers to make some generalizations.
- While student learning objectives were available within course syllabi, little information was provided related to instructional strategies or curricular materials. This lack of specificity within syllabi resulted in reviewers making some alignment determinations based on implicit alignment.
- There may be variations in the actual course implementation and classroom practices compared to what is described in the syllabus.

- Our analysis does not address quality of instruction (at the high school or postsecondary level), or the availability and quality of student supports, all of which impact the degree to which students are able to meet content expectations.

C.3. Analysis Approach for the Predictive Validity of the Interim and Alternative CCR Standards (Objective 3)

In this section, we describe the key components of our approach to the predictive validity analysis. We describe the data sources, student samples, measures of CCR and postsecondary progress, and our data analysis methods.

Data Source

We used data from the Maryland Longitudinal Data System (MLDS) Center to conduct the predictive validity analysis. The MLDS connects student data from across Maryland's education and workforce agencies, including MSDE, the Maryland Higher Education Commission, and the Maryland Department of Labor. These data support the examination of student preparation, progress, and outcomes across time, K–12 public schools, postsecondary education and training, and the workforce.

We accessed MLDS data from as far back as the 2011–12 school year and as recently as the 2021–22 school year (the most recent year of data available at the time we started the analysis). The K–12 data cover only those students who attended a Maryland public school, and the postsecondary data on course credits are available for only those students who attended a Maryland college or university affiliated with the Maryland Higher Education Commission.

Students Included in the Analysis

The analysis includes Maryland public high school students who were in one of five cohorts, defined by students' expected on-time high school graduation year from the time they were a first-time ninth grader.[10] Because the analysis requires data from a student's time in high school and, minimally, the first year after high school, we included students who were in the expected high school graduation classes of 2017–2021 (Exhibit 8). Throughout this report, we refer to years relative to when a student entered ninth grade, such that the first year is High School Year (HSY) 1 and the fourth year is HSY4. After the expected on-time high school graduation year, we refer to years relative to the expected postsecondary year (i.e., Postsecondary Year [PSY] 1 for the first year after expected high school graduation). Students in the class of 2017, for example, started ninth grade in the 2013–14 school year (HSY1), were

[10] We determined a student's first-time ninth-grade year based on the end-of-year grade level for each student. A student could be assigned to a particular cohort in one of three ways: (a) the student was in Grade 9 in HSY1 and Grade 8 the previous year; (b) the student was in Grade 9 in HSY1 and not in a Maryland public school the previous year; or (c) the student was in Grade 10 in HSY2 and not in a Maryland public school in HSY1.

expected to graduate high school in the 2016–17 school year (HSY4), and would then enter an initial postsecondary pathway in the 2017–18 school year (PSY1).

Three of the student cohorts (the classes of 2019, 2020, and 2021) had their high school and/or initial postsecondary experiences disrupted by the COVID-19 pandemic. We examined results broken out by cohort to see if our findings might be distorted by the COVID-19 pandemic.

Exhibit 8. Student Cohorts and Timing of High School and Postsecondary Progress

School year	Expected on-time high school graduation class year				
	2017	2018	2019	2020	2021
2013–14	HSY1				
2014–15	**<u>HSY2</u>**	HSY1			
2015–16	HSY3	**<u>HSY2</u>**	HSY1		
2016–17	**<u>HSY4</u>**	HSY3	**<u>HSY2</u>**	HSY1	
2017–18	PSY1	**<u>HSY4</u>**	HSY3	**<u>HSY2</u>**	HSY1
2018–19	PSY2	PSY1	**<u>HSY4</u>**	HSY3	**<u>HSY2</u>**
2019–20	PSY3	PSY2	PSY1	**<u>HSY4</u>**	HSY3
2020–21	PSY4	PSY3	PSY2	PSY1	**<u>HSY4</u>**
2021–22		PSY4	PSY3	PSY2	PSY1

Note. HSY# = high school year; PSY# = postsecondary year (number of years a student has been in a postsecondary pathway if they graduated on time from high school). The years in bold underline indicate the years the student samples and high school measures of CCR were defined.

Student Samples

Because the *Blueprint* calls for the assessment of student readiness "by the end of 10th grade, and not later than the end of 12th grade," our primary student sample was restricted to students enrolled in a Maryland public high school at the end of their second year of high school (HSY2), when most students should be in Grade 10. Exhibit 9 presents, by cohort, the total number of students included in the primary sample. Overall, the primary sample includes 318,967 students, and about 85% of them were on-time high school graduates. The graduation rates are consistent across cohorts, providing evidence that any COVID-19 pandemic disruptions did not significantly alter high school graduation rates for the classes of 2020 and 2021. Student characteristics for the primary student sample are in Exhibit 10.

Exhibit 9. Number of Students in the HSY2 Sample and Percentage With On-Time High School Graduation, by Cohort

Student cohort	Number of students in HSY2 sample	Percentage with on-time high school graduation
Total student sample	318,967	85%
Class of 2017	61,514	86%
Class of 2018	63,775	85%
Class of 2019	63,020	85%
Class of 2020	65,853	85%
Class of 2021	64,805	86%

Note. HSY = high school year.

Initial Postsecondary Pathways

What constitutes "readiness" and which measures of postsecondary progress are available may depend on the postsecondary pathway a student takes after high school. As a result, we disaggregated the student samples based on a student's initial postsecondary pathway. Initial postsecondary pathways were defined based on enrollment in each type of postsecondary institution in the fall term immediately following expected on-time high school graduation (e.g., Spring 2017 high school graduates enrolling in postsecondary institutions in Fall 2017). We categorized students into the following postsecondary pathways:

- Maryland community colleges (i.e., public 2-year institutions)
- Maryland public 4-year institutions (e.g., University System of Maryland institutions)
- Maryland state-aided independent 4-year institutions
- Non-Maryland 4-year institutions[11]
- Non-Maryland 2-year institutions[12]
- No college enrollment (i.e., students who have no college enrollment record in the fall term after expected on-time high school graduation)

[11] We included the U.S. Naval Academy in the non-Maryland pathway because it is a federally operated institution. Approximately 50 students in our sample enrolled at the U.S. Naval Academy for their initial postsecondary pathway.
[12] Fewer than 10 students enrolled at an out-of-state less-than-2-year institution.

Our primary analysis focuses on students who enrolled in a Maryland postsecondary pathway. A list of the colleges and universities included in each Maryland postsecondary pathway is in Appendix I (Exhibit I.1.1).

Exhibit 10. Student Characteristics for the Grade 10 Sample, by Selected Initial Postsecondary Pathways

Student characteristic	Grade 10 sample (HSY2)	MD community college	MD public 4-year institution	MD state-aided independent institution	No enrollment
Total number of students (% of Grade 10 sample)	318,967 (100%)	61,663 (19%)	51,067 (16%)	8,272 (3%)	146,756 (46%)
Sex/gender (%)					
Female	49%	52%	55%	66%	42%
Male	51%	48%	45%	34%	58%
Race/ethnicity (%)[a]					
Asian	7%	7%	16%	7%	3%
Black/African American	34%	31%	34%	33%	38%
Hispanic/Latinx	16%	16%	6%	12%	23%
White	40%	42%	39%	45%	33%
Multiracial	4%	4%	4%	4%	4%
Percentage English learners, current[b]	6%	4%	1%	2%	12%
Percentage English learners, recent exit[b]	4%	6%	5%	5%	4%
Percentage students with disabilities	10%	8%	2%	3%	17%
Percentage FARMS eligible	38%	34%	22%	29%	53%

Note. Student characteristics were defined based on a student's status as of the end of their HSY2. FARMS = free and reduced-price meal services; HSY = high school year. Students whose initial postsecondary pathway was a non-Maryland postsecondary institution (n = 48,837) are not included in the table.

[a] Less than 1% of students were classified as American Indian, Alaska Native, Native Hawaiian, or Pacific Islander.

[b] For the purposes of our analysis, students were considered a current EL if they were classified as an EL at the end of their HSY2. English learners were considered a recent exit if they were reclassified within 2 years prior to the end of their HSY2.

Across the five student cohorts examined, about half of the students (54%) attended a college in the fall immediately after their HSY4. About 38% of the HSY2 student sample attended a Maryland college. Student characteristics for each of the initial postsecondary pathways are presented in Exhibit 10. See Appendix I for breakdowns of the percentage of the HSY2 student sample in each initial postsecondary pathway (i.e., the pathway in the fall of PSY1) by cohort (Exhibit I.1.2), student group (Exhibit I.1.3), and local educational agency (LEA) (Exhibit I.1.4).

High School Measures of CCR

Our analysis of high school measures of CCR was limited to measures available in the MLDS data for the years students in our study sample were in high school. The interim CCR standard, for example, is based on the state assessment for English 10, Algebra 1, Algebra 2, and Geometry, as well as the SAT Math Test. In addition to the tests included in the interim CCR standard, we sought to examine other test-based measures and non-test-based measures available in the MLDS that might be used to determine CCR. The additional test-based measures we considered include the PSAT (composite, reading, and math), SAT (composite, reading, and math), and ACT (composite, reading, and math). For the non-test-based measures, we considered HSGPA and advanced course success. Other potential measures of CCR, such as placement tests commonly used by community colleges, were not included in our analysis because they are not typically administered to students while they are in high school.[13]

Although our intent was to examine each measure considered, many of the measures were not available for most of the students in our study sample. For example, Algebra 2 and Geometry PARCC scores did not exist for more than half of the students, and ACT scores did not exist for more than 80% of the students. Given the data limitations for many of the potential measures and the *Blueprint*'s emphasis on assessing readiness by the end of a student's 10th-grade year, we restricted the primary analysis for the final report to three high school measures of CCR: English 10 state assessment scores, Algebra 1 state assessment scores, and overall HSGPA (see Exhibit 11). This final set of potential CCR measures was selected for consideration in our analysis based on our findings from the academic literature, our content and standards alignment review, an exploratory analysis of the relationship between high school measures and postsecondary progress, and preliminary findings from the predictive validity interim report.[14] For example, findings from the advanced statistics analysis (machine learning) indicated that HSGPA is the most important high school measure for identifying students who are college and career ready or not (see Appendix K). For the primary analysis, we defined measures of CCR by the end of a student's HSY2.[15]

[13] See Appendix I for details regarding the additional measures of CCR we examined.
[14] See Appendices J and K for the full approach and results of the exploratory analysis.
[15] As an exploratory step, we also defined measures of CCR by the end of a student's HSY4. See Appendix I for additional details.

Exhibit 11. Focal High School Measures of College and Career Readiness for the Primary Predictive Validity Analysis

Measure	Description
English 10 state assessment score[a]	Scale score on the HSA Reading or PARCC English 10 assessment. We converted the HSA scores to PARCC-equivalent scores using the concordance table developed by MARC (2016).
Algebra 1 state assessment score[a]	Scale score on the HSA Algebra or PARCC Algebra 1 assessment. We converted the HSA scores to PARCC-equivalent scores using the concordance table developed by MARC (2016).
Overall GPA[b]	Student's unweighted cumulative GPA calculated by taking the sum of all grade points earned in every course they took for a grade in the first 2 years of high school and divided by the sum of all units attempted for a grade during the same period.

Note. HSA = Maryland High School Assessment; HSGPA = high school grade point average; MARC = Maryland Assessment Research Center; MSDE = Maryland State Department of Education; NMSQT = National Merit Scholarship Qualifying Test; PARCC = Partnership for Assessment of Readiness for College and Careers. For additional details on the methodology adopted to calculate HSGPA, see Appendix I.

[a] Measure is part of the interim CCR standard.

[b] Overall HSGPA is strongly correlated with two other versions of HSGPA we considered: (a) HSGPA for academic subjects only and (b) HSGPA for core academic subjects only.

In addition to the focal high school CCR measures outlined above, we also explored several other potential measures including additional standardized test scores (e.g., PSAT) and measures of advanced course completion (e.g., AP, IB, dual enrollment, and CTE courses). See Appendix I for additional details about all the potential measures considered for our analysis. Based on correlations among all the potential measures, results for the three focal measures should reasonably capture the range of results we would expect from the broader set of potential measures.[16]

Measures of Postsecondary Progress

To assess the quality of different high school measures of CCR, we examined how well the high school measures of CCR predicted progress toward postsecondary success. For our primary predictive validity analysis, we examined two measures of postsecondary progress that focus on success in first-year credit-bearing college coursework: (a) the number of college course credits accumulated in the first-year fall term (PSY1F) and (b) whether a student passed at least one credit-bearing, college-level course in three subject areas: English, math, science.

[16] For example, the Algebra 1 state assessment scores are strongly correlated with Algebra 2 and Geometry state assessment scores, whereas the PSAT composite scores are strongly correlated with SAT and ACT scores. In addition, SAT scores and advanced course success are relevant for only the HSY4 time point. See Appendix Exhibit I.2.5 for the full set of correlations between measures.

The measures of postsecondary progress, and the associated benchmarks we used to proxy "successful" progress, are outlined in Exhibit 12. The percentage of students who met each of the focal benchmarks is provided in Appendix I. For credit accumulation, we selected the benchmark that corresponds to earning at least 12 credits in the first term, which means that a student successfully completed at least four 3-credit hour courses. We selected 12 credits as a benchmark because it is a credit-earning threshold typically used to determine Satisfactory Academic Progress for federal financial aid purposes for full-time students.

In addition to the primary analysis, we conducted a series of supplemental analyses to examine whether results from our primary predictive validity analysis hold up for alternative measures of postsecondary progress and for students who do not attend a Maryland postsecondary institution immediately after high school. We explored how well our potential CCR measures perform for three additional measures of postsecondary progress: (a) GPA during the first year of postsecondary education, (b) retention at the same postsecondary institution from fall to spring within PSY1 and from fall PSY1 to the following fall in PSY2, and (c) persistence in any postsecondary college pathway at the same two time points as the retention measure.[17] While GPA is a common measure of postsecondary performance, we excluded it from the primary analysis due to concerns with the timing and completeness of the GPA data, as well as potential relationships between GPA and the number of courses a student takes in a semester. Retention and persistence measures, which are based on enrollment records and require no course-level data, are available for all students whose initial postsecondary pathway begins with college enrollment, including in-state and out-of-state institutions. These two measures provide a more comprehensive view of students' progress through the broader higher education system, which often includes transferring between postsecondary institutions (e.g., moving from a community college to a 4-year university, initially enrolling at an out-of-state university but returning to Maryland after one semester). In addition, these measures may serve as more meaningful measures of postsecondary progress (i.e., continued enrollment) for students unable to enroll full-time due to work and family obligations, particularly community college students. We present results from the supplemental analysis that uses these measures in Appendix L.4.

[17] Retention is defined as continuous enrollment at *the same* postsecondary institution as a student's initial postsecondary pathway, whereas persistence is defined as continuous enrollment at *any* postsecondary institution.

Exhibit 12. Focal Postsecondary Progress Measures for the Primary Predictive Validity Analysis

Measure	Description	Benchmark	Included population
Credit accumulation	Cumulative number of postsecondary credits applicable toward a recognized postsecondary credential (e.g., certificate, degree) awarded to a student. Credits include both those earned at the reporting institution and at other postsecondary institutions (i.e., transfer-in credit).[a]	Accumulating 12 credits in the first year fall term (PSY1F)[b]	• Includes students who enrolled in the fall term after expected on-time high school graduation. • Includes Maryland community colleges, 4-year public, and 4-year state-aided independent institutions.
Subject course passing	Whether a student passed at least one credit-bearing, college-level course in three subject areas: English, math, science.[c]	Passing a first-year course in math, English, or science	• Includes students who enrolled in subject-specific course(s) at any time through PSY1, inclusive of dual enrollment while in high school. • Includes Maryland community colleges and 4-year public institutions.

[a] Credit accumulation includes postsecondary credits earned while in high school (e.g., dual enrollment, AP), summer enrollment immediately following high school graduation, and postsecondary enrollment at multiple institutions (e.g., taking one course at a community college while predominantly enrolled at a 4-year university), with the assumption that students submit their outside postsecondary credits earned to their postsecondary pathway institution.

[b] Additional credit accumulation benchmarks tested include accumulating 15 credits in the first-year fall term (PSY1F), and 24 or 30 credits in the first-year spring term (PSY1S). Credits for the spring term represent the cumulative number of credits for the entire first year, not just the spring term. See Appendix L.2. for results based on these additional college credits benchmarks. At the time of data collection for this study, credit accumulation data were not available in the Maryland Longitudinal Data System Center's source files for spring 2022. Therefore, for the 2021 cohort, credit accumulation values are available only for students' first fall term (i.e., fall 2021).

[C] Course passing status was determined by students' course-level records though PSY1, which could include postsecondary records before high school completion. Due to differences in course coding systems across institutions, math courses include three unique subject codes (e.g., MATH, MTH), English courses include three unique codes (e.g., ENGL, ENG), and science courses include 20 unique codes (e.g., BIO, CHEM).

We examined the predictive validity of the high school measures of CCR for students who did not attend a postsecondary institution immediately after high school in two ways. First, we used employment and earnings data in the first year after expected high school graduation as a proxy for "career progress." Second, we examined college credits earned and college GPA for students who delayed their enrollment by a semester or year. We present results from the supplemental analysis that uses these measures in Appendix L6 and L7, respectively.

Data Analysis

We used a classification approach to assess the predictive validity of the interim CCR standard and alternative specifications of the standard as an instrument for identifying (or screening) students who are or are not on track for CCR. Our analysis uses metrics of classification accuracy and error to understand how well the dichotomous indicator of CCR at the end of HSY2 predicts different dichotomous benchmarks of postsecondary progress during the first year after expected high school graduation. Additional details about our approach and the classification metrics are provided in Appendix I.

Predictive Validity Metrics

- **Accuracy rate:** The probability of correctly identifying a student as ready or not ready to make postsecondary progress (i.e., "true positive" and "true negative").
- **Sensitivity rate:** The probability of correctly identifying students who are truly ready to make postsecondary progress.
- **Specificity rate:** The probability of correctly identifying students who are truly not ready to make postsecondary progress.

For simplicity of presentation and interpretation, we focus on the accuracy rate metric because it provides an overall picture of a standard's predictive validity (i.e., how well the standard classifies students as ready or not ready to make postsecondary progress). We calculated each predictive validity metric using different postsecondary progress benchmarks. However, the accuracy rate can change depending on how common (or rare) it is for a student to meet a given benchmark, which may distort comparisons across postsecondary benchmarks or across student groups.

The sensitivity and specificity rates provide a more detailed picture of a standard's validity and are more appropriate for comparisons between postsecondary benchmarks and student groups. In addition, the sensitivity and specificity rates are important metrics when considering the practical trade-offs of incorrectly identifying a student as not ready when they truly are (Type II error = 1 – the sensitivity rate) or incorrectly identifying a student as ready when they truly are not ready (Type I error = 1 – the specificity rate).

While there are no established standards for what level of accuracy, sensitivity, and specificity is appropriate for an indicator of CCR, rates of at least 70% are typically desired for diagnostic or screening instruments used to identify students for academic interventions (National Center on Intensive Intervention & National Center on Improving Literacy, n.d.).

To examine whether performance of the interim CCR standard and alternative specifications of the CCR standard differ across student groups and contextual factors, we disaggregated results by initial postsecondary pathway (where appropriate), student group, and Maryland region.

The MLDS Center defines Maryland regions, where larger LEAs constitute their own region (e.g., Baltimore County) and smaller LEAs are grouped into the following regions: Lower Shore (Somerset, Wicomico, and Worcester Counties), Mid Maryland (Carroll and Howard Counties), Southern Maryland (Calvert, Charles, and St. Mary's Counties), Susquehanna (Cecil and Harford Counties), Upper Shore (Caroline, Dorchester, Kent, Queen Anne's, and Talbot Counties), and Western Maryland (Allegany, Garrett, and Washington Counties). For the predictive validity analysis, students were assigned a region on the basis of the LEA they attended at the end of their second year of high school.

In addition to the traditional classification analysis, we conducted a supplemental analysis using more advanced statistical methods that utilize machine learning techniques. Results from this analysis are presented in Appendix K and were used to inform how to define alternative specifications of the CCR standard.

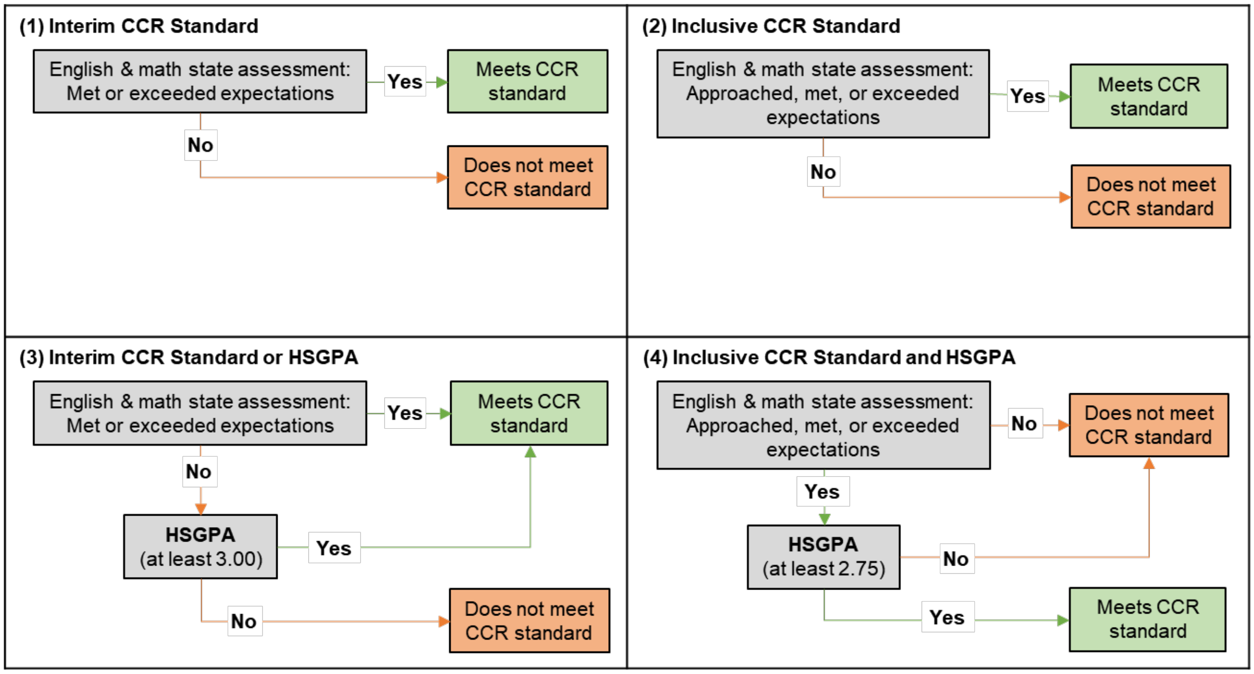
Alternative Specifications of the CCR Standard

To examine whether there are ways to improve the predictive validity of the interim CCR standard, we assessed the validity of 13 alternative CCR standards. Three principles guided how we selected alternative CCR standards to test:

- Use high school measures (and thresholds) that are intended to reflect student learning or mastery of skills expected to relate to CCR based on prior research, the interim or exploratory analyses conducted for this study, or stakeholder input collected as part of this study.
- Use high school measures that are readily available for most Maryland public high school students, particularly by the end of Grade 10.
- Define the CCR standard in a way that is transparent for students, parents, and school administrators.

For simplicity of presentation and interpretation, the presentation of results in the main body of the report focuses on the interim CCR standard and three alternative standards defined at the end of a student's HSY2 (see Exhibit 13). These three options illustrate alternative specifications that tend to be more accurate than the interim CCR standard by either lowering the state assessment threshold or incorporating HSGPA into the standard. Findings from the advanced statistical methods analysis (machine learning) indicated that an HSGPA threshold of about 3.00 best distinguished between students who are college and career ready or not (see Appendix K). In addition to the focal alternative specifications for the CCR standard, we tested alternative specifications that incorporated the PSAT, advanced course completion (AP or IB), CTE course completion, and dual enrollment. Definitions for every alternative standard we tested are provided in Appendix I (Exhibit I.4.1). Overall results for every alternative standard we tested are presented in Appendix L. In general, these other approaches did not improve accuracy rates to the same degree as the focal alternative specifications.

Exhibit 13. Four Versions of the CCR Standard Evaluated for the Predictive Validity Analysis



Note. Students could meet the math state assessment criterion by scoring at or above the threshold on the Algebra 1, Algebra 2, or Geometry state assessment. In addition, students could meet the math state assessment criterion by scoring at least 520 on the SAT math test. HSGPA = high school grade point average; CCR = college and career readiness.

Limitations

When interpreting the findings from the predictive validity analysis, it is important to consider the following potential limitations of the data and analysis.

- The results from the high school graduation classes of 2017–2021 may not apply to future student cohorts. We included five student cohorts in our analysis to minimize concerns that our results are specific to a particular time period, but the COVID-19 pandemic created unique challenges for the more recent cohorts in our sample, and shifting economic, educational, and college admissions conditions may influence factors associated with CCR, the selection of postsecondary pathways, and/or postsecondary progress. Similarly, a CCR standard was not in place when the students in our sample were in high school. The introduction of a CCR standard, and associated accountability policies, may alter students' high school and/or postsecondary experiences in ways that shift the predictive validity of specific measures.

- The results reflect averages for Maryland college-going students and may not directly apply to specific students or postsecondary situations. Throughout our analysis, we present results across different student groups and college sectors to gauge the extent to which the findings differ across contexts, but there may be a great deal of unexplored variation within the broad categories we examined. We did not, for example, look at how the results differ for students who pursue different areas of study within a college sector (e.g., an engineering major versus an anthropology major at a 4-year institution).
- The analysis is restricted to measures available for Maryland public high school students. This data limitation means that we could not examine the performance of the MCAP, for example, which is the current state assessment that will be used to determine whether students meet the CCR standard. Student performance scores on the MCAP are not available for students who already transitioned from high school to a postsecondary pathway. As a result, our analysis of state assessment scores is primarily based on the PARCC. Given that the PARCC and MCAP tests cover very similar content and given the strong correlations we see between high school tests of the same subject, we expect results based on the PARCC to apply to the MCAP as well. However, without data to formally test this assumption, one should still consider the implications of the change in state assessments. In addition, we were not able to examine factors many consider important for CCR, such as self-management and self-regulatory skills, because they are not systematically measured in the state.

C.4. Analysis Approach for Identifying Areas of Bias Within Assessments Used to Determine CCR (Objective 4)

To identify areas of bias within assessments, we conducted a literature review and gathered input from stakeholders via focus groups.

Sources of Bias in CCR Assessments

To identify potential sources of bias in assessments, the primary activity was a literature review. We reviewed existing research literature on: assessments commonly used to determine CCR (e.g., ACCUPLACER, PARCC); potential sources of bias in these types of assessments and on standardized assessments in general; and studies that specifically tested commonly used CCR assessments for bias. We primarily included findings from articles published in academic journals (e.g., *Community College Review, Educational Researcher, Education Economics*). We prioritized sources that were published within the last five years, were found in peer-reviewed journals, or from independent third-party organizations that steward education data.

Because much of the available literature is related to the types of assessments that are used and to sources of bias in assessments in general, rather than specific studies about bias in individual assessments, we also identified literature on potential sources of bias that come from inequities in preparation for assessments.[18]

Stakeholder Input

In addition to the literature review, we included questions about potential sources of bias in assessments in the postsecondary focus group protocol (Appendix D.2). To identify insights from the focus group data, we conducted a thematic analysis. As described earlier in Section C.1, thematic analysis is a qualitative analysis method that is designed to identify key themes and patterns in data; in a thematic analysis, researchers look for meaning across a data set and for shared meaning and themes related to identified research questions (Braun & Clarke, 2012).

D. Findings

In this section, we present key findings for all four objectives of the study. We draw on multiple sources of data to address each objective.

D.1. Knowledge and Skills Required to Be College and Career Ready (Objective 1)

We begin by presenting summaries of the conceptual frameworks, which synthesize knowledge and skills required to be college and career ready in Maryland. Next, we describe key stakeholders' perceptions of students' knowledge and skills when they enter college or postsecondary courses. We then describe findings related to CCR from the analysis of top-performing educational systems nationally and internationally.

Conceptual Frameworks for Postsecondary Expectations

The conceptual frameworks summarize our understanding of what knowledge and skills are needed to succeed in entry-level college courses. Essentially, they serve as a composite of common course content across Maryland's 16 community colleges. Conceptual frameworks for developmental courses show what students should have learned in high school, even though they may not be college ready; and frameworks for first-year credit-bearing courses show what is expected of students who are college ready. We provide a high-level description below identifying topic coverage in each content area as reflected in the conceptual frameworks. The full conceptual frameworks for postsecondary expectations are provided in Appendix H.

Developmental English. Developmental English courses integrate reading and writing instruction to prepare students for success in college-level credit-bearing courses. Students learn to use the conventions of standard written American English to establish a clear purpose

[18] The literature review was led by CALCO Consulting Group.

in their writing, use information from texts and research to support their ideas, adapt their writing to suit a range of audiences, and gain an understanding of the writing process by incorporating feedback. Students engage with texts by reading, annotating, summarizing, and analyzing. Students also focus on developing their vocabulary, critical thinking skills, and other skills.

First-Year Credit-Bearing English (English Composition). First-year credit-bearing English composition courses offer instruction and practice in the skills that are necessary to read college-level texts critically; write effective, persuasive, thesis-driven text; understand the recursive writing process; and incorporate feedback into writing. Students learn to use the conventions of standard written American English to establish a clear purpose in their writing, support their purpose with adequate and pertinent evidence, and adapt their writing to suit a range of audiences. Students also learn how to conduct academic research, navigate a library's resources, and correctly cite sources.

Developmental Math. Developmental math courses provide students with the foundational mathematical knowledge and skills that are necessary for success in college entry–level math courses. These courses typically focus on strengthening fundamental concepts in arithmetic, algebra, geometry, and statistics to ensure students have a solid mathematical foundation. Expectations include developing proficiency in basic operations, understanding numerical relationships, solving equations and inequalities, working with geometric concepts, and analyzing and interpreting data. Developmental math courses also emphasize problem-solving strategies, critical thinking skills, and effective communication of mathematical ideas to support students in overcoming mathematical challenges and building confidence in their mathematical abilities.

First-Year Credit-Bearing Math. First-year math courses develop a solid foundation in fundamental mathematical concepts and skills across various domains, including arithmetic, algebra, geometry, and statistics. Students are expected to demonstrate proficiency in problem solving, critical thinking, mathematical reasoning, and communication. They should be able to analyze and interpret mathematical information; apply mathematical techniques to solve problems; and effectively communicate mathematical ideas, both orally and in written form. Students also are expected to use mathematical modeling and data analysis, and to use technology and digital tools to enhance understanding and visualization of mathematical concepts.

Science. Physical science courses typically cover content from several physical science disciplinary ideas. These include matter and its interactions, motion and stability, energy, and waves and their applications in technologies for information transfer. Courses also include scientific methods and math skills along with developing skills in investigation, information use, and critical thinking. Life science courses typically include content from several life science disciplinary ideas. These include biochemistry, structures and processes of molecules and organisms, as well as ecosystems, heredity, and biological evolution. Courses also include scientific methods, and information and technology use.

While workforce training did not have sufficient publicly available detail for the generation of a full conceptual framework for postsecondary expectations, we provide a high-level description of coverage:

Technical Education. The content of workforce training programs is tremendously varied, with Maryland community colleges offering more than 300 Workforce Training Certificate programs across 11 industries. Workforce training certificate programs include skills in trades, communications, manufacturing, health care, education, transportation, public safety, business, and professional skills, among others.

Perceptions of Student Readiness for Postsecondary Courses

Postsecondary stakeholders identified reading, writing, precalculus, and scientific thought as areas of concern for incoming students. In the focus group discussions, English course stakeholders reported that critical reading and writing are areas where students are not performing at college level. As one stakeholder's comment exemplifies:

> Some of our students are being held back by their [in]ability to read and write.

Survey responses suggest that students' ELA readiness is stronger for the "English language" component of the ELA standards than it is for other components, with more than half of respondents (53%) reporting that 81% or more of their students were college ready in "English language." Only 30% of the respondents reported that 81% or more of their students were college ready in "speaking and listening." Survey responses about perceptions of readiness for reading literature and writing were mixed (see details of survey results in Appendix B.2).

Overall, postsecondary stakeholders' perceptions indicate that their students are not adequately prepared in math and scientific thought. Only 18% of survey respondents said that 81% or more of their students were college ready in algebra. And just 8% of respondents reported that 81% or more of their students were college ready in precalculus and scientific thought. Across focus groups, postsecondary stakeholders noted that many students are not performing at the college level. Math and science stakeholders also expressed concern about their students' readiness for entry-level courses, especially with regard to scientific thinking and algebra.[19]

Postsecondary stakeholders view intrapersonal and interpersonal skills as necessary for success and an important component of determining CCR. Our analyses suggest that skills like self-direction, time management, and critical thinking should be considered alongside academic content knowledge in determining CCR. Faculty noted that, despite placement in courses based on academic measures, these skills for success are also important for postsecondary progress and achievement. For example, one faculty member described how underdeveloped skills can be a barrier for students:

> I feel like the biggest barrier when students are successful or not has to do with their non-cognitive skills, their ability to manage time to meet deadlines, to be able to transition from a really more structured environment of high school to having the free time.

Consistent with these findings, USM provosts observed that faculty are struggling to support the increasing number of students entering college with lower levels of preparedness and engagement as well as high levels of social-emotional challenges. Other respondents commented that faculty need training to address student success from an angle that considers the "whole student" (e.g., background, lived experience).

Workforce stakeholders also pointed to the importance of these skills for students to be workforce ready. Focus group participants highlighted skills like critical thinking and understanding of workplace norms and expectations as especially important for students to develop and that these are developed through experience. For example, one workforce stakeholder said:

> The question is expectations of high school students to show that they're career ready. I would probably say that the greatest indicator of success is whether they've had an internship.

Postsecondary stakeholders point to the need for multiple measures for determining CCR. Focus group participants shared course prerequisites and several assessments that their colleges use to assess student readiness for college and to place students in courses, including GPA, ACCUPLACER, ALEKS,[20] and student self-assessments of readiness. However, stakeholders reported concerns with overreliance on these measures alone, especially given their

[19] Comments from the USM provosts echoed focus group participants' sentiments. In general, USM provosts raised concerns regarding the level of academic readiness of many students at college entry. In particular, critical reading was raised as a growth area for incoming students.
[20] ALEKS is an adaptive learning platform and placement tool that measures students' math readiness.

perspectives on the importance of skills for success. For example, several focus group participants agreed that standardized testing is not always a complete assessment of college readiness. One stakeholder reported:

> We've been doing a lot of research with our ALEKS and placement scores… What we see is that there is very little correlation between placement score and success in a class.

In addition, stakeholders noted that although the assessments for reading and writing readiness may be effective, they do not measure the critical thinking, independence, self-direction, and other skills that students need to be successful in college-level courses. Another stakeholder comment exemplified this idea:

> Students should be able to follow directions in a timely fashion, ask for assistance [or] clarification, tolerate ambiguity and diverse viewpoints, and develop effective meta-cognitive strategies.

Stakeholder comments related specifically to assessments suggest that considering multiple indicators of readiness may be the best approach for assessing college readiness. For instance, one stakeholder described how considering success in high school Algebra 2 alongside GPA may be more effective than GPA alone:

> GPA is not working for us, it just isn't at all. I had a student [who] came in at very good GPA, but the last math class they had was Algebra 1 two years ago. And they had been placed into college algebra because of the GPA. And there was no way they could thrive there because they were missing all of Algebra 2. So it was a problem.

USM provosts expressed opinions that support these perspectives. One respondent suggested placement tests support student success by helping students enroll in courses for which they are prepared. Still, several respondents discussed the need for a "variety of methods" for assessing incoming student preparedness, as some methods can be a barrier for students. For example, placement tests can be a barrier to some students who cannot pay the fees or who require accommodations.

Student supports play an important role in ensuring incoming students are college ready. Faculty in focus groups noted the importance of having resources for additional student support and the need to provide scaffolding to ensure student success. The effects of the COVID-19 pandemic, the increasing number of dually enrolled students, and a lack of academic skills were cited as reasons for why postsecondary stakeholders have observed an increase in students who need scaffolded support. Comments from focus group participants, along with the syllabi collected through the programmatic survey, point to a range of supports, including tutoring and writing centers, zero-cost textbook models, and disability support services.

Stakeholders also highlighted a need for wraparound services, especially to support skills for success that influence CCR (e.g., self-direction, critical thinking), which can be a challenge for students despite their placement into courses. They also pointed to the importance of understanding other factors that affect students' success on placement tests and in entry-level and developmental courses, like balancing family and work responsibilities or managing disabilities. Stakeholders noted that these issues became more pronounced during the COVID-19 pandemic and questioned the reliability of placement tests during that period.

Characteristics of Top-Performing Education Systems

Several key themes emerged from the landscape analysis of top-performing education systems—select U.S. states and countries—that may be useful for Maryland to consider in developing and refining the state CCR system. In this section, we first discuss the CCR definitions across the three focal top-performing U.S. states and how they compare to the Maryland definition. We also identify common practices across those states. Next, we present a discussion of themes extracted from our analysis of top-performing international education systems, focusing on insights most relevant to Maryland.

Top-Performing States' CCR Systems

The analysis of three top-performing states—Colorado, Connecticut, and Massachusetts—produced the following insights related to CCR.

Definitions of CCR vary across top-performing states. Exhibit 14 shows the definitions of CCR across the three focal top-performing states (Colorado, Connecticut, and Massachusetts) for comparison with Maryland. Both Maryland and Massachusetts specify that students who are college and career ready will be able to enroll in credit-bearing college courses, and the two states also focus on skills required to be successful in college or a career. Like Maryland, Massachusetts breaks these skills down by subject: English and math. Connecticut quantifies requirements with specific testing parameters. Colorado's definition refers to state standards and requirements, and includes that a student should not need remediation, as similarly mentioned by Maryland's and Massachusetts' statements on credit-bearing courses.

Additionally, the top-performing states have different ways to measure CCR, as well as different uses for CCR within the state's accountability system(Exhibit 15). Colorado and Connecticut have multiple ways in which students can demonstrate CCR, with Colorado allowing LEAs to select at least one assessment from a menu of options. Massachusetts does not use an assessment explicitly for the determination of CCR, but the state's ELA, math, and science assessments are required for high school graduation. Similarly, Colorado's CCR assessment is part of the state's high school graduation requirements. Both Colorado and Massachusetts have individualized options (e.g., capstone project, appeals process) in lieu of passing a standardized test for high school graduation. None of the three states use HSGPA as an indicator of students' CCR, though all three states require students to pass a certain number of courses for high school graduation.[21] In Connecticut, CCR assessments are used for district and school accountability but are not part of the state's graduation requirements. In addition, none of the three states in our analysis use CCR assessments to determine which students can access certain courses or postsecondary pathways in high school.

Exhibit 14. College and Career Readiness Definitions by State

State	College and career readiness definition
Colorado	"CCR is currently indicated by the percentage of students that graduate from high school with a postsecondary and workforce readiness (PWR) endorsement, the high school graduation rate, and the proportion of students who scored at or above achievement level on college entrance exams. To be considered for a PWR-endorsed diploma, a student must (1) satisfy the existing Higher Education Admissions Recommendations (HEAR) (which are currently under review and specify that students should complete recommended courses: four years of English, four years of math, three years of natural/physical science, three years of social science, one year of foreign language and two years of academic electives) or HEAR proxies (e.g., completion of a college-level course in a subject area with a grade of C or better), (2) meet a postsecondary institution's Admissions Index, and (3) demonstrate they do not require remediation by testing above existing approved cut scores in math and literacy" (Colorado Department of Labor and Employment, 2021).
Connecticut	"To be considered CCR according to CCR-Exam metric, a student must meet any one of the following: (a) SAT: an Evidence-Based Reading and Writing score of at least 480 and a Math score of at least 530; (b) ACT: on at least 3 of 4 exams, an English score of 18, a reading score of 22, a math score of 22, and/or a science score of 23; (c) AP Exam score of 3 or higher; or (d) International Baccalaureate exam: a score of 4 or higher" (Caro & Kiehne, n.d.). Connecticut also defines CCR as "individual meets the admissions requirements for a two-or four-year college or university. This typically includes meeting high school graduation requirements, maintaining an acceptable GPA in specified courses, and obtaining satisfactory SAT or ACT scores" (Connecticut State Department of Education, 2018).

[21] While HSGPA is not used as a CCR indicator in high school, some states use HSGPA for college course placement decisions. For example, HSGPA is one of the measures recommended by the Massachusetts Department of Higher Education to determine placement in entry-level college English and math courses (Massachusetts Department of Higher Education, 2019). Similarly, HSGPA is one of the criteria for CCR in a memorandum of understanding between the Maryland Association of Community Colleges and the Public School Superintendents Association of Maryland.

State	College and career readiness definition
Massachusetts	"Massachusetts students who are college and career ready and prepared for civic life will demonstrate the knowledge, skills and abilities that are necessary to successfully complete entry-level, credit-bearing college courses, participate in certificate or workplace training programs, enter economically viable career pathways, and engage as active and responsible citizens in our democracy." To be considered college and career ready under this definition, students must meet a set of learning competencies, capacities, and experiences: (1) achieve "college-ready levels of competence" in ELA and math, in addition to competencies identified by the MassCore program of study (four units of English, four units of math, three units of science, three units of history, two units of foreign language, one unit of arts, and five additional "core" courses); 2) workplace readiness competencies including work ethic and professionalism and communication and interpersonal skills; and (3) apply "academic strategies to problem solving in diverse professional and life contexts" (Massachusetts Board of Elementary and Secondary Education, 2013).

Exhibit 15. Comparison of College and Career Readiness Assessments by State

State	College and career readiness assessments	How assessments are used
Colorado	Students must demonstrate readiness according to at least one of a set of available measures in reading, writing, and communicating and in math. LEAs can select from a menu of assessment options: • ACT: 18 on English and 19 on math • Advanced Placement: 2 on English and 2 on math • SAT: 470 on English and 500 on math, or • ASVAB: 31 on English and 31 on math • ACCUPLACER: 62 on reading comprehension or 70 on sentence skills; 61 on elementary algebra • ACT WorkKeys: Bronze or higher • Concurrent enrollment: passing grade in English or math course • District capstone: individualized • Industry certificate: individualized • IB: 4 on reading, writing, and communicating; 4 on math • Standards-based scoring criteria: state-wide scoring criteria	• District and school accountability • Part of high school graduation requirement

State	College and career readiness assessments	How assessments are used
Connecticut	• SAT: 480 on evidence-based reading and writing; 530 on math • ACT, on at least 3 of 4 exams: English score of 18, reading score of 22, math score of 22, and/or science score of 23 • AP Exam: score of 3 or higher • International Baccalaureate Exam: score of 4 or higher • College course credits: 3 or more college credits with a C or better grade	• District and school accountability
Maryland (Interim CCR Standard)	• MCAP or PARCC: Score at or above the proficient (or met expectations) performance level in English and math • SAT: 530 on math	• District and school accountability • Additional uses under development
Massachusetts	• No required assessment for students to demonstrate college and career readiness but passing scores on the state's Grade 10 ELA and math assessments, as well as one science test, are part of the state's high school graduation requirements • A state-recommended program of study (MassCore) intended to align high school coursework with college and workforce expectations • ACT WorkKeys National Career Readiness Certificate (based on earning a score of 3 or better on Applied Math, Workplace Documents, and Graphic Literacy WorkKeys assessments)	• District and school accountability • Part of high school graduation requirement

Note. In Massachusetts, students who do not pass the state assessments have alternative options for meeting high school graduation requirements. Students with a score that is "approaching proficiency," can fulfill the graduation requirements through an Educational Proficiency Plan. In addition, students can meet the requirements through the Massachusetts Comprehensive Assessment System (MCAS) Performance Appeals process, which requires "compelling evidence that a student has demonstrated the attainment of the state's learning standards through coursework but has been unable to meet the minimum score requirements on MCAS" (https://www.doe.mass.edu/mcas/graduation.html).

Top-performing states provide formal CCR counseling to students before Grade 10 and an easily accessible CCR plan. The three focal top-performing state education systems provide formal CCR counseling to students prior to or starting in Grade 9, which is consistent with research that points to the success of such counseling programs (Bhat & Stevens, 2021; Bryan et al., 2022; Martinez et al., 2017). In conjunction with counseling, these states provide students and families with an easily accessible, individualized CCR plan prior to Grade 10, and in some cases as early as elementary school. Massachusetts offers the My Career and Academic Plan (MyCAP) electronic platform option students can begin using in either sixth or ninth grade. Connecticut requires students to work with a Student Success Plan beginning in sixth grade, which is a student-driven plan that focuses on "setting goals for social, emotional, physical and academic growth, meeting rigorous high school expectations, and exploring postsecondary education and career interests" (Connecticut's Official State Website, 2023). Colorado employs the Individual Career and Academic Plan (ICAP) beginning in Grade 9; Colorado's ICAP is a multiyear process that guides students and families in the exploration of career, academic, and postsecondary opportunities. In contrast, the *Blueprint for Maryland's Future* mandates a CCR plan to students only after they do not meet specific benchmarks in Grade 10, which may be too late to develop a student's understanding of their college and career options and associated educational requirements. The state of Maryland does require that students develop "individual academic and career" plans prior to Grade 9; however, this is distinct from the CCR plan mandated in the *Blueprint* and may not be consistently used across LEAs (Maryland Division of State Documents, 2023).

Insights From Top-Performing Countries

In this section, we present insights that highlight promising practices from the four focal top-performing countries. Comparisons between U.S. states and top-performing international systems are difficult given key contextual differences, such as country size and population, centralization of the education system, cultural differences, and the lack of "college and career readiness" as a concept outside of the U.S. With these challenges in mind, we focused on factors that are most meaningful to the Maryland context. As described in Section C.1, the research team reviewed international data and collaborated with MSDE to select the following countries to examine closely: Estonia, Germany, Japan, and Singapore.

While the observations gleaned from studying these countries may be useful, within-U.S. comparisons (i.e., comparisons with other states) are probably more meaningful than international comparisons when it comes to understanding best practices in education (Carnoy et al., 2015). An overview of each country's education system is provided in Box 3.

BOX 3. OVERVIEW OF THE EDUCATION SYSTEM IN EACH FOCAL TOP-PERFORMING COUNTRY

- **Estonia.** Although Estonia's school system is decentralized, the central government sets national standards and establishes principles of education funding, supervision, and quality assessment. While most basic (primary and lower secondary) and upper secondary schools are owned and run by municipalities, most vocational schools are owned by the central government (OECD, 2020). Some of Estonia's education components are centralized and schools adhere to a national curriculum. For example, each of Estonia's 15 counties has a municipal education office that oversees their share of 589 schools across the country. These offices manage school operations, including selecting school leaders and supporting extracurricular activities and other school services. In addition, municipalities sometimes come together to share resources, such as teachers, services, or extracurricular facilities. As a result, schools have a high level of autonomy for resource allocation and staffing (NCEE, 2023). Estonia also manages school choice, and schools are economically integrated—all students receive free lunch and textbooks as well as computers and internet (OECD, 2020; NCEE, 2023).
- **Germany.** Germany's governance of education is highly decentralized. The central Ministry of Education and Research oversees vocational education, education research, and some aspects of higher education. The ministry also monitors the allocation of slots in the higher education programs in the professions (including teaching) based on a national analysis of supply and demand across the economy. The central government sets regulations for the civil service workforce, which includes the majority of the teacher workforce, although salary levels are set at the state level. The 16 Länder (states) in the country have primary responsibility for all other aspects of the early childhood, primary, secondary, and higher education systems (NCEE, 2023). Also, Germany's vocational education and training provides dual programs in over 300 trades. German schools have three tracks, typically beginning in Grade 5: gymnasium (college preparatory, 8 to 9 years), Realschule (general education leading to technical school or university, 6 years), and Hauptschule (vocational training, 5 years).
- **Japan.** In Japan, there is no ability tracking during compulsory education (9 years of schools), teachers are paid centrally, and there is a common nationwide curriculum. These policies have supported Japan in providing students from low-income backgrounds with relatively equal educational opportunities; for example, socioeconomic status (SES) accounts for only 8% of the variation in reading performance, as compared to the 13% OECD average (NCEE, 2023). Most students select an academic upper-secondary school, and for those who want a vocational option, there are several choices: specialized vocational high schools, colleges of technology, and specialized training colleges. Students in the 3-year specialized vocational high schools take core academic courses in addition to focusing on one of seven areas of specialization. Further, there are integrated schools that combine academic and vocational coursework. Admission to academic upper-secondary school is competitive; the schools are ranked based on their success in sending graduates to prestigious universities. Each school has its own admissions process and requirements, but most require students to take a test.
- **Singapore.** The Singapore Ministry of Education regulates the country's highly centralized education system for primary, secondary, and tertiary education. Singapore's higher education pathways offer 2- and 3-year certificate programs, and technical diploma programs (similar to apprenticeship programs). To move on to secondary education opportunities, students in Singapore must pass differing levels of exams, and students fall into either academic (O-Level) or technical (N-Level) tracks for assessments (NCEE, 2023). Singapore offers a National Institute of Technical Education Certificate. While academic achievement is highly stratified by SES, for students who pursue vocational pathways, these can lead to high-income careers. Similar to Estonia and Japan, Singapore uses a national curriculum for all school systems.

Top-performing countries offer multiple formalized tracks for postsecondary success. Vocational or technical tracks are among several options for upper-secondary school leading to a postsecondary career, with specific sets of requirements for completing each secondary track so that it feeds directly into the corresponding career pathway. In Estonia, for example, two tiers of vocational education are offered: a basic track and a comprehensive vocational education and training program, which allows students to obtain a bachelor's degree. The pathways offered may be focused on academics, arts, or technical fields, and there is a clear connection between secondary training and postsecondary options. The existence of multiple track options requires students to make career-based decisions earlier than in the United States (e.g., around Grade 5 in Germany) and offers different academic content and courses to students based on their choices.

Technical secondary programs are overseen and regulated centrally. Although the four focal countries have national curricula with some local control or autonomy (or variations depending on pathways), there is a national or centralized body that oversees the quality of both academic and technical programs. Singapore has a National Certificate for the Institute of Technical Education programs. In 2014, Japan began developing a national qualifications framework covering seven levels of qualifications, from entry to professional level, with corresponding assessments of knowledge and practical skills (NCEE, 2023). In Estonia, several advisory bodies and industry organizations—including the Chamber of Commerce and Industry, Employers' Confederation, and Confederation of Trade Unions—advise the Ministry of Education and Research on the vocational curriculum. This oversight and regulation may contribute to the quality of vocational programs.

Postsecondary readiness consists of a range of skills including core academic content, critical thinking, and collaboration skills. While the term "college and career readiness" is not explicitly used in the four focal countries, their educational systems effectively prepare most students for academic or technical career pathways. To successfully complete secondary school, students in these countries must master academic and life skills. Competencies related to character, values, critical thinking, success in a global economy, and collaboration must be mastered for students to successfully move on to—and succeed in—postsecondary programs. While it was difficult to obtain details about specific courses required for successfully completing secondary school (or upper-secondary school, in some countries), most systems require similar academic courses: math, home language, foreign language, and science. In Singapore, the national mathematics exam for completion of secondary school assesses a student's mastery of basic mathematics concepts, including algebra, geometry, statistics, and data analysis. But the desired outcomes for students also include "excellence in life skills, knowledge skills, and subject discipline knowledge organized into eight core skills and values: character development, self-management skills, social and cooperative skills, literacy and numeracy, communication skills, information skills, thinking skills and creativity, and knowledge application skills” (NCEE, 2023). In Estonia, all students are required to complete a creative project or a research project to graduate from “basic” secondary school, which ends in Grade 9. At that point, they are required to pass an exam to move on to upper-secondary school or may advance via teacher recommendation.

D.2. Alignment Between Maryland CCR Content Standards and Postsecondary Expectations (Objective 2)

In this section, we present the results of the alignment review. Overall, we found that the Maryland high school standards are reflected in the content of developmental and first-year credit-bearing college courses where we would expect the standards to be reflected. We did not find content in the college courses that were not addressed in the high school content standards. Maryland high school standards are aligned with postsecondary course content, but some content areas may be emphasized more than others. The primary source of “misalignment” was that the high school content standards cover more than what is reflected in the college course content. Details by topic are presented in the sub-sections below.

There is no expectation that all Grade 9–10 ELA standards would or should reflect the same material as postsecondary course content. The Grade 9–10 ELA standards span topics across reading, writing, speaking and listening, and language while college course content is more focused on writing and composition. Similarly, high school math standards span topics that are not expected to be prevalent in introductory community college courses, such as geometry, which would be more likely to surface in more advanced courses for math majors. First-year college science courses have a specific focus on biological and physical science and course objectives prioritized science content. Differences between high school and college course content are expected, and where high school standards are not addressed in college course content, that should not be interpreted as a negative finding.

ELA Standards and Alignment Results

The Maryland high school ELA content standards are organized by five strands: *Reading Literature, Reading Informational Text, Writing, Speaking and Listening*, and *Language*. Each strand contains clusters or categories comprised of one or more "Anchor Standards." Each Anchor Standard is accompanied by a short sentence outlining the expectation for each grade level and followed by a list of essential skills and knowledge students are expected to demonstrate. Appendix G.2 provides a description of each strand and cluster and Exhibits G.2.1 through G.2.5 (Appendix G.2) provide alignment ratings for each standard by strand and cluster.

Exhibit 16 summarizes the alignment between the Maryland high school ELA standards and college developmental English course content and rigor. Exhibit 17 summarizes the alignment between the Maryland high school ELA standards and content in first-year credit-bearing college English composition course content and rigor. It is expected that some of the high school ELA content standards are not addressed in the college courses. The high school content standards span topics across reading, writing, speaking and listening, and language while college course content is more focused on writing and composition, particularly in developmental and first-year credit-bearing college courses. We found that all content expectations in the developmental and first-year credit-bearing college courses are addressed by the high school content standards.

How to Interpret the Exhibits That Summarize the Alignment Ratings

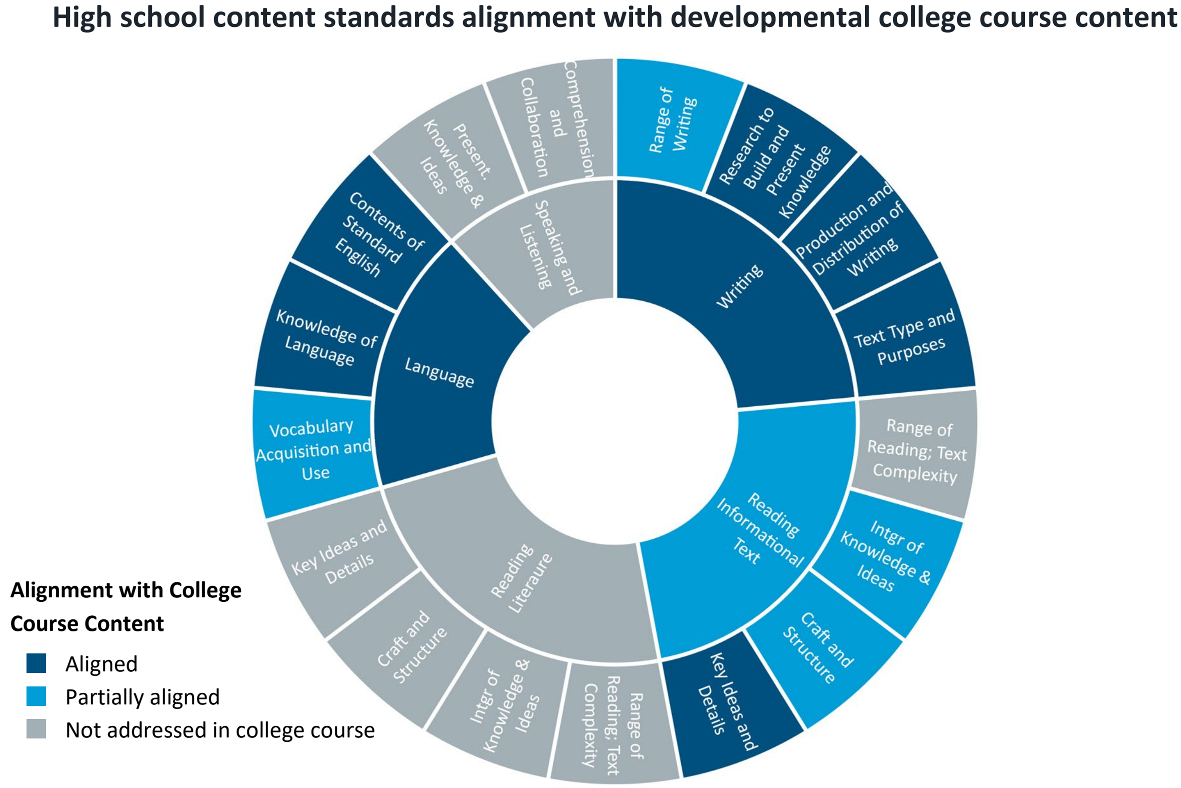
We summarized the content and rigor alignment ratings in a series of graphics. The inner circle of each graphic shows the Maryland high school content standards strand or domain, and the outer circle shows the high school content standards cluster.

Content alignment. The strongest content alignment between the high school standards and college developmental and first-year credit-bearing course content expectations are indicated by dark blue segments in the content graphics, with partial alignment indicated by lighter blue segments. High school content standards that were not addressed in the available information about college course content are shaded in gray. We did not find content in the college courses that are not addressed in the high school content standards.

Rigor alignment. For rigor, the graphics indicate whether the level of rigor for a particular high school content cluster or strand/domain was higher in the college course (dark green), similar to the college course (green), or lower in the college course (light green).

Alignment expectations. It is expected that some of the high school content standards are not addressed in the developmental and first-year credit-bearing college courses because the college courses tend to focus on more specific content. For rigor, our expectation was that developmental college courses would have a similar or lower level of rigor than the high school content standards and first-year credit-bearing college courses would have a similar or higher level of rigor than the high school content standards.

Exhibit 16. Content and Rigor Alignment of High School ELA Standards With College Developmental English Course Content



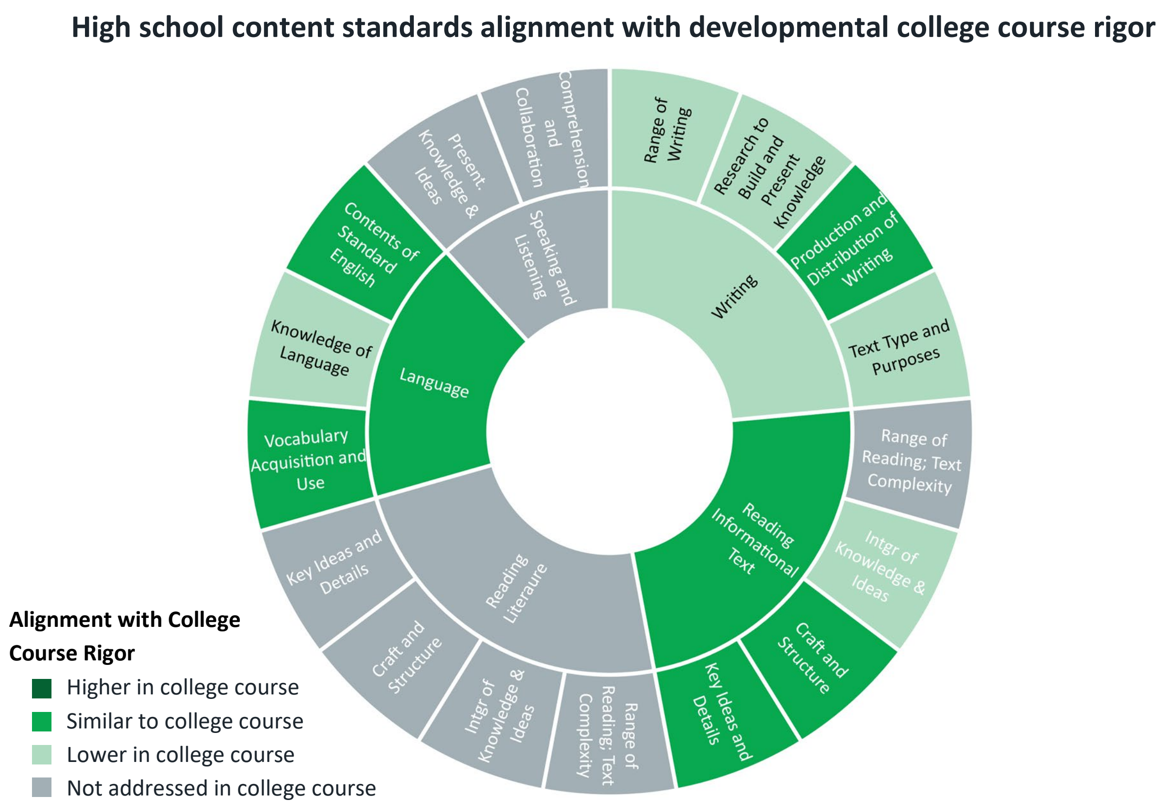
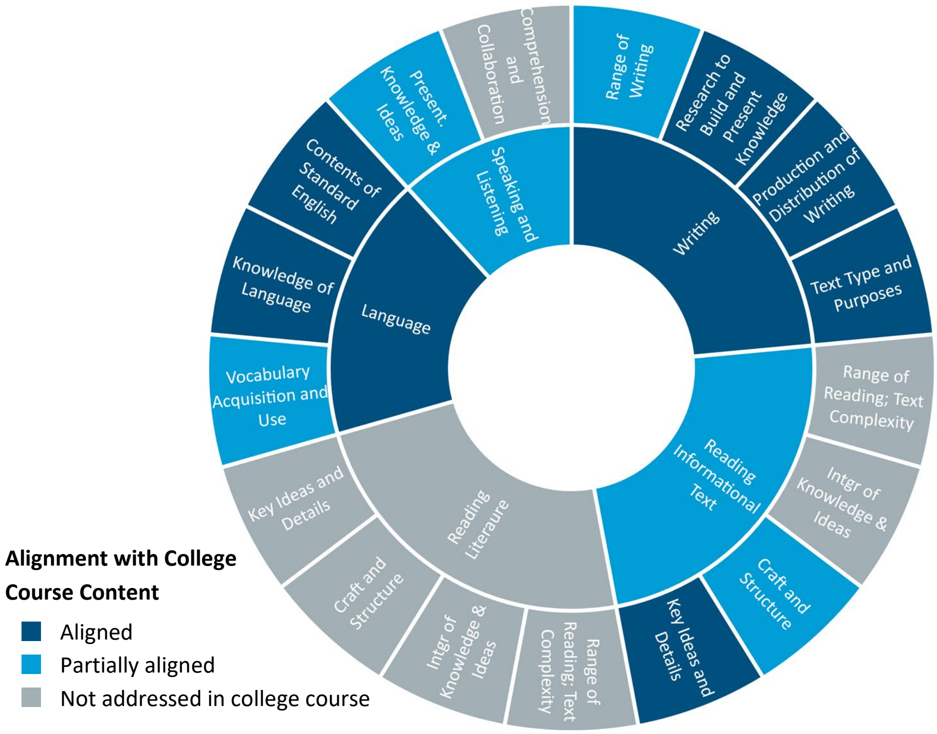
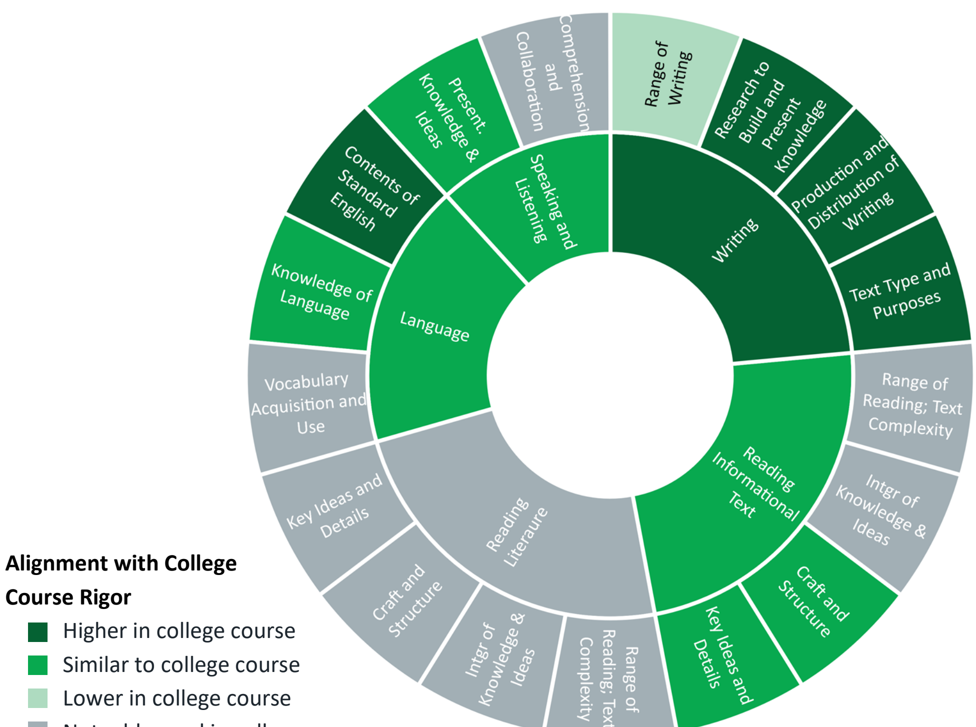


Exhibit 17. Content and Rigor Alignment of High School ELA Standards With College First-Year Credit-Bearing English Courses

High school content standards alignment with college course content



High school content standards alignment with college course rigor



Reading Literature. Reading Literature contains four clusters: Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas, and Range of Reading and Level of Text Complexity. Reviewers concluded that the Maryland Grade 9–10 Reading Literature standards were not reflected in developmental or first-year credit-bearing college English course content. Content of developmental and first-year credit-bearing college English courses focused primarily on writing[22] and did not address narrative, either from a reading or writing standpoint.

Reading Informational Text. Reading Informational Text contains the same four clusters as Reading Literature, but the Anchor Standards are altered to reflect the change in genre. Reviewers found that in the *Key Ideas and Details* cluster, the high school standards were generally aligned with content expectations for developmental college English courses; two standards were aligned and one was partially aligned. All three of the high school standards in this cluster were aligned with first-year credit-bearing college English Composition course content. The rigor of the high school standard was at a similar level as in the developmental college English courses for two of the standards and higher than in the developmental college English courses for the third standard. The rigor of the high school standard was at a similar level as in the first-year credit-bearing college English course content for all three standards. For the C*raft and Structure* cluster, three high school standards were partially aligned or aligned with developmental college English course content.

In addition, the rigor of the high school standards was at a similar or higher level of rigor as in the developmental college English course content. For the C*raft and Structure* cluster, one high school standard was not reflected in first-year credit-bearing college English Composition course content expectations (RI. 9-10-4; vocabulary/word meaning). The second standard was partially aligned with first-year credit-bearing college course content expectations and was at a similar level of rigor to the first-year credit-bearing college courses. The third standard was aligned with first-year credit-bearing college course content expectations and was at a lower level of rigor than that of the first-year credit-bearing college courses. The discrepancy between the high school standards alignment with developmental and with first-year credit-bearing course content supports reviewers' suggestion that the content of the standard may be assumed prior knowledge. The *Integration of Knowledge and Ideas* cluster had one of three high school standards that was partially aligned with developmental college English content expectations and aligned with first-year credit-bearing college course content expectations. The rigor of this standard (RI.9-10.8. Delineate and evaluate the argument and specific claims in

[22] Maryland's General Education Requirements for Public Institutions specify an English composition requirement (COMAR 13B.06.01.03)

text) was at a higher level than for developmental college courses and was at a lower level than for first-year credit-bearing courses.

Writing. The Writing strand has four clusters: *Text Types and Purpose*, *Production and Distribution of Writing*, *Research to Build and Present Knowledge*, and *Range of Writing.* In general, reviewers found that content such as writing process, structure, purpose, and basic research skills were reflected in both high school standards and developmental level college course content, but the detailed skills and applications mentioned in the high school standards were frequently omitted in the developmental college course descriptions and objectives.

In the *Text Type and Purpose* cluster, two of the three high school standards were aligned with developmental college course content expectations and were at a higher level of rigor than in developmental college courses. In the *Production and Distribution of Writing* cluster, two of the three high school standards were aligned with developmental college course content expectations, and the rigor of the high school standards was at a similar level as in the developmental college courses. In the *Research to Build and Present Knowledge* cluster, high school standards were generally aligned with developmental college course content expectations and the rigor of the high school standards was generally higher than the level in developmental college courses. The singular *Range of Writing* high school standard was partially aligned with developmental college course content and the rigor of the high school standard was at a higher level than in the developmental college courses.

Similarly, the Maryland high school standards were strongly aligned with the first-year credit-bearing college English course content. The rigor of the high school standards was generally at a similar level to or lower than in college courses. The high school standards retain a focus on the sequencing of writing, including transitions, cohesion, and flow; a literary/narrative component; and a focus on specific texts that does not appear in the college course descriptions and objectives, even when the alignment is otherwise very strong. In the *Text Type and Purpose* cluster, two of the three high school standards were aligned with first-year credit-bearing college course content expectations. In addition, the rigor of these high school standards was at a similar level or lower than in first-year credit-bearing courses. In the *Production and Distribution of Writing* cluster, all three high school standards were aligned with first-year credit-bearing course content expectations and the level of rigor of the high school standards was generally lower than the rigor in first-year credit-bearing courses. In the *Research to Build and Present Knowledge* cluster, high school standards were all aligned with first-year credit-bearing course content expectations and the rigor of the high school standards was generally at a lower level of rigor than in the first-year credit-bearing courses. The singular *Range of Writing* high school standard was partially aligned with first-year credit-bearing course content expectations and the high school standard was at a higher level of rigor than in the first-year credit-bearing courses.

Speaking and Listening. The Speaking and Listening strand has two clusters: *Comprehension and Collaboration* and *Presentation of Knowledge and Ideas*. Reviewers concluded that the Maryland high school Speaking and Listening standards were not reflected in developmental English college course content. Developmental college course content focused on reading, writing, and language comprehension skills and did not focus on oral presentation, auditory comprehension, or peer discussion and debate. While first-year credit-bearing college English course content was similar to developmental English college course content, reviewers did find partial alignment of high school standards to first-year credit-bearing college course content expectations through implicit expectations for use of multimedia in the writing and research process. In the *Comprehension and Collaboration c*luster, only one of the three high school standards was evidenced in first-year credit-bearing college course content expectations, showing partial alignment. The rigor of the high school standard was at a higher level of rigor than in first-year credit-bearing courses. In the *Presentation of Knowledge and Ideas* cluster, two of the three high school standards were partially aligned with first-year credit-bearing college course content and the rigor of the high school standards was similar to or higher than the rigor in first-year credit-bearing courses.

Language. The Language strand has three clusters: *Conventions of Standard English*, *Knowledge of Language*, and *Vocabulary Acquisition and Use*. Reviewers found that in the Language strand, the high school standards had a fairly strong overall alignment to developmental college English course content expectations, and that the rigor of the high school standards was largely similar to the level of rigor in the developmental college courses. For half of the standards, where the content was strongly aligned with first-year credit-bearing college English course content and the rigor of the high school standards was at a similar level of rigor or lower level of rigor than in the first-year credit-bearing college courses. The other half of the high school standards were not addressed at all in the first-year credit-bearing English course materials; reviewers posited that the standards addressed skills that were implicit or considered a pre-requisite. In the *Contents of Standard English* cluster, both high school standards were aligned with content expectations in developmental college courses and also first-year credit-bearing college courses. The high school standards were at a similar level of rigor as in developmental college courses and were at a similar or lower level of rigor than first-year credit-bearing college courses. In the *Knowledge of Language* cluster, the singular high school standard was aligned both with content in developmental college courses and first-year credit-bearing college courses. The rigor of the high school standard was higher than the rigor in developmental college courses and was similar to the level of rigor in first-year credit-bearing college courses.

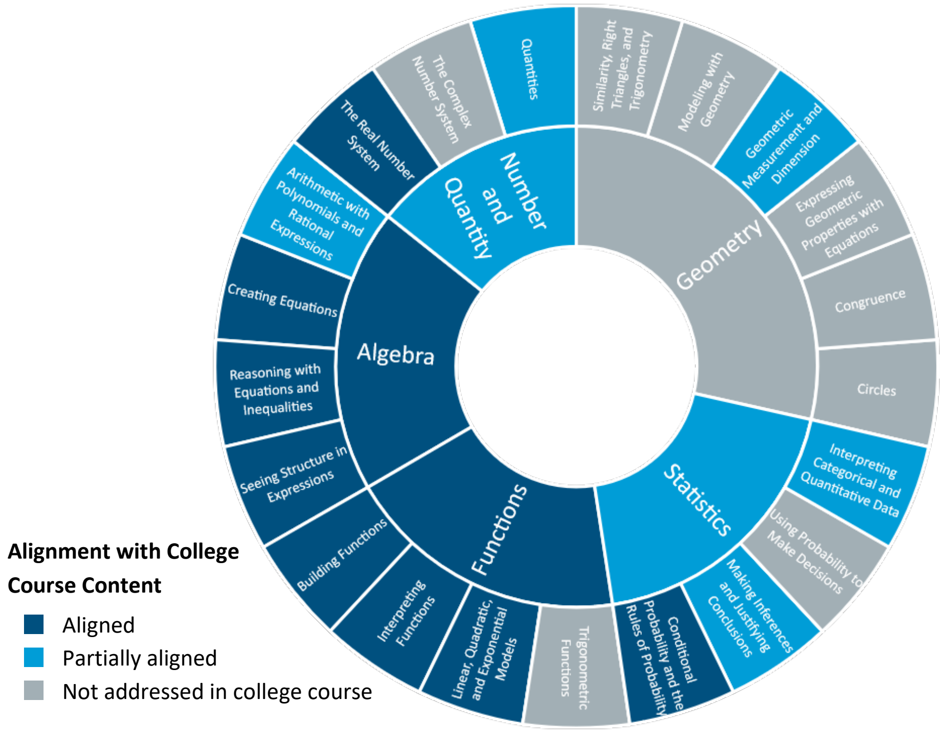
Math Standards and Alignment Results

The Maryland College and Career Ready Mathematics Standards (MCCRMS) are part of a framework that provides a structured and comprehensive approach to student learning and achievement. The framework focuses on organizing the standards by domains and clusters, outlining student progression through math understanding. The high school mathematics standards are categorized into different mathematical domains, such as number systems, algebra, geometry, functions, and statistics. Each domain represents a distinct area of mathematical knowledge. Appendix G.3 provides a description of the domains and Exhibits G.3.1 through G.3.5 (Appendix G.3) provide alignment ratings for each standard by domain and cluster within the MCCRMS.

Exhibit 18 summarizes alignment between the MCCRMS and developmental college math course content and rigor. Exhibit 19 summarizes alignment between the MCCRMS and content in first-year credit-bearing college math course content and rigor. As a reminder, we do not expect full alignment between high school math standards and college math content. High school math standards span topics that are not expected to be prevalent in introductory community college courses (e.g., geometry, which is not commonly found in general introductory courses); rather they would be more likely to be covered in advanced courses for math majors and for specific areas of study, such as engineering. We found that all content expectations in the developmental and first-year credit-bearing college courses are addressed by the high school content standards.

Exhibit 18. Content and Rigor Alignment of High School Math Standards With College Developmental Math Courses

High school content standards alignment with developmental college course content



High school content standards alignment with developmental college course rigor

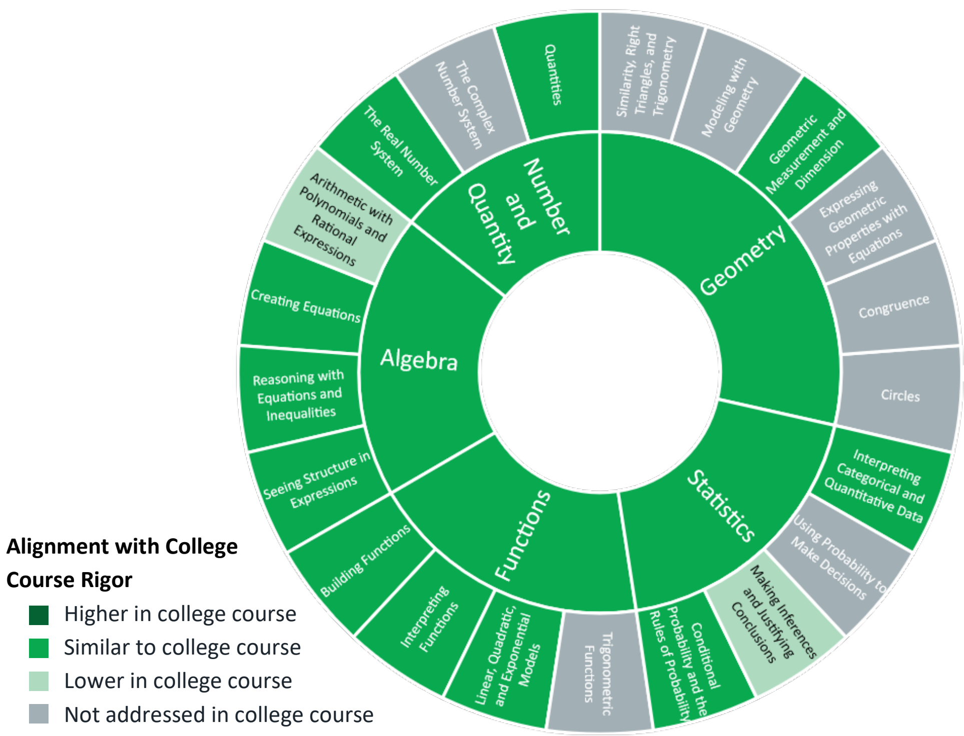
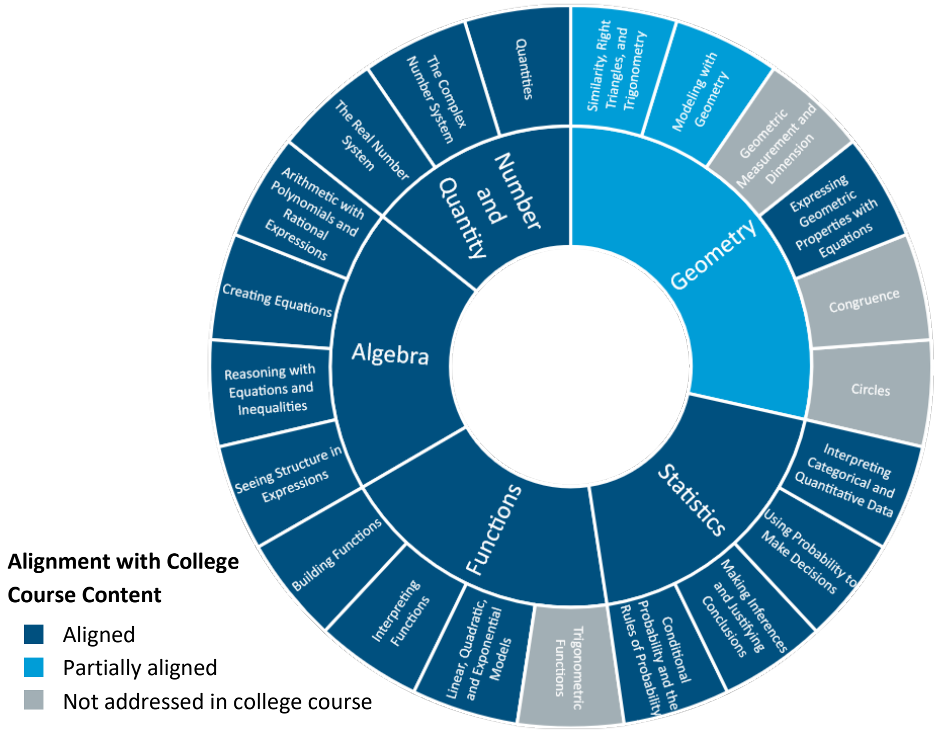
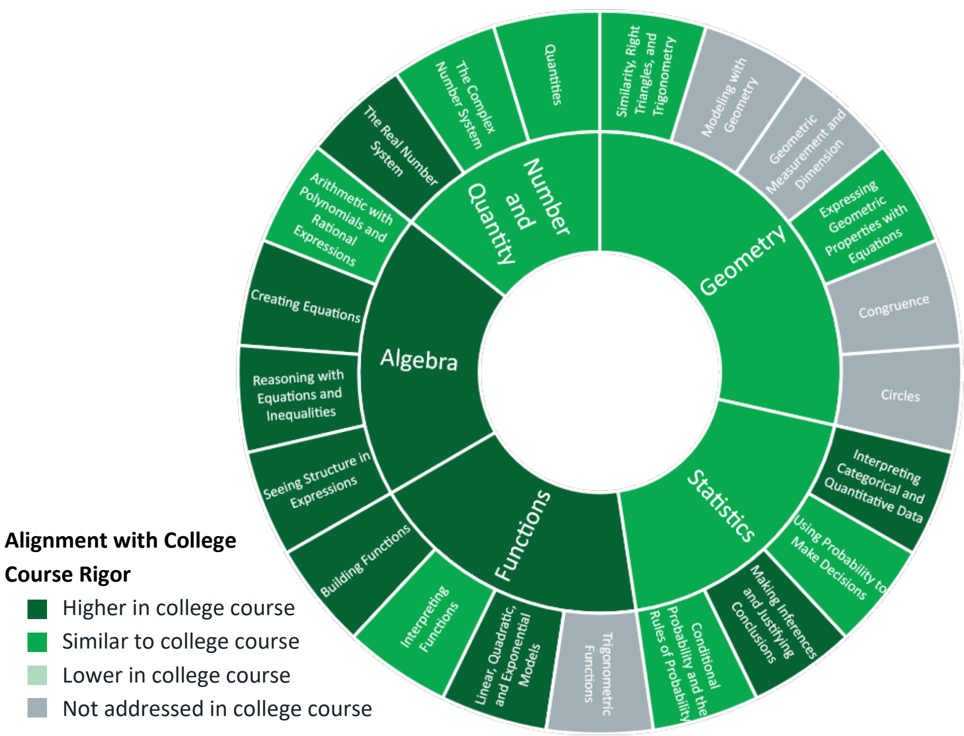


Exhibit 19. Content and Rigor Alignment of High School Math Standards With College First-Year Credit-Bearing Math Courses

High school content standards alignment with college course content



High school content standards alignment with college course rigor



Algebra. The 10th-grade algebra domain expands students' understanding of algebraic concepts and problem-solving techniques. Students explore variables, expressions, equations, and inequalities, applying properties of real numbers to simplify expressions and combine like terms. For the Algebra domain, across each cluster, the high school content standards were aligned with the math content expectations in the developmental and first-year credit-bearing college math courses. One exception is the Arithmetic with Polynomials and Rational Expressions high school standard cluster, which was partially aligned with the developmental college course expectations. In addition, the rigor of the high school standards was at a similar level as in the developmental college math courses and lower than in the first-year credit-bearing college math courses.

Where high school standards were categorized as having partial alignment, this was due to college course objectives being vague and lacking explicit references to context. Overall, while most high school standards demonstrated alignment with college course content expectations, others showed variations in the level of alignment between high school standards and college course objectives.

Functions. Within the MCCRMS domain of functions, detailed skills in the clusters include interpreting, analyzing, and building functions. Additionally, students work with linear, quadratic, and exponential models. In the Functions domain, alignment was determined between the high school standards and college course content when addressing the interpretation, analysis, and construction of functions. High school standards related to interpreting functions through graphical representations, equations, and tables, and identifying key features and properties of functions were aligned with both developmental math course content expectations and first-year credit-bearing math course content expectations. The emphasis on understanding the representation of real-world phenomena through functions is shared across high school standards and college course content. The Trigonometric Functions cluster was not aligned for either the developmental or the first-year credit-bearing college math course content, as none of the college objectives directly correspond to the high school standards, despite the presence of some shared terminology.

Number and Quantity. In the domain of Number and Quantity, clusters focus on developing a deep understanding of rational exponents, radicals, and the properties of rational and irrational numbers. Across the Numbers and Quantity domain, high school standards were partially aligned for developmental college math course content expectations and aligned for first-year credit-bearing college math course content. The content and concepts of the high school standards are reflected at the college course level; however, there are some subtle differences in the language used in the high school standards, resulting in partial alignment with college course content expectations. For instance, while the high school standards specifically emphasize solving quadratic equations with complex solutions, the objectives in the college-level courses focus more generally on addressing quadratic equation solving patterns. The rigor of the high school standards was at a similar level as in the developmental and first-year credit-bearing college math courses.

Geometry. The geometry standards covered in this domain encompass a wide range of fundamental geometric concepts and applications. Across the clusters, students study shapes, transformations, measurements, and their practical implications. In the geometry domain, the high school standards cover various fundamental geometric concepts and applications. One cluster of the high school standards for geometry showed partial alignment with developmental college math course content expectations, but not with first-year credit-bearing college course content. Three high school standard clusters did not align with developmental college math course content expectations, yet they did align or partially align with first-year credit-bearing math course content expectations. For other clusters, like circles, there was no alignment between the high school standards and either developmental college math course content expectations or first-year credit-bearing math course content expectations.

Statistics. The statistics domain covers data representation, analysis, inference, and probability. Two of the three high school statistics standards clusters were aligned or partially aligned with developmental college math course content expectations and all three clusters of the high school statistics standards were aligned for first-year credit-bearing college math course content expectations. The rigor of the high school standards was at a similar level (one cluster) and a higher level (one cluster) than the level of rigor for developmental college math courses. The level of rigor of the high school standards was similar (two clusters) or lower (one cluster) than the level of rigor for first-year credit-bearing college math course content. Overall, there is continuity in coverage of statistical concepts and skills from high school to college-level courses, but there is generally higher alignment between high school standards and first-year credit-bearing college math course content.

Science Standards and Alignment Results

To supplement the ELA and math alignment, we also looked at the extent to which Maryland's high school standards in ELA, math, and science were aligned to first-year credit-bearing college science course content.[23] Maryland adopted the Next Generation Science Standards (NGSS) as its high school college and career ready science standards. The NGSS are organized by three dimensions of science learning: practices that describe behaviors related to scientific inquiry and engineering design; cross-cutting concepts that apply across all the domains of science; and disciplinary core ideas (DCIs) that are used to focus "curriculum, instruction and assessment on

[23] For the science alignment, since there is a lab component, we looked only at content alignment.

the most important aspects of science" (NGSS, n.d.). As part of the alignment review for science, we looked at two DCIs and the Disciplinary Literacy Standards for Science and Technical Subjects, along with the ELA and math findings discussed above. As a reminder, we do not expect full alignment between high school standards and college science content. First-year science courses have a specific focus on biological and physical science and course objectives prioritize science content. The lack of alignment should not be interpreted as a negative finding.

Disciplinary Core Ideas: Life Science and Physical Science

DCIs are the foundational ideas or knowledge that a student requires to engage in science learning from kindergarten to Grade 12 and continues to build upon following high school. DCIs can be thought of as the fundamental scientific content that is specific to a science discipline. Life science and physical science each have four main DCIs (with subtopics) whose content and skills a student must know and be able to do (at varying rigor appropriate to grade level). Appendix G.4 provides a description of the DCIs and subtopics and Exhibits G.4.1 through G.4.3 (Appendix G.4) provide alignment ratings for each DCI by subtopic within the NGSS.

Life Science alignment findings. For the concepts within this DCI, the high school standards showed a high level of alignment for the first-year credit-bearing college life science course content. All of the subtopics within each DCI were reflected in college course content and learning objectives. In addition, the rigor of the high school standards was at a similar level as in the first-year credit-bearing college life science courses.

Physical Science alignment findings. For the concepts within this DCI, the high school standards showed a high level of alignment for the first-year credit-bearing college physical science course content; however, one high school topic was partially aligned due to a lack of detail found within the college course content, and two high school topics were not addressed explicitly in the college course content. In addition, the rigor of the high school standards was at a similar level as in the first-year credit-bearing college physical science courses.

English Language Arts and Mathematics

First-year credit-bearing science courses at Maryland's community colleges typically have prerequisite requirements of completion or proficiency of 100-level English and math courses. Findings from the overall ELA alignment and math alignment generally show strong high school standards alignment for first-year college course content, which would indicate preparedness for first-year credit-bearing science courses.

We conducted a secondary review focused on content alignment using the Disciplinary Literacy Standards developed for science and the math standards that the NGSS identified as being connected to the life science and physical science DCIs. Appendix G.4 provides a description of the DCIs and subtopics and Exhibits G.4.4 and G.4.5 (Appendix G.4) provide alignment ratings for each strand and cluster of the Maryland Disciplinary Literacy Standards for Science and Technical Subjects.

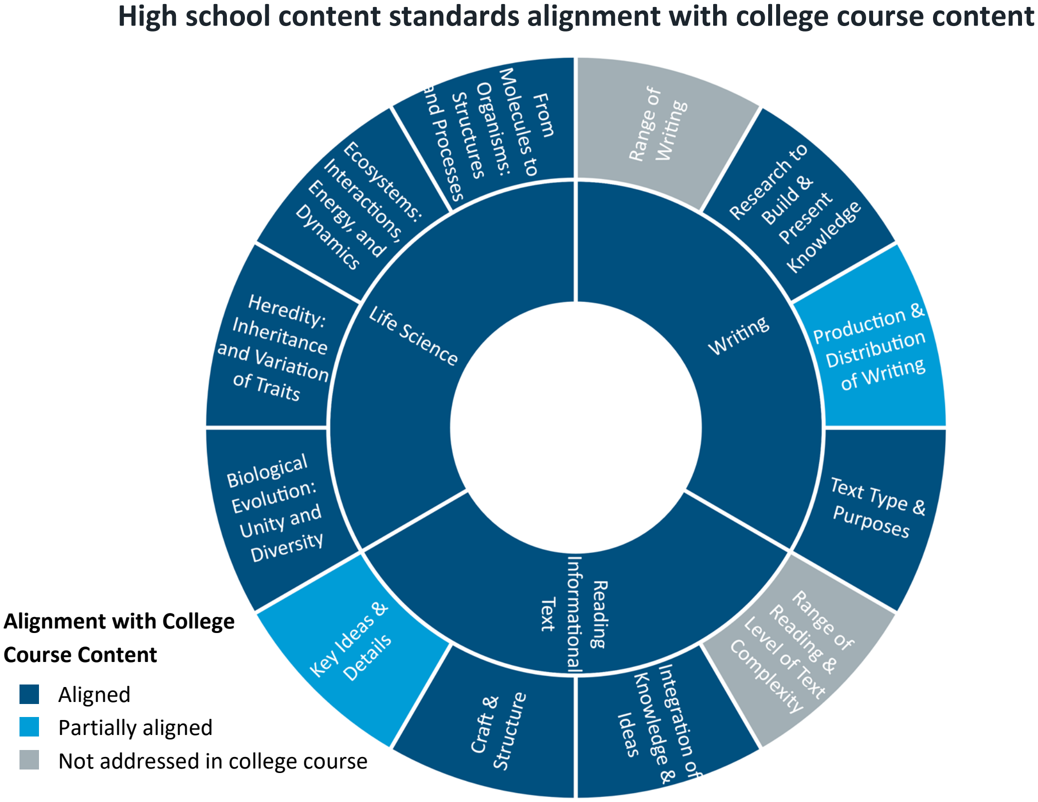
Life Science alignment findings. Overall, high school Disciplinary Literacy Standards were aligned with first-year credit-bearing life science course content expectations. This was supported through explicit ELA content expectations included within college course learning objectives.

Physical Science alignment findings. Overall, high school Disciplinary Literacy Standards were partially aligned with first-year credit-bearing physical science course content expectations. Partial alignment was due to a lack of explicit ELA content expectations included within college physical science course content expectations, which resulted in more variation across reviewers based on the extent to which they considered implicit alignment. For example, one high school reading standard focuses on citing textual evidence. One reviewer rated this high school standard as aligned with college course content since course learning objectives reflected an expectation that students complete laboratory work and a research project, which the reviewer felt requires student to effectively draw from textual evidence. Another reviewer did not consider analyzing and describing results from observations/experiments as meeting the high school standard for citing textual evidence. There was a similar pattern across high school standards and college science course content alignment where the tension between explicit and implicit alignment was present.

Exhibit 20 summarizes the alignment between the high school science, writing, and reading standards and first-year credit-bearing college life science course content expectations and the similarity in level of rigor between high school standards and college life science courses.

Exhibit 21 summarizes the alignment between the high school science, writing, and reading standards and first-year credit-bearing college physical science course content expectations and the similarity in level of rigor between high school standards and college physical science courses.

Exhibit 20. DCI and Disciplinary Literacy Alignment to Life Science Course Content



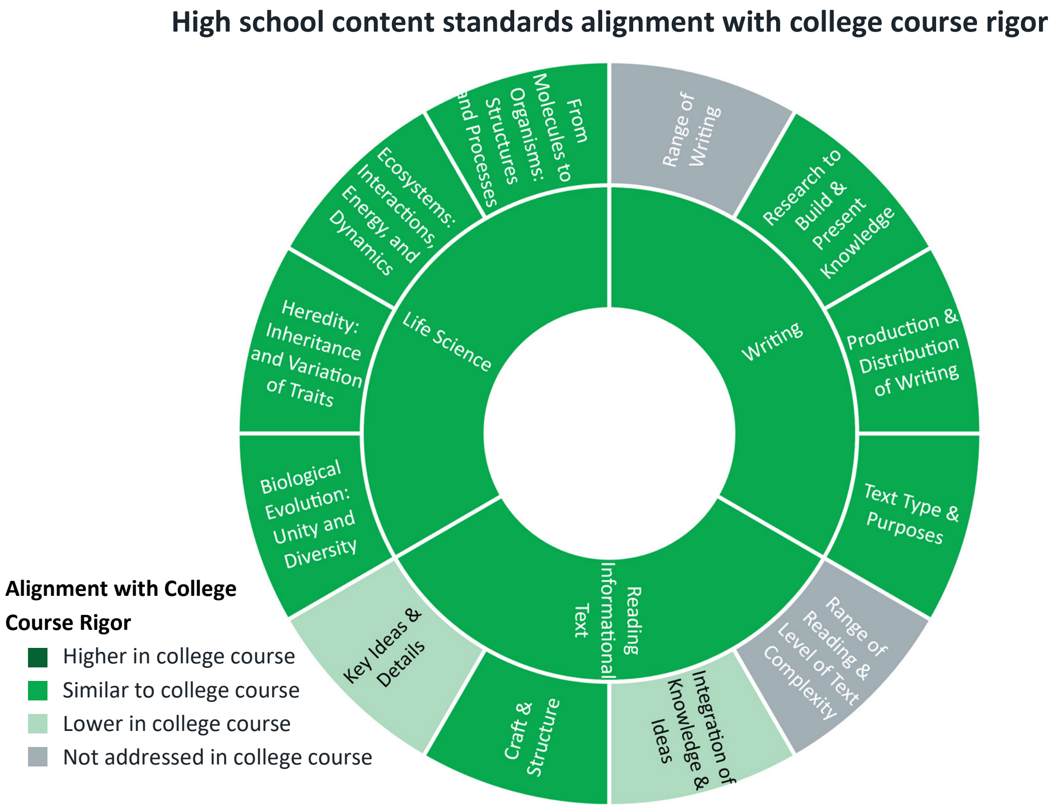
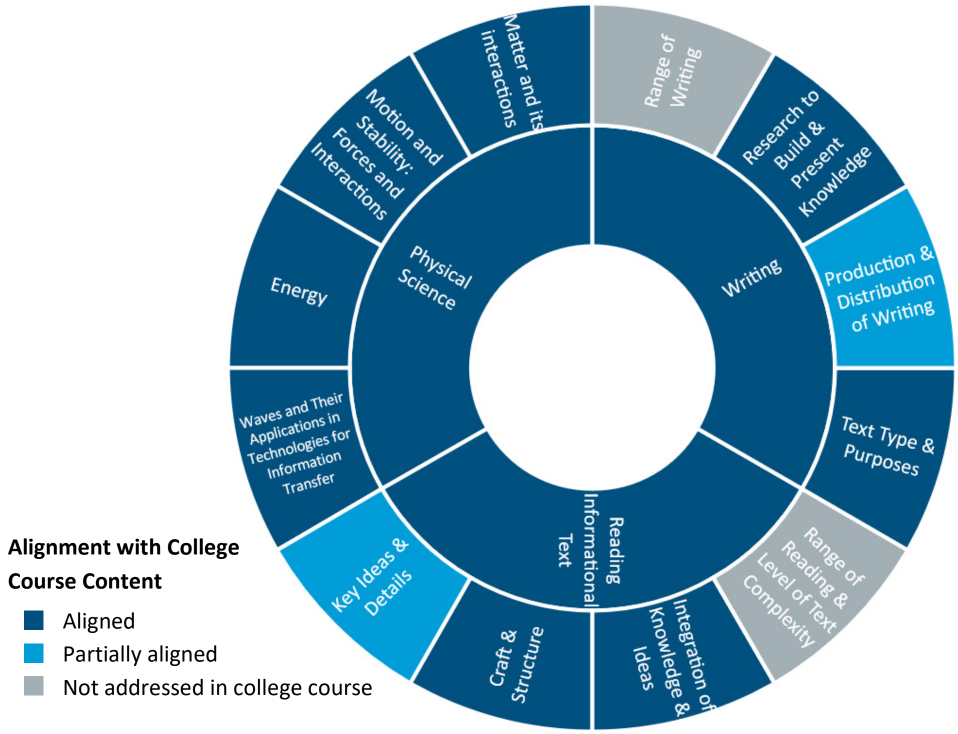
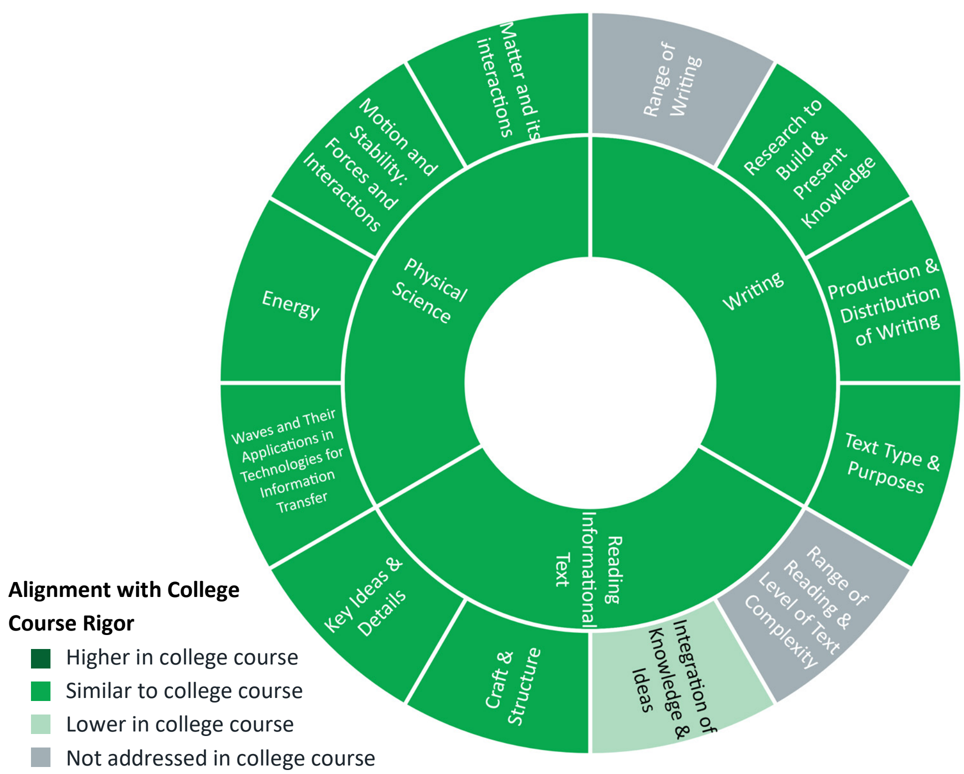


Exhibit 21. DCI and Disciplinary Literacy Alignment to Physical Science Course Content

High school content standards alignment with college course content



High school content standards alignment with college course rigor



Technical Education Standards and Alignment Results

The standards and content alignment analysis also looked at the alignment of high school content standards with college content expectations for certificate-granting training programs at Maryland’s community colleges. In FY22, Maryland’s community colleges offered more than 300 Workforce Training Certificate (WTC) programs and 241 different courses leading to licenses or certifications (MCCA, 2022). When we looked across these programs to identify the most common licenses and certificates in an effort to identify and synthesize readiness expectations into a conceptual framework similar to ELA, math, and science we found the following:

- **Colleges vary widely regarding the type of information provided about certificate programs and requirements.** Most colleges identify general enrollment requirements such as age, high school diploma/GED, background check, and prior work experience for programs; however, specific content related to program learning objectives or prerequisite academic content/ technical skills is not provided.
- **Most certificate programs do not require students to take an English or math course.** In reviewing program information, some colleges provide course sequence information, but most certificates do not include a specific English or math requirement. Instead, they focus on technical skill development related to the certificate/industry.
- **Certificate programs vary widely in the duration and intensity of the program and the type of certification/license earned.** Across the hundreds of certificate programs there are no clear standard expectations related to duration of program or depth of knowledge.

Our initial plan—to review ELA and math standards against a conceptual framework and course content for certificate-granting programs—had to be adapted. Findings from the overall ELA alignment and math alignment generally show strong high school standards alignment for first-year college course content, which would indicate preparedness also for postsecondary certificate-granting training programs. However, since we were unable to develop a conceptual framework from the available information about expectations related to certificate-granting programs, we examined two existing workforce frameworks and the extent to which Maryland’s Disciplinary Literacy Standards, Mathematical Practices, and Science and Engineering Practices align to those college program content expectations. The first framework was developed by the U.S. Department of Labor (O*NET Content Model) from occupational data and the second was developed through the Office of Career and Technical Education at the Department of Education (Employability Skills Framework). Appendix G.5 provides a description of each framework and Exhibits G.5.4 through G.5.7 (Appendix G.5) provide alignment ratings for standards within the Maryland CCR Disciplinary Literacy Standards, Mathematical Practices, and Science and Engineering Practices.

Alignment findings. Both O*NET and the Employability Skills Frameworks include a focus on basic skills in reading comprehension, writing, speaking, and listening skills. The overall high school ELA content expectations at the end of Grade 10 are sufficient to meet these employability expectations; however, explicit mentions of disciplinary literacy were limited given the lack of detail in these frameworks. Similarly, the overall math content expectations at the end of Grade 10 are sufficient to meet workforce needs. When looking at the O*NET and the Employability Skills Frameworks, the high school mathematical practices were generally aligned with employability expectations. All but one of the scientific and engineering practices had at least partial alignment to the O*NET and Employability Skills Frameworks.

While academic content standards are aligned, postsecondary expectations shared through the course syllabi, focus groups, and national workforce frameworks emphasize skills for success (e.g., communication, critical thinking, self-regulation), which are not as present or explicit within Maryland's CCR standards. Some skills for success are reflected within the high school Mathematical Practices and Science and Engineering Practices, and skills for success are the focus of MSDE's Maryland Career Development Framework for College and Career Readiness, but there is less emphasis on these skills in the formal Maryland CCR standards than what is seen in workforce expectations.

D.3. Predictive Validity of the Interim and Alternative CCR Standards (Objective 3)

In this section, we present the main findings from the predictive validity analysis. We focus the discussion on how well the interim CCR standard and three alternative standards predict postsecondary progress in the first year of college (PSY1). To meet the interim CCR standard, a student must meet or exceed the following criteria for both English and math:

- **English**: Score in the met or exceeded expectations performance level on the English 10 state assessment (a score of at least 750 on the PARCC English 10 test).
- **Math**: Score in the met or exceeded expectations performance level on the Algebra 1, Algebra 2, or Geometry state assessment (a score of at least 750 on the PARCC test) or score at least 520 on the SAT Math Test.

We compare the interim CCR standard to the following alternative specifications:

- An "inclusive standard" specification that includes the same measures as the interim CCR standard, but students can score at or above 725 on the state assessments to get classified as college and career ready (the approximate threshold for the approaching expectations performance level) instead of having to score at or above 750. Students can also meet the math criterion with a score of at least 520 on the SAT Math Test.

- A specification where students can get classified as college and career ready if they meet the interim CCR standard *or* have an overall HSGPA ≥ 3.0.
- A specification where students can get classified as college and career ready if they meet the “inclusive standard” *and* have an HSGPA ≥ 2.75.

Detailed results for other alternative standards and other measures of postsecondary progress are provided in Appendix L.

Readiness Rates Based on the Interim and Alternative CCR Standards

Before addressing the accuracy of the interim CCR standard in predicting postsecondary progress, it is useful to understand how many students would have met the standard if it were applied to them at the end of their second year of high school (HSY2). Exhibit 22.a presents the readiness rates based on the interim CCR standard and the alternative standards by initial postsecondary pathway. Readiness rates by student group and geographic region are presented in Exhibits 22.b and 22.c, respectively.

Overall, 30% of the students in our sample would have met the interim CCR standard by the end of HSY2, with 40% of students who were in one of the three Maryland college postsecondary pathways meeting the interim CCR standard.[24] The rate was lower (27%) for students who went to a Maryland community college and higher (56%) for students who went to a Maryland public 4-year institution. Large differences in the rates exist across students. For example, the rates for Black and Hispanic students are 13% and 15%, respectively, and the rate for current English learners and students with disabilities is less than 5%.

[24] Among the 223,175 students in our sample who did not meet the interim CCR standard at the end of their second year of high school, 66% did not meet the English or math standard, 23% met the English standard but not the math standard, and 10% met the math standard but not the English standard (percentages do not sum to 100% because of rounding).

Exhibit 22.a. Percentage of Students Who Met the CCR Standard at the End of Grade 10, by Initial Postsecondary Pathway

	(1) Interim Standard	(2) Inclusive Standard	(3) Interim or HSGPA	(4) Inclusive & HSGPA
All students	30%	52%	49%	39%
Any MD institution of higher ed	40%	68%	64%	55%
MD community college	27%	57%	49%	39%
MD public 4-year institution	56%	80%	80%	71%
MD state-aided independent	46%	77%	78%	67%
Non-MD 4-year institution	58%	80%	82%	72%
No college enrollment	12%	30%	25%	16%

Note. Standard 1 is the interim CCR standard where students must score at or above 750 on the state assessments. Standard 2 includes the same measures as the interim CCR standard but students can score at or above 725 on the state assessments to be classified as college and career ready. Students can meet Standard 3 based on the interim CCR standard or with an overall high school grade point average (HSGPA) ≥ 3.0. Standard 4 requires students to meet the 725 version of the interim CCR standard and have an HSGPA ≥ 2.75. CCR = college and career readiness. MD = Maryland.

Exhibit 22.b. Percentage of Students Who Met the CCR Standard at the End of Grade 10, by Student Characteristics

	(1) Interim Standard	(2) Inclusive Standard	(3) Interim or HSGPA	(4) Inclusive & HSGPA
All students	30%	52%	49%	39%
Female students	33%	57%	56%	46%
Male students	27%	47%	42%	33%
Asian students	57%	76%	82%	69%
Black students	13%	34%	29%	22%
Hispanic students	15%	34%	36%	24%
White students	46%	70%	64%	55%
English learners (current)	1%	3%	30%	3%
English learners (recent exit)	27%	57%	56%	47%
Students with disabilities	4%	12%	19%	7%
FARMS-eligible students	12%	32%	28%	19%

Note. Standard 1 is the interim CCR standard where students must score at or above 750 on the state assessments. Standard 2 includes the same measures as the interim CCR standard but students can score at or above 725 on the state assessments to be classified as college and career ready. Students can meet Standard 3 based on the interim CCR standard or with an overall high school grade point average (HSGPA) ≥ 3.0. Standard 4 requires students to meet the 725 version of the interim CCR standard and have an HSGPA ≥ 2.75. CCR = college and career readiness; FARMS = free and reduced-price meal services.

Exhibit 22.c. Percentage of Students Who Met the CCR Standard at the End of Grade 10, by Geographic Region

	(1) Interim Standard	(2) Inclusive Standard	(3) Interim or HSGPA	(4) Inclusive & HSGPA
Anne Arundel County	34%	58%	52%	45%
Baltimore City	9%	23%	17%	11%
Baltimore County	22%	44%	39%	31%
Frederick County	48%	71%	68%	60%
Lower Shore Region	31%	57%	48%	43%
Mid Maryland Region	50%	72%	67%	61%
Montgomery County	35%	56%	64%	50%
Prince George's County	13%	32%	32%	23%
Southern Maryland Region	34%	60%	52%	44%
Susquehanna Region	39%	66%	54%	48%
Upper Shore Region	33%	61%	50%	42%
Western Maryland Region	31%	58%	41%	16%

Note. The MLDS Center defines Maryland regions, where larger LEAs constitute their own region (e.g., Baltimore County) and smaller LEAs are grouped into the following regions: Lower Shore (Somerset, Wicomico, and Worcester Counties), Mid Maryland (Carroll and Howard Counties), Southern Maryland (Calvert, Charles, and St. Mary's Counties), Susquehanna (Cecil and Harford Counties), Upper Shore (Caroline, Dorchester, Kent, Queen Anne's, and Talbot Counties), and Western Maryland (Allegany, Garrett, and Washington Counties). For the predictive validity analysis, students were assigned a region on the basis of the LEA they attended at the end of their second year of high school. Standard 1 is the interim CCR standard where students must score at or above 750 on the state assessments. Standard 2 includes the same measures as the interim CCR standard but students can score at or above 725 on the state assessments to be classified as college and career ready. Students can meet Standard 3 based on the interim CCR standard or with an overall high school grade point average (HSGPA) ≥ 3.0. Standard 4 requires students to meet the 725 version of the interim CCR standard and have an HSGPA ≥ 2.75. CCR = college and career readiness.

The percentage of students who would meet an alternative CCR standard was greater than with the interim CCR standard. Overall, the readiness rates are highest for the inclusive standard (52%). This trend also is true for students with a Maryland community college initial postsecondary pathway, where an additional 28% of students (from 40% to 68%) would meet the standard if the test score threshold was reduced from 750 to 725. For students with an initial postsecondary pathway in a 4-year institution, the readiness rates under the inclusive standard and the standard with HSGPA as an option were similar. For example, for students who attended a Maryland public 4-year institution, the readiness rate was 80% using the inclusive standard and using the HSGPA option.

Including an HSGPA option may be particularly salient for current English learners and students with disabilities. For current English learners, only 1% would meet the interim CCR standard, whereas 30% would meet the CCR standard if the HSGPA option was available. Similarly, for students with disabilities, only 4% would meet the interim CCR standard, whereas 19% would meet it if the HSGPA option was available.

Accuracy of the Interim and Alternative CCR Standards

An important indicator of a standard's quality is how well it can correctly predict which students will experience postsecondary progress and which students will not. The accuracy rate is a key statistic that summarizes the percentage of students who would be correctly classified as ready to make postsecondary progress or not ready based on a definition of successful postsecondary progress. While the rate can range from 0% (all students misclassified) to 100% (all students correctly classified), it is not realistic to expect a CCR standard to perfectly predict postsecondary progress.[25] Generally, accuracy rates of at least 70% are desired, with higher rates desirable if the CCR standard is to be used for consequential decision making.

In this section, we focus on the findings for the following four postsecondary progress benchmarks:

- Earned at least 12 college course credits in the first-year fall term after expected high school graduation.
- Earned college English course credits in the first year after expected high school graduation.
- Earned college math course credits in the first year after expected high school graduation.
- Earned college science course credits in the first year after expected high school graduation.

Results for other postsecondary progress benchmarks are provided in Appendix L.[26]

[25] There are many reasons why a 100% accuracy rate is not feasible, especially when trying to predict postsecondary progress multiple years in the future. Aside from the multitude of factors that influence postsecondary progress between Grade 10 and the first year after high school that are not easy to measure or predict, measurement error in the available high school data (e.g., test scores) limits the accuracy of any prediction based on those data. The PARCC CCR benchmark and the SAT CCR benchmark, for example, are defined as the point at which a student has a 75% chance of earning a C or better in college courses (College Board, n.d.; Davis & Moyer, 2015), which implicitly acknowledges the imperfect nature of the prediction.
[26] In addition to Appendix L, we created a supplemental document that contains complete reporting on the percentages of students who met each of the different definitions of the CCR standard and postsecondary progress benchmarks examined for

The analysis of accuracy rates for overall college credits earned is based on 117,819 students in one of the three Maryland college postsecondary pathways. Among this sample, 64% of the students earned at least 12 college credits in their first-year fall term (43% for students at a MD community college and 85% for students at a MD public 4-year institution). The analysis of accuracy rates for subject-specific course credit is restricted to students in the Maryland community college or Maryland public 4-year institution postsecondary pathway because only these institutions report subject-specific credit information to the MLDS Center. The analysis of subject-specific course credits is further limited to students who enrolled in one of the subject-specific courses within the first year of college. Because subject-specific course passing can be measured only for students who attempted a course, our analytic sample sizes differ for each subject-specific course credit benchmark: 80,739 for English, 80,017 for math, and 48,035 for science. For each subject-specific sample, 80% earned college English credits in the first year (73% for students at a MD community college and 90% for students at a MD public 4-year institution), 66% earned college math credits in the first year (52% for students at a MD community college and 83% for students at a MD public 4-year institution), and 87% earned college science credits in the first year (80% for students at a MD community college and 93% for students at a MD public 4-year institution).

Exhibit 23 presents the accuracy rates for each of the four focal CCR standard specifications predicting each of the four focal postsecondary progress benchmarks. Overall, the interim CCR standard accurately classified (a) 65% of students based on the benchmark of at least 12 credits earned and (b) between 47% and 63% of students based on the subject-specific benchmarks. Each alternative CCR standard was more accurate than the interim CCR standard, with the HSGPA option having the highest accuracy rates: 75% for at least 12 college credits and 67% to 77% for the subject-specific benchmarks.[27] In general, accuracy rates were lower for students who were in a Maryland community college pathway compared to students who were in a Maryland public 4-year institution pathway.

To examine whether the accuracy rates for the interim and alternative CCR standards differ across student groups, we report the average accuracy rates across the four focal postsecondary benchmarks in Exhibit 24. For each of the student groups we examined, the average accuracy rates were higher for the alternative CCR standards than the interim CCR standard, with the HSGPA option having the highest average accuracy rates. For example, the

this study, along with the related predicative validity metrics between each high school CCR standard specification and postsecondary progress benchmark. All results are broken down by initial postsecondary pathway, student cohort, geographic region, and student characteristics. This supplemental document is available upon request.

[27] The accuracy rates for the alternative standard with an HSGPA option were about 2 to 14 percentage points lower (depending on the postsecondary progress benchmark) than when we use a machine learning approach that takes 11 high school measures into account and generates optimal thresholds for each measure (see Appendix K for the machine learning results).

average accuracy rate for students from low-income families (FARMS-eligible) was 52% with the interim CCR standard and 67% for the alternative specification with the HSGPA option. However, regardless of how the CCR standard is specified, the accuracy rates are lower for some student groups than others. In particular, for Black students, Hispanic students, current English learners, students with disabilities, and FARMS-eligible students, accuracy rates for all the focal specifications are less than 70%.

Average accuracy rates for different geographic regions are presented in Exhibit 25. For most regions, the average accuracy rates were higher for the alternative CCR standards than the interim CCR standard, with the HSGPA option having the highest average accuracy rates. For students in Baltimore City and the Western Maryland region, however, the inclusive standard was a more accurate predictor of postsecondary progress than the other standards examined. More research is needed to understand why the standard with the HSGPA option does not perform as well in these two regions than in other regions of the state. One possible explanation is that there is variability in the meaning of HSGPA across LEAs and schools, which may limit the predictive power of HSGPA in some places (see exploratory correlational analysis in Appendix J for evidence of variability in the predictive power of HSGPA across geographic regions and schools).

Exhibit 23. Accuracy Rates for Each CCR Standard Predicting First-Year College Credits Earned, by Postsecondary Benchmark and Initial Postsecondary Pathway

Students in Any MD Institution of Higher Ed	(1) Interim Standard	(2) Inclusive Standard	(3) Interim or HSGPA	(4) Inclusive & HSGPA
Earned Credits ≥ 12 (PSY1F)	65%	71%	75%	72%
Earned English Credits (PSY1)	47%	66%	67%	60%
Earned Math Credits (PSY1)	63%	71%	75%	71%
Earned Science Credits (PSY1)	57%	75%	77%	69%

Students in MD Community College	(1) Interim Standard	(2) Inclusive Standard	(3) Interim or HSGPA	(4) Inclusive & HSGPA
Earned Credits ≥ 12 (PSY1F)	67%	64%	69%	69%
Earned English Credits (PSY1)	44%	60%	61%	55%
Earned Math Credits (PSY1)	62%	65%	71%	68%
Earned Science Credits (PSY1)	49%	69%	70%	62%

Students in MD Public 4-Year Institution	(1) Interim Standard	(2) Inclusive Standard	(3) Interim or HSGPA	(4) Inclusive & HSGPA
Earned Credits ≥ 12 (PSY1F)	64%	78%	81%	75%
Earned English Credits (PSY1)	52%	74%	75%	68%
Earned Math Credits (PSY1)	64%	77%	81%	75%
Earned Science Credits (PSY1)	62%	80%	82%	75%

Note. Standard 1 is the interim CCR standard where students must score at or above 750 on the state assessments. Standard 2 includes the same measures as the interim CCR standard but students can score at or above 725 on the state assessments to be classified as college and career ready. Students can meet Standard 3 based on the interim CCR standard or with an overall high school grade point average (HSGPA) ≥ 3.0. Standard 4 requires students to meet the 725 version of the interim CCR standard and have an HSGPA ≥ 2.75. Color shading in the exhibit distinguishes between rates < 70% (light gray), between 70% and 75% (light blue), and ≥ 75% (darker blue). CCR = college and career readiness; MD = Maryland; PSY1 = postsecondary year 1; PSY1F = postsecondary year 1 fall semester.

Exhibit 24. Average Accuracy Rate for Each CCR Standard Across Postsecondary Benchmarks for First-Year College Credits Earned, by Student Characteristics

	(1) Interim Standard	(2) Inclusive Standard	(3) Interim or HSGPA	(4) Inclusive & HSGPA
All students	58%	71%	73%	68%
Female students	56%	71%	74%	68%
Male students	60%	70%	73%	68%
Asian students	65%	79%	84%	77%
Black students	50%	63%	65%	61%
Hispanic students	53%	66%	69%	64%
White students	63%	75%	77%	72%
English learners (current)	39%	45%	68%	45%
English learners (recent exit)	53%	69%	75%	68%
Students with disabilities	55%	61%	66%	61%
FARMS-eligible students	52%	64%	67%	62%

Note. Standard 1 is the interim CCR standard where students must score at or above 750 on the state assessments. Standard 2 includes the same measures as the interim CCR standard but students can score at or above 725 on the state assessments to be classified as college and career ready. Students can meet Standard 3 based on the interim CCR standard or with an overall high school grade point average (HSGPA) ≥ 3.0. Standard 4 requires students to meet the 725 version of the interim CCR standard and have an HSGPA ≥ 2.75. Color shading in the exhibit distinguishes between rates < 70% (light gray), between 70% and 75% (light blue), and ≥ 75% (darker blue). CCR = college and career readiness.

Exhibit 25. Average Accuracy Rate for Each CCR Standard Across Postsecondary Benchmarks for First-Year College Credits Earned, by Geographic Region

	(1) Interim Standard	(2) Inclusive Standard	(3) Interim or HSGPA	(4) Inclusive & HSGPA
Anne Arundel County	60%	71%	73%	70%
Baltimore City	53%	64%	59%	57%
Baltimore County	55%	68%	71%	66%
Frederick County	67%	77%	80%	77%
Lower Shore Region	62%	69%	74%	71%
Mid Maryland Region	64%	77%	79%	75%
Montgomery County	55%	70%	77%	69%
Prince George's County	50%	64%	69%	62%
Southern Maryland Region	59%	71%	74%	71%
Susquehanna Region	65%	76%	77%	76%
Upper Shore Region	59%	71%	72%	66%
Western Maryland Region	60%	72%	67%	45%

Note. The MLDS Center defines Maryland regions, where larger LEAs constitute their own region (e.g., Baltimore County) and smaller LEAs are grouped into the following regions: Lower Shore (Somerset, Wicomico, and Worcester Counties), Mid Maryland (Carroll and Howard Counties), Southern Maryland (Calvert, Charles, and St. Mary's Counties), Susquehanna (Cecil and Harford Counties), Upper Shore (Caroline, Dorchester, Kent, Queen Anne's, and Talbot Counties), and Western Maryland (Allegany, Garrett, and Washington Counties). For the predictive validity analysis, students were assigned a region on the basis of the LEA they attended at the end of their second year of high school. Standard 1 is the interim CCR standard where students must score at or above 750 on the state assessments. Standard 2 includes the same measures as the interim CCR standard but students can score at or above 725 on the state assessments to be classified as college and career ready. Students can meet Standard 3 based on the interim CCR standard or with an overall high school grade point average (HSGPA) ≥ 3.0. Standard 4 requires students to meet the 725 version of the interim CCR standard and have an HSGPA ≥ 2.75. Color shading in the exhibit distinguishes between rates < 70% (light gray), between 70% and 75% (light blue), and ≥ 75% (darker blue). CCR = college and career readiness.

Relying solely on the accuracy rate masks some differences in performance between the interim CCR standard and the alternative standards. It is important to also consider the sensitivity rate (how well the standard correctly identifies students making progress) and the specificity rate (how well the standard correctly identifies students not making progress) to understand differences in predictive validity across alternative CCR standards. Ideally, a quality CCR standard should have both sensitivity and specificity rates of at least 70%. The sensitivity and specificity rates for each CCR standard and each postsecondary progress benchmark, as well as breakdowns of the classification groups for the focal standard definitions and benchmarks, are in Appendix L.1.

For the postsecondary benchmark of at least 12 credits earned, the interim CCR standard had a sensitivity rate of 54% and a specificity rate of 83%. This means the interim CCR standard can do a relatively good job of identifying students who are not ready to make postsecondary progress but will misclassify a higher percentage of students who are ready to make postsecondary progress. In other words, the interim CCR standard will misclassify a substantive share of students as not college and career ready when those students really should be identified as college and career ready.

Among the focal alternative standards, the inclusive standard has the opposite issue: a sensitivity rate of 81% and a specificity rate of 53%. The alternative with the HSGPA option has a sensitivity rate of 81% and a specificity rate of 64%. The alternative standard that uses the inclusive standard and HSGPA is the specification where the sensitivity and specificity rates are both over 70% (71% and 73%, respectively).

Summary of Results from Supplemental Predictive Validity Analyses

Findings from the supplemental analyses examining additional postsecondary progress benchmarks reinforce the findings presented for the primary analysis. In particular, accuracy rates are higher for the alternative CCR standards than the interim CCR standard, with the highest accuracy rates with the HSGPA option, when using college GPA, college persistence, or college retention as the benchmark for postsecondary progress (see Exhibit L.2.1 and Exhibit L.4.2). When looking at college persistence and retention, we also found that accuracy rates for students who went to a non-Maryland 4-year institution are similar to accuracy rates for students who went to a Maryland 4-year institution. In addition, results regarding the accuracy rate for the primary student sample (students enrolled in a Maryland high school at the end of HSY2) are similar to results based on students who graduated from a Maryland high school within four years, regardless of whether the CCR standard was defined at the end of HSY2 or HSY4 (Exhibit L.5.2).

The supplemental analyses to examine postsecondary progress for students who did not enroll in college the fall after expected high school graduation are not consistent with the primary analysis findings. In particular, the interim CCR standard had higher accuracy rates than the alternative standards when looking at employment benchmarks for students who did not enroll in college (see Exhibit L.6.2), and accuracy rates were similar across the different CCR standard specifications when looking at college benchmarks for students who delayed college enrollment (see Exhibit L.7.1).

D.4. Potential Areas of Bias Within Assessments Used to Determine CCR (Objective 4)

This section presents findings related to the potential sources of bias in assessments of CCR. In addition to focus group data, we examined research on different types of bias as they relate to common assessments used to gauge CCR. Insights from the literature review and the focus groups highlight not only potential biases within some assessments, but also disparities in preparation for assessments that can contribute to inequities in testing results.

Standardized Assessments Frequently Are Subject to Cultural Bias.

Our literature review suggests that large-scale assessments can be subject to varying types of bias. The research shows that cultural bias in standardized testing is well-documented (Bazemore-James, 2016). On average, students of color score lower on college admissions tests, leading to significantly reduced chances of higher education, merit scholarships, and therefore access to a better quality of life (Bhattacharya, 2022; Rosales, 2021). The cause of the bias is mostly attributed to language used in the tests, which is normed to background knowledge often held by White, middle-class students (Choi, 2020). Most of the research looks at the SAT and ACT tests, but studies are emerging that raise questions of equity on ACCUPLACER (Helvie, 2020). Data on performance by race on these tests raises questions about whether students have been incorrectly placed into developmental coursework because of a biased assessment (Helvie, 2020).

In another example exhibiting cultural bias, research on the Florida Postsecondary Education Readiness Test (PERT) showed racial bias disadvantaging Hispanic students. Researchers found that PERT scores did not accurately predict first-year college GPA for Hispanic students as it did for the other students in the study (Criss, 2021). In addition, some studies raise equity concerns about the reliance on college admissions tests to determine CCR. For example, Klasik and Strayhorn (2018) found that a college readiness benchmark based on the SAT could differ substantially across student groups and college selectivity. Citing equity, access, and relevance concerns, colleges across the country have moved toward test-optional admissions policies, with one in four institutions no longer requiring submission of SAT or ACT scores in student applications (Einhorn, 2022; Tugend, 2019). Although research on Maryland-specific assessments like the MCAP and the PARCC is limited, cultural bias also may exist on these specific assessments given existing documentation of cultural bias in large-scale assessments.

Inequities Exist in Opportunities to Prepare for Assessments.

Several postsecondary stakeholders shared their perspectives on the importance of preparation for placement tests, noting that inequitable opportunities to prepare for placement tests exist. For example, one stakeholder noted that not all students are able to participate in test preparation courses because of financial and/or time constraints. Stakeholders also noted the opportunity gap for students in districts with fewer resources, recognizing that those students may not receive good advice about college preparation and pathways. These stakeholder reflections are consistent with existing research that points to inequities in preparation for such assessments. Overall, according to Doran (2022), although the assessments themselves may not be biased, the educational opportunity and preparation for those assessments is inequitable, as students in different school systems are exposed to varied curricula and preparation opportunities yet are expected to perform comparably on assessments. Additionally, some states offer "pathways" that push students into various college and career tracks. For students in these states who choose or are tracked into a career pathway based on performance or subjective observations of school staff, entering college may be difficult (Sattem & Hyslop, 2021).

In addition, another stakeholder reflected on the importance of advising in advance of placement testing:

> They will be asked just to take the test and they don't know that that is for them to be placed. And some of them will be placed to developmental math because they did not do well in their test.

Others echoed this sentiment, noting that effective advising is key to preparing students and ensuring that they understand the purpose of placement tests like ACCUPLACER. Although postsecondary stakeholders are referring to postsecondary-based advising, advising to prepare students before leaving high school also may support better understanding of and preparation for placement tests.

Relatedly, stakeholders suggested that using multiple measures to place students in appropriate entry-level or developmental courses is important. For example, one stakeholder described their institution's process for placing students:

> [Students' placement exams] are auto scored by ACCUPLACER, but we also read them. And so it's also a conversation. So any student who needs developmental coursework must have a conversation with an advisor and sometimes English faculty are pulled into those conversations. So we look at a variety of things. Is the student non-traditional? Are they recent high school graduates? What program are they looking for? Where do they live? Are they going to be doing most of their coursework remotely? So it is a conversation with an advisor and that has improved placement immensely.

Similarly, research shows that placement tests can underestimate students' likelihood of being ready for college-level work (Bahr et al., 2019). More specifically, CCR indicators may undermeasure students' postsecondary potential by "undermatching" those students, which is especially prevalent in states that use only a single measure of CCR (Zhou, 2023).

D.5. Summary of Findings

In this section, we summarize the key findings for each study objective.

Objective 1. Identify Knowledge and Skills Required to Be College and Career Ready

Content knowledge considered important for college readiness is covered in the Maryland K–12 content standards.

- Postsecondary stakeholders identified reading comprehension and writing as foundational ELA content knowledge; algebra and functions as foundational math content knowledge; and critical reasoning and writing, scientific thought, and basic math skills as foundational science content knowledge. These foundational content knowledge areas are similar to content covered in high school courses and the Maryland K–12 content standards.
- Postsecondary stakeholders reported that many incoming college students struggle with reading, writing, precalculus, and scientific thought.

Skills for Success, including collaboration and healthy work habits, are critical for CCR.

- Postsecondary and workforce stakeholders mentioned time management, critical thinking, and workplace knowledge as important skills for students to master for college and career success.
- Postsecondary stakeholders spoke about the importance of multiple measures for determining CCR, including measures of skills for success, which are not yet measured consistently in Maryland.
- Top-performing international education systems require students to master both academic and life skills to be prepared for academic or technical career pathways.

Top-performing education systems provide formal CCR counseling early in students' journeys and clear options for college and career pathways.

- Top-performing U.S. states provide formal CCR counseling to students before Grade 10 and an easily accessible CCR plan. In addition, the top-performing states have multiple ways for students to demonstrate CCR or content knowledge for high school graduation, including individualized options (e.g., capstone project, appeals process) in lieu of passing a standardized test for high school graduation. None of the three top-performing states in our analysis use CCR assessments to determine which students can access certain courses or postsecondary pathways in high school.

- Top-performing international education systems offer multiple rigorous tracks; vocational or technical tracks are among several options for upper secondary school leading to a postsecondary career, with specific sets of requirements for completing each secondary track so that it feeds directly into the corresponding career pathway.

Objective 2. Assess the Alignment Between Maryland's College and Career Ready Academic Content Standards and Postsecondary Expectations

In general, the high school ELA, math, and science standards align to the content expectations of college course content in developmental and first-year credit-bearing courses.

- The Maryland high school content standards cover the relevant content expectations in college developmental and first-year credit-bearing courses. We found that all content expectations in the developmental and first-year credit-bearing college courses are addressed by the high school content standards.
- The Writing and Language strands of the high school ELA standards had the highest level of alignment with the college developmental and first-year credit-bearing English course content expectations. The Reading Informational Text strand of the high school ELA standards was partially aligned with the college course content expectations.
- The high school math standards classified within the Algebra and Functions domains had the highest level of alignment with the college developmental and first-year credit-bearing math course content expectations. The Number and Quantity and Statistics domains of the high school math standards were at least partially aligned with the college course content expectations.
- The rigor of the high school ELA and math standards was most often at a similar or higher level as in the developmental college courses. The rigor of the high school standards was most often at a similar or lower level as in the first-year credit-bearing college English courses.
- There was content alignment of the high school science disciplinary core ideas with life science course content and generally a high level of alignment with physical science course content.

Maryland's high school ELA and math standards align to content knowledge expectations for certificate-granting programs using two national frameworks that articulate workforce skills.

- Content expectations for Maryland's Workforce Training Certificate programs are not articulated on college websites, with most sites only including general admissions requirements (e.g., age, high school diploma/GED) making it challenging to identify content expectations. Nevertheless, using national frameworks as an alternative source for content expectations, we concluded that high school ELA and math content standards do cover the ELA and math expectations in common frameworks for workforce skills.
- While academic content standards are aligned, postsecondary expectations shared through the course syllabi, focus groups, and national workforce frameworks emphasize skills for success (e.g., communication, critical thinking, self-regulation), which are not as present or explicit within Maryland's CCR standards.

Objective 3. Assess How Well the Interim CCR Standard and Alternative Specifications of the Standard Predict Postsecondary Progress

The interim CCR standard, utilizing state assessments, correctly classified 47%–65% of students as college ready or not college ready at the end of Grade 10.

- Overall, 40% of students who enrolled in a Maryland college the fall after their fourth year of high school met the interim CCR standard by the end of HSY2. The interim CCR standard correctly classified 47%–65% of students as college ready or not college ready, depending on the college credits earned postsecondary progress benchmark used to validate readiness. This means that the interim CCR standard could misclassify 35%–53% of students at the end of HSY2, and especially misclassify many students as not college and career ready when they are likely to be ready.
- The accuracy rates for the interim CCR standard were similar for students who went to a Maryland community college and students who went to a Maryland public 4-year institution.
- Accuracy rates were lower for some student groups than others. In particular, for Black students, Hispanic students, current English learners, students with disabilities, and FARMS-eligible students, the interim CCR standard had average accuracy rates that were less than 60%. In addition, the average accuracy rate for the interim CCR standard was lower in some Maryland regions (e.g., Baltimore City, Prince George's County) than other regions.

- Using a more inclusive threshold on the state assessments (i.e., score of 725 instead of 750) allows more students to meet the CCR standard and provides a more accurate prediction of readiness.

Adding an alternative way to meet the CCR standard with HSGPA increased the percentage of students who meet the CCR standard and improved accuracy rates for predicting first-year college credits earned.

- Adding an option that allows students to meet the CCR standard based on the interim CCR standard criteria or with an overall HSGPA of at least 3.0 at the end of Grade 10 increased the percentage of students who met the CCR standard from 40% to 64% (among students who enrolled in a Maryland college). In addition, an alternative CCR standard with HSGPA as an option correctly classified 67%–77% of students as college ready or not college ready, depending on the college credits earned postsecondary progress benchmark used to validate readiness. This means fewer students will be misclassified at the end of Grade 10 if CCR determination is based on student performance on state assessments or a student's HSGPA, rather than state assessments only.
- Adding HSGPA into the CCR standard improved accuracy rates more for students who attended a Maryland public 4-year college (75%–82% with HSGPA compared to 52%–64% without HSGPA) than for students who attended a Maryland community college (61%–71% compared to 44%–67%).
- Adding HSGPA into the CCR standard improved the average accuracy rate for all student groups. For example, the average accuracy rate for English learners increases from 39% to 68% if the HSGPA option is included.
- Adding HSGPA into the CCR standard results in higher accuracy rates, on average, compared to other alternative specifications of the CCR standard. This is not the case, however, in Baltimore City and the Western Maryland Region, where accuracy rates were highest when using a more inclusive threshold on the state assessments.
- Adding HSGPA into the CCR standard does not improve accuracy rates when predicting employment outcomes for students who did not go to college after expected high school graduation, or when predicting college credits earned for students who delayed college enrollment. For these situations, the interim CCR standard had higher accuracy rates, though more research is needed to understand why.

Objective 4. Identify Potential Areas of Bias Within Assessments Used to Determine CCR

Standardized assessments are frequently subject to cultural bias.

- Cultural bias in standardized tests is well-documented and mostly attributed to language used on the tests, which is normed to background knowledge often held by White, middle-class students.
- Some studies raise equity concerns about the reliance on college admissions tests to determine CCR. Citing equity, access, and relevance concerns, colleges across the country have moved toward test-optional admissions policies.

Data on performance on standardized placement tests by race/ethnicity raise questions about whether students have been incorrectly placed into developmental coursework because of a biased assessment.

Inequities exist in students' opportunities to prepare for assessments.

- Postsecondary stakeholders raised concerns about inequities in preparation for college entrance assessments and noted the opportunity gap for students in less resourced districts, as well as concerns about limited information and guidance about college preparation and pathways.
- Financial and time constraints present challenges to lower-resourced communities and districts being able to prepare students for college entrance assessments.

E. Policy Recommendations and Suggestions for Future Research

In this section, we present policy recommendations, based on a synthesis of the findings presented in this report. These recommendations are intended to guide and foster further discussion among decision makers and stakeholders and should be interpreted within the context of the study's scope and limitations. In addition, we present suggestions for future research that may inform how to continue improving CCR in Maryland.

E.1. Revise the Maryland CCR Standard to Assess CCR More Accurately and Equitably

Postsecondary stakeholders and the literature review on bias in assessments pointed to the importance of using multiple measures to assess CCR. The utility of multiple measures is further supported in the broader research literature and the predictive validity analysis we conducted for this study.

Relying solely on the test-based measures in the interim CCR standard likely will result in misclassifying many students, and disproportionately, students from historically marginalized groups. In particular, the interim CCR standard will misclassify a lot of students as not ready who, in fact, will be college and career ready. Using the interim CCR standard as a gatekeeper for educational opportunities (e.g., access to advanced courses or dual enrollment programs) could adversely affect educational outcomes for many students. In addition, relying solely on state assessments, which research indicates can include cultural biases, may structurally disadvantage students who have a diverse range of lived experiences.

The Maryland CCR standard should be flexible enough to support decisions that are tailored to individual student needs and aspirations. In particular, we recommend MSDE consider the following options for revising the CCR standard.

- **Provide at least two options for students to meet the CCR standard: one option based on the state assessments in the interim CCR standard, and another option based on having an HSGPA of at least 3.0.** Including options to meet the CCR standard based on (1) the state assessments in the interim CCR standard or (2) an overall HSGPA of at least 3.0 will provide a more accurate indicator of whether students will succeed in first-year credit-bearing college courses or not (compared to just using the interim CCR standard) and reduce the number of students who are misclassified as not ready when they are, in fact, on track to be college and career ready. Including the HSGPA option may be particularly useful for student groups that have limited opportunities to take the assessments in the interim CCR standard (e.g., English learners) by the end of Grade 10.
- **If an HSGPA option is included in the CCR standard, provide guidance and support to LEAs and schools to better standardize and align grading practices across the state.** In our study, we found that overall HSGPA is a strong predictor of future postsecondary progress in all regions of the state. However, there is variability in the predictive utility of HSGPA across LEAs and schools that requires further investigation into how measures like HSGPA are operationalized across the state.
- **Incorporate flexibility into the CCR standard that allows students individualized ways to demonstrate mastery of the foundational skills needed for a particular postsecondary pathway.** Regardless of the high school measures included in the CCR standard, some students will be misclassified as not college and career ready when they will, in fact, be ready for a postsecondary pathway. This misclassification could be especially problematic if the CCR standard is used as a gatekeeper for future educational opportunities. Among the different specifications of the CCR standard we tested, overall accuracy rates typically

were less than 80%, and significantly lower for some student groups. Policymakers should consider additional ways for students to demonstrate readiness for specific pathways to better reflect the diversity of individual students' lived experiences and needs. For example, the CCR standard could include an option for LEAs to establish alternative mastery- or competency-based assessments (e.g., capstone projects) that, with MSDE approval, would give students whose individual circumstances do not align with the measures in the CCR standard another opportunity to meet the CCR standard.[28] More individualized options could be modeled on alternative options for satisfying high school graduation requirements, such as Maryland's Bridge Plan for Academic Validation, Colorado's Collaboratively-Developed, Standard-Based Performance Assessment and capstone options for high school graduation, or Massachusetts's Educational Proficiency Plan and state assessment appeals process.

E.2. Strengthen Learning Opportunities and Supports for Content Mastery, Along With CCR Counseling Early in Students' Educational Journeys

Findings from the alignment analysis indicate that Maryland's high school content standards are generally aligned with the English, math, and science content expected for students to succeed in entry-level college courses. However, many students are not ready when entering college and the workforce. Given the breadth of the high school content standards, more guidance and supports may be needed to help LEAs and schools prioritize the standards most aligned with college readiness and for students to engage in career pathway planning. However, revising or reorganizing content expectations for high school students will not address the underlying barriers to student learning and mastery of foundational content needed for college and career success. Rather, students are likely to succeed if provided with more engaging learning opportunities, individualized learning strategies, and wraparound services in middle and high school.

Our analysis of top-performing education systems revealed several key commonalities related to curriculum and support. While the exact definitions of CCR vary somewhat across the states we examined (Colorado, Connecticut, and Massachusetts), all provide counseling and individualized CCR planning to students and their families beginning prior to Grade 10. By beginning postsecondary planning early, teachers and counselors can intervene if students are not on track to gain the skills necessary to be college and career ready upon high school graduation. For example, MSDE could expand its existing individualized academic and career planning programs for students beginning in middle school and work with LEAs to increase use

[28] Massachusetts is currently piloting a competency-based system of grading. For information about the Rethinking Grading Pilot, see https://www.doe.mass.edu/ccte/rethinking-grading/default.html.

of such plans statewide. With accurate and timely data, provided early in a student's secondary career, schools can provide extra support to students who need it most.

For future research studies, MSDE may benefit from expanded and in-depth analyses of CCR expectations and systems within the United States, beyond the three comparison states used in this study. We found that international comparisons were of limited value because the major differences in context, structure, and culture across the comparison countries. However, learning more from other U.S. states may inform how state agencies, K–12, and postsecondary institutions can collaborate to best address CCR needs for diverse groups of students.

E.3. Consider Integrating Skills for Success Into CCR Standards Alongside the Provision of Supports That Develop These Skills

Beyond concerns of academic readiness, postsecondary stakeholders consistently emphasized the importance of critical thinking, self-direction, and other skills for success that are not part of formal course content standards or expectations, though many college course syllabi indicated opportunities to develop such skills. In addition, workforce stakeholders noted that workforce readiness is built through experience, like internships and work-based learning. The comparisons of top-performing education systems, nationally and internationally, also underscore the importance of social skills and work habits emphasized as a part of CCR.

The utility of HSGPA as a predictor of CCR may partially be because high school course grades can reflect a student's content knowledge, intrapersonal skills (e.g., self-direction), perseverance, and study habits. Establishing more explicit standards and measures of skills for success may result in more accurate and equitable application of a CCR standard. Skills for success are already a focus of the Maryland Career Development Framework for College and Career Readiness and service-learning hours are already part of Maryland's graduation requirements, but the career development framework and service-learning requirements are not formally part of the Maryland College and Career Ready Standards and may not address all the skills for success identified as important for CCR. While formal assessments of skills for success are not as established as content knowledge assessments, work on how to assess social and emotional competencies may provide guidance.[29] In addition, Maryland institutions of higher education may benefit from developing a common framework for their workforce training programs, which emphasize skills for success and can be used by MSDE to better align skills for success opportunities at the K–12 level.

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[29] See, for example, Taylor et al.'s (2018) guide on measuring social and emotional learning competencies: https://measuringsel.casel.org/pdf/Choosing-and-Using-SEL-Competency-Assessments_What-Schools-and-Districts-Need-to-Know.pdf

Postsecondary stakeholders discussed the importance of not only considering additional measures of CCR but also of providing supports to students to develop the skills linked to these measures. In addition, stakeholders reflected on the need for supports for mental health, disability, and social-emotional needs, especially in the wake of the COVID-19 pandemic. College course syllabi also consistently pointed to available supports for students in these areas.

E.4. Provide Clear Guidance on How the CCR Standard Should and Should Not Be Used

Findings from the predictive validity analysis indicate that the interim CCR standard could misclassify up to half of the state's students in Grade 10: an error rate generally considered too high for high-stakes decisions for individuals. In particular, the interim CCR standard would likely misclassify a lot of students as not ready who, in fact, will be college and career ready. Using the interim CCR standard as a gatekeeper for educational opportunities (e.g., access to advanced courses or dual enrollment programs) could adversely affect educational outcomes for many students. In addition, relying solely on state assessments, which research indicates can include cultural biases, may structurally disadvantage students with a diverse range of lived experiences.

Revising the CCR standard to include additional measures such as HSGPA or to use a more inclusive test score threshold can help, but the overall accuracy rates may still be too low (i.e., less than 75%) for high-stakes placement decisions. Use of the CCR standard should be balanced with individualized guidance for each student and not prevent students from pursuing educational opportunities that support their college and career goals.

It may be more appropriate to use the CCR standard to monitor system-level progress toward CCR and support school-level decisions related to college and career counseling and identify students who need additional CCR supports. If the primary intent of the CCR standard is to identify students who need additional supports, the interim CCR standard or another specification of the standard may be appropriate because the predictive validity results indicate that the interim CCR standard does a relatively good job correctly identifying students who are not college and career ready.

E.5. Continue to Monitor How Well the CCR Standard Accurately Predicts Student Preparation for College and Career Success

Empirically validating measures of CCR should not be a one-time process. Instead, key stakeholders should routinely monitor how well established CCR measures are aligned with and accurately predict college and career success (Balestreri et al., 2019). Our study could not investigate all the factors that go into developing a CCR standard or all the scenarios in which the CCR standard might be used. In particular, we have the following recommendations for future research.

- **Revisit how well state assessment performance levels are aligned with CCR expectations.** Findings from the predictive validity analysis indicate that adjusting the PARCC threshold from the meets expectations performance level to the approaching expectations performance level increased the CCR standard's accuracy rates. This implies that the performance level benchmarking, not the content standards or the assessments more broadly, may be misaligned with what is required for a student to be college and career ready. A 2020 study by the Maryland Assessment Research Center (MARC) also found that a threshold of 725 instead of 750 on the PARCC was a better predictor of college progress (Salmon, 2020). Similarly, a study of Florida's test of postsecondary readiness concluded that adjusting the cutoff score for postsecondary course placement could improve placement accuracy instead of adding additional measures like HSGPA (Leeds & Mokher, 2020). It is unclear whether the misalignment of performance level benchmarks for the PARCC applies to the current MCAP performance levels. As more data from the MCAP assessments become available, MSDE should examine how well the MCAP performance levels are calibrated with CCR expectations and monitor the relationship over time.
- **Provide further insight into predictors of career success as more data become available.** For the student cohorts included in our study, important information regarding CTE program completion, as well as completion of apprenticeship programs and non-credit certifications, were incomplete because these data collection efforts are relatively new. As a result, our analysis of how well measures of CCR predict career readiness was not as robust as our analysis of college readiness. As more career-related data become available, future studies can address this gap in the research.
- **Include student voice, more K–12 and workforce representation in future research.** For this study, we gathered input from a wide range of stakeholders across the state of Maryland, including college faculty, K–12 curriculum leaders, and workforce representatives. In addition, we examined a great deal of administrative student data. Given the scope of the study, however, we did not hear directly from the students and a large number of K–12 educators who have the most firsthand experience with what is required for students to be college and career ready. It is important to recognize that the voices of these critical stakeholders are not well represented in this study. Additional efforts to get input from students and more K–12 educators from across Maryland's varied communities could help identify ways to improve learning opportunities and student readiness for college and career. Future research may also benefit from expanding input from workforce representatives. Gathering additional perspectives from

these groups would provide a deeper understanding of CCR needs and expectations across Maryland.

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