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The middle school science course landscape: Course offerings, enrollment patterns, and implications for assessment

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Abstract

Historically, US middle school science instruction has been organized as a three-year, single-discipline sequence (life, Earth/space, and physical science), but shifts in standards have increasingly encouraged multidiscipline instruction. As schools shift among these models of instruction, questions arise about what students have access to learn and implications for assessment. Given a lack of recent data on the prevalence of each instructional model, this study drew on data from nearly 2,200 NWEA® partner schools administering the MAP® Growth™ Science assessment in 2023–2024 to examine the landscape of middle school science course offerings, enrollment patterns, and assessment outcomes. We find that middle school science is predominately multidisciplinary; most schools offer only multidiscipline courses (83%), a smaller share offers both course types (14%), and very few exclusively offer single-discipline courses (3%). Where both course types are available, enrollment differs by race/ethnicity, and students in single-discipline courses begin the year with higher achievement. Despite the potential misalignment between single-discipline instruction and a multidisciplinary assessment, we also found students in single-discipline courses perform similarly to their peers on the overall science assessment. These findings complicate assumptions about curriculum-assessment alignment and raise questions about equity and access to comprehensive and differentiated science instruction in middle school.

Introduction

Starting in the middle of the twentieth century, American science education existed in disciplinary silos of life, Earth/space, and physical science. Science instruction in middle school was taught by disciplinary specialists in domain-specific courses with little overlap and a somewhat arbitrary three-year course sequence.

In the late twentieth century, science education researchers and early national standards architects (including creators of AAAS Benchmarks and the National Science Education Standards) decried this artificial separation of domains, advocating instead for integrated or multidiscipline science instruction as an alternative. Integration, or multidiscipline science instruction, involves teaching every science domain every year. Some schools might truly integrate the disciplines, with thematic units that require application of life, Earth/space, and physical sciences to explain everyday natural phenomena; while other schools might simply break their science instruction into siloed units, offering life science, Earth/space, and physical science units each year across grades 6–8. Note that in this paper, integration refers to either multidiscipline science or integration of the disciplines of science (life, Earth/space, and physical science), but does not include integration across science, technology, engineering, and mathematics (i.e., STEM integration).

The push for integration of scientific knowledge across disciplines accelerated with the publication of *A Framework for K–12 Science Education* (the *Framework*) and the Next Generation Science Standards (NGSS). The *Framework* and the subsequent NGSS emphasized crosscutting concepts—key scientific concepts that cut across disciplines—as central to any rigorous science education. Since 2013, almost every state in the nation has either adopted the NGSS or developed their own standards based on the *Framework*, and with that, an emphasis on multidisciplinary science instruction, particularly at elementary and middle school levels. Despite the near unanimous adoption of the *Framework*, if not the NGSS, states still approach integration and the sequencing of courses differently.

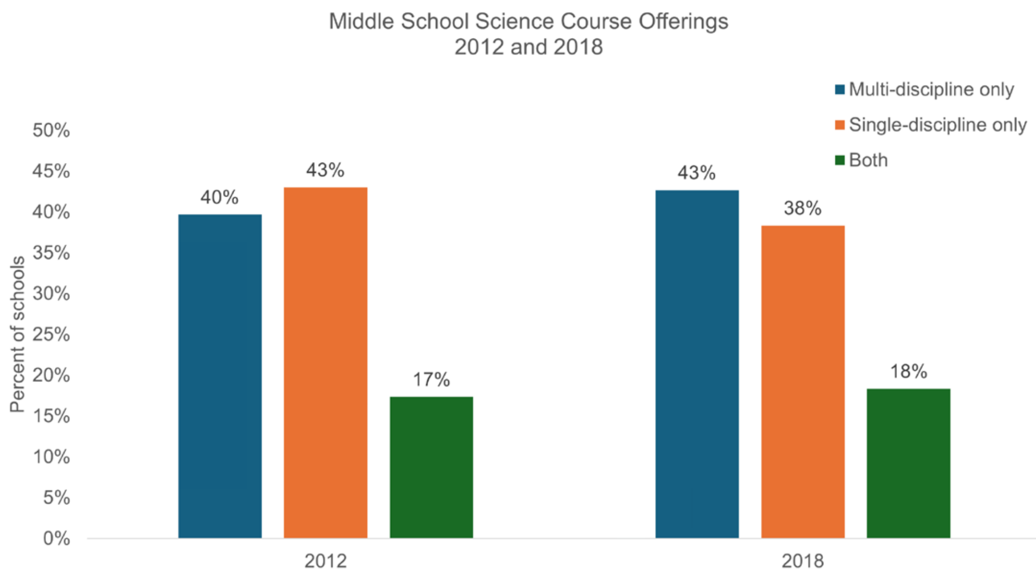
Although the shift in standards with the Framework and the NGSS clearly emphasized integrated or multidiscipline science, there have also long been logistical incentives for integration. From a staffing perspective, integrated or multidiscipline science courses offer greater flexibility for schools, as they can be taught by teachers certified in general science or with varied disciplinary backgrounds, rather than requiring separate, domain-specific certifications in areas such as physics or chemistry—credentials that can be difficult to staff at the middle school level. Importantly, this flexibility reflects hiring and certification structures rather than differences in instructional rigor or expertise. Yet despite both the standards-driven emphasis on integration and these logistical considerations, some middle schools continue to offer domain-specific, year-by-year science sequences. To what extent do schools offer domain-specific science in middle school? The actual prevalence of different instructional patterns remains unclear.

Prevalence of multidiscipline and single-discipline science courses in middle schools

The National Survey of Science and Mathematics Education (NSSME) by Horizon Research has provided data about the US math and science education system. In 2018, Horizon added computer science and engineering to their survey and rebranded it as the NSSME+.

The Horizon surveys provide insight into the proportion of schools that offer single-discipline science courses, multidiscipline science courses, or both, and how those offerings shifted between 2012 and 2018. See Figure 1.

Figure 1. Percent of schools offering science courses by course type.



Note. Data taken from Horizon Research, Inc., NSSME 2012 and NSSME+ 2018 reports on the status of middle school science teaching.

As shown in Figure 1, from 2012 to 2018, schools shifted slightly toward more multidiscipline courses and away from single-discipline courses, with the percentage of schools offering both types of courses remaining steady. NSSME+ 2018 is the most recent data available, with a new report due in 2027. That is, the best information on science course offerings in middle school is 8 years old and out-of-date. It is unclear whether the nationwide trend of increasing emphasis on offering only multidiscipline science has continued in the past decade.

The nature of state and national science assessments

Middle school science standards. Another source that might provide insight on the state of middle school science courses are state content standards themselves. Just as such standards might inform the offering of certain math courses at specific times, so too might state content standards point to what science courses are offered at certain grades. We reviewed standards in several states, including Texas, Ohio, and California. Texas and Ohio both emphasize integrated science instruction, with standards associated with life, Earth/space, and physical science distributed across grades 6–8. California articulates a preference for integrated science but offers schools the choice between an integrated science progression model and a discipline specific model. The overall gist of all three seems to support integrated middle school science course offerings.

Middle school science assessments. Despite the instructional flexibility that California affords schools compared with Ohio and Texas, we found a consistent assessment pattern. Each state tests middle school students only in eighth grade, and all state science assessments include key concepts across all three science disciplines. This suggests that even though California allows schools to choose, students will still be tested in all three areas come eighth grade.

We found a similar assessment pattern in the National Assessment of Educational Progress (NAEP). NAEP assesses middle school students in eighth grade and the assessment includes key concepts across the three science disciplines of life, Earth/space, and physical science. The consensus across state and national assessments appears to be that a single middle school assessment opportunity should measure students' mastery of their accumulated middle school science experiences, whether those experiences occurred in a multidiscipline or single-discipline progression.

The MAP Growth Science assessment administration pattern diverges from state and national patterns

Just as state and national assessments of science address standards across disciplines, the blueprint for MAP Growth Science dictates that one-third of the items address concepts in each of the three major domains (or learning areas) of life, Earth/space, and physical science. Such a distribution is sensible given the idiosyncrasies in the sequencing of concepts across states, districts, and schools. That said, **MAP Growth Science differs from state and national assessments in its frequency of administration**: many schools administer MAP Growth Science up to three times per year, every year (in fall, winter and spring, and grades 6, 7, and 8). Unlike cumulative assessments administered at a single point in time (e.g., NAEP eighth-grade science) MAP Growth assessments are interim adaptive tests designed to measure students' growth over time. With fall, winter, and spring administrations, the MAP Growth Science assessment provides timely information on students' growth as they progress through instruction over the course of the academic year.

The inclusion of all three domains on MAP Growth Science has potential implications for students enrolled in single-discipline versus multidiscipline science courses. Ideally, an assessment would be a close match to the instruction a student received. A seventh-grade student enrolled in a discipline-specific life science course would not necessarily get exposure to the Earth/space or physical science concepts addressed in a multidisciplinary science assessment. Would such a student be unfairly disadvantaged by a multidisciplinary assessment? To our knowledge, the possible differentiation in achievement on multidisciplinary middle school science assessments as a function of student enrollment in single-discipline versus multidiscipline science courses has not been studied.

We stress that we are *not* studying the *efficacy* of single-discipline progression versus multidiscipline progression of science instruction on student achievement. Such an investigation would require a causal inference research design and data we simply do not have. Instead, our purpose is to understand the landscape of middle school science course offerings for schools that administer MAP Growth Science, the characteristics of students enrolled in those course offerings, and consider any possible differences in achievement on single-discipline subscores and overall assessment scores based on student characteristics and course progression sequence. We hope to better understand any potential limitations of using a multidiscipline science assessment to measure student growth in science when students are enrolled in very different science instructional progressions across middle school.

Current study

The current study examined schools that administered NWEA's MAP Growth Science assessment, their course offerings, and the characteristics of the students in those schools. We hypothesized that some students were enrolled in single-discipline science course sequences (some permutation of life, Earth/space, and physical science) in middle school, while other students were enrolled in multidiscipline courses each year for three years, with enrollment in the multidiscipline sequence predominating. If our hypothesis was correct, some students—those enrolled in a single-discipline sequence—may experience a lack of alignment between curriculum and instruction on one hand, and assessment on the other. We hypothesized that these students would underperform on the overall assessment since what they were being taught was only one of three components of the assessment.

We posed three research questions:

- **Question 1:** What are the science courses taken in middle schools that administer NWEA's MAP Growth science assessment?
- **Question 2:** What are the characteristics of students taking single-discipline and multidiscipline courses? Do they differ meaningfully, particularly in terms of achievement?
- **Question 3:** Do students enrolled in single-discipline science courses perform lower than their peers on the overall score?

Methods

Data

This study utilized NWEA Science MAP Growth test event and course roster data. Schools utilizing the MAP Growth Science assessment may opt in to their test event data being included in the NWEA Growth Research Database (GRD). In addition to test events, schools submit detailed course rosters for students including the name and subject of courses students enrolled in during a given term. Test event and course roster data provided by schools opting in to the GRD are anonymized by removing personal identifiable information. For the test event data, sample inclusion rules were set at the student level. Data for a particular student were included in the original sample if: 1) the student was assessed with the MAP Growth Science—General Science assessment during both the fall 2023 and spring 2024 terms, 2) the student was enrolled at a US public school, and 3) the student was enrolled in grades 3–8.

Course classification strategy

To identify science course enrollment and further categorize the course by domain (i.e., life, Earth/space, or physical science), the roster data were first filtered using the available class subject variable (CLASS_SUBJ) to only include courses listed as "Science" or "NA". For courses listed as "NA," we identified science courses using the strings "science," "stem," and "sci," to filter course names, and a similar approach for courses that were obviously math, English/language arts, social studies, physical education, business, technology, and entrepreneurship, music, art, and homeroom (see Appendix Table A1 for detailed string filtering approach).

We then used string filtering to categorize all science courses as "life science," "earth/space science," or "physical science" based on course name. Life science courses were identified by filtering course names using string detection for the strings "life," "bio," "env," "living," "ag," "botany," and "hortic." Earth/space science courses were identified by course names containing the strings "earth," "space," "climate," "erth," and "spa." Physical science courses were identified by course names containing the strings "phys," "force," “motion,” “matter,” “chem,” and “phy.” We developed this string filtering strategy based on our knowledge of common concepts and terminology covered in each domain. The final list of strings was decided after replicating the filtering strategy with the course name data multiple times and spot checking the resulting labels for inaccurate or incomplete categorization (e.g., “erth” was included after finding a course called “Erth Sci” was not picked up by the “earth” string filter).

All remaining science courses that could not be classified into those domains were coded as “general science.” Following classification into domains and general science, we applied string filtering to flag advanced courses. Course names containing the strings “hon,” “honor,” “adv(anced),” “accel,” “accl,” and “enrich(ed)” were combined under one category which we refer to as “honors.”

Sample

The resulting course roster data file contained 958,339 unique students. After initial exploration of the distribution of domain-specific courses by grade, we excluded grades 3–5 due to small numbers of students taking domain-specific courses in elementary school. The final merged data file used in analysis was created by joining the test event data to the roster data using a left join to prioritize keeping students who had roster data. The full sample from the merged roster and test event data consisted of 556,766 middle school students (grades 6–8) across 2,199 schools who completed the general science assessment in fall and spring of 2023–2024. A demographic comparison between our analytic sample and the total population of middle school students in the US revealed approximately equal representation of Black, Hispanic, and white students, and underrepresentation of Asian students, in our sample compared to the US (see Appendix Table A2). The proportions of the sample broken down by grade and course enrollment type are shown below in Table 1.

Table 1. Sample counts (percent) by grade and course type.

	6th Grade	7th Grade	8th Grade
Multi-discipline	170246 (96.13%)	179400 (93.45%)	173432 (92.40%)
Earth/Space Science	4012 (2.27%)	675 (0.35%)	3715 (1.98%)
Physical Science	247 (0.14%)	3044 (1.59%)	6648 (3.54%)
Life Science	2600 (1.47%)	8854 (4.61%)	3893 (2.07%)
Total	177105 (100%)	191973 (100%)	187688 (100%)

We also examined student demographics by course type (shown in Table 2) to determine if there were meaningful differences between the students enrolled in single-disciplinary and multidisciplinary science courses by race or gender, as well as which course types were more commonly flagged as honors. Note that the descriptives in Table 2 refer to the entire sample. It includes students across all schools whether those schools offer multidiscipline, single-discipline science courses, or both.

Table 2. Student demographics by course type across all schools.

Course	Percent Black	Percent Hispanic	Percent White	Percent Male	Percent Honors
Multi-discipline	16.29	29.94	36.69	50.91	8.50
Life Science	9.53	31.39	45.29	51.63	8.32
Earth/Space Science	10.60	32.10	45.29	51.63	35.09
Physical Science	15.83	34.51	37.70	51.62	31.23

Measuring and modeling science growth

We used a two-step approach to modeling growth. For each score type produced by the MAP Growth Science assessment (overall science score, life, Earth/space, and physical science sub-scale scores), we calculated growth using linear regression models predicting spring RIT score conditioned on instructional weeks and fall RIT score. Instructional weeks were calculated as the number of weeks between the fall test event and spring test event and serve as a measure of the time students spent under instruction. The residuals from these models (observed—predicted) were saved as adjusted growth scores. The adjusted growth scores take into account prior achievement and instructional weeks, which is more robust than just using raw RIT gains. We then used these residuals as dependent variables in the second step of our analysis, with dummy codes for course type serving as independent variables to predict associations between course-type, science subscore growth, and overall science growth.

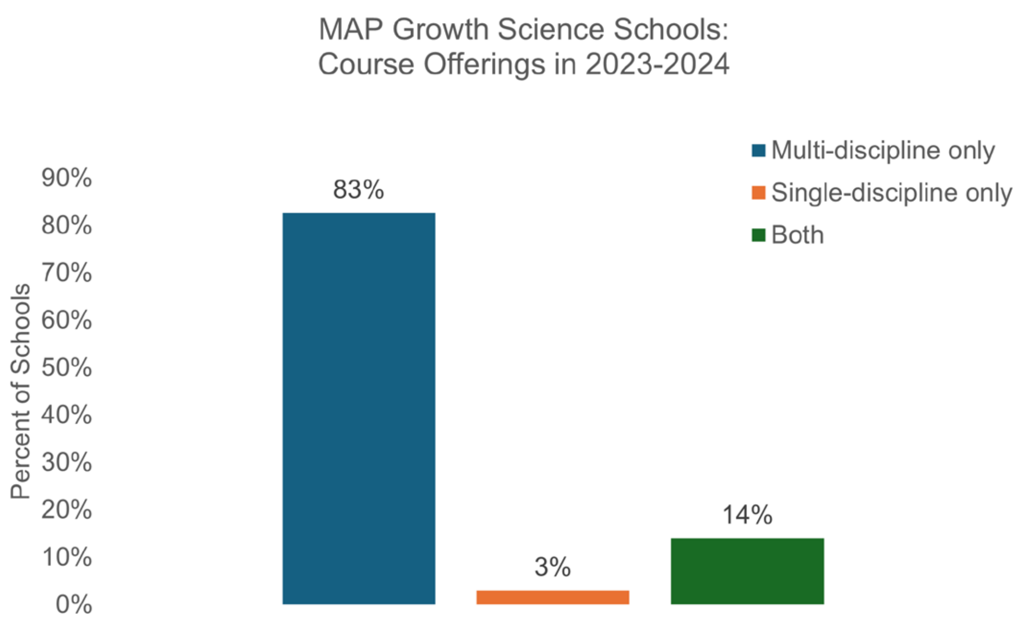
The dummy variables for course type indicated whether the student took a discipline-specific or multidiscipline science course. That is, for our regression analysis, we coded all single-discipline courses into a single category, whether they focused on life, Earth/space, or physical science. We made this analytic choice because there were wide variations in the courses offered within schools and within grades, with many single-discipline courses within the life sciences, and far fewer in Earth/space and physical sciences. After examining the distribution of single-discipline and multidiscipline science courses that could be flagged as honors courses, we decided to also include a dummy variable for honors in our models. We ran four separate models predicting overall science growth, and life, Earth/space, and physical science subscore growth, respectively. In all four models, we included controls for students' prior growth and achievement in math and reading to better account for any preintervention differences. To account for unobserved school and grade-level differences, we also included a compound school-grade fixed effect. The inclusion of this fixed effect allows us to address potential sorting and selection effects such as schools and grade-level contributing to students being systematically assigned to single- or multidiscipline courses. As a result, our models compare single-discipline science course takers to their peers in multidiscipline courses within the same school and grade-level and account for prior reading, math, and science achievement.

Results

NWEA partners tend to offer only multidiscipline courses and rarely offer only single-discipline courses.

We examined courses offered by schools within the NWEA sample to parallel the analyses Horizon conducted in 2012 and 2018. A similarity between NWEA data and the Horizon data from 2018 lies in the percentage of schools that offer both multidiscipline and single-discipline courses (14% of the NWEA sample; 18% of the 2018 Horizon national sample). However, the percentage of NWEA schools offering *only* multidiscipline science courses was nearly double that of the Horizon 2018 sample (83% vs. 43%). This difference emerged primarily through a reduction in the number of schools offering only single-discipline science courses in the NWEA sample (3% vs. 38% for the national Horizon sample). This difference could be due to the nature of the NWEA sample in the current study or it could be the result of continued movement away from domain-specific courses. See Figure 2.

Figure 2. MAP Growth Science schools course offerings.



Note. The percent of MAP Growth schools offering both multidiscipline and single-discipline courses is similar to that of the national sample (as measured by Horizon in 2018). However, MAP Growth schools are far more likely to offer only multidiscipline science and far less likely to offer only single-discipline science than the national sample of schools.

Middle school science progression is rarely organized by single disciplines (one discipline per year).

We dug further to better understand the progression of single-discipline courses available in NWEA partner schools. Most schools that offer single-discipline courses do so *in addition* to offering a multidiscipline course, and *without* offering the full progression of all three domains (life, Earth/space, and physical science). Just under 1% of schools in the full sample offered all three single-discipline courses, with or without multidiscipline science.

We further explored whether we could explain this finding by examining the grades enrolled at the school. Some of the schools offering only one or two discipline-specific courses are schools that enroll only one or two grades of students (e.g., grade 6 only, or grades 7–8 only). But the grades offered by the school did not explain the data pattern. Fully 18% of schools that enroll all three grades (6–8) offer multidiscipline science and some *subset* of discipline-specific courses (one or two discipline-specific courses, but not all three); and just 1.5% of schools that enroll all three grades (6–8) also offer all three discipline-specific courses. In other words, in middle schools in our sample, access to the complete discipline-specific course sequence is an anomaly, regardless of the grades enrolled by the school.

Table 3 summarizes the frequency of specific course sequences offered within schools by discipline. For example, row one in Table 3 indicates that almost 83% of schools offered only multidiscipline science, with no single-discipline courses. The last two rows (below the horizontal line) show the number and percent of schools offering all three disciplines. Although schools predominantly offer only multidiscipline science, they are more likely to offer single-discipline courses to seventh- and eighth-graders than to sixth-graders (see Appendix Table A3 for course offerings by grade and by school).

We also examined the frequency of honors designations for single- and multidiscipline courses by course sequence. We see little in the way of meaningful differences, with single-discipline courses slightly less likely to have an honors designation than multidiscipline courses.

Table 3. Summary of the most common course offerings in schools

Multi-discipline Science	Life Science	Earth/Space Science	Physical Science	Number of Schools	% of Schools	% Honors Multi-discipline	% Honors Discipline-specific
Schools that do not offer all three discipline-specific courses							
1	0	0	0	1816	82.6%	13.5%	0.0%
1	1	0	0	168	7.6%	25.0%	19.1%
1	0	0	1	53	2.4%	30.2%	28.3%
1	1	1	0	31	1.4%	25.8%	22.6%
1	1	0	1	22	1.0%	22.7%	31.8%
... (additional combinations each occur in $< 1\%$ of schools; see Appendix)							
Schools that offer all three discipline-specific courses							
1	1	1	1	11	0.5%	9.1%	18.2%
0	1	1	1	9	0.4%	0.0%	11.1%

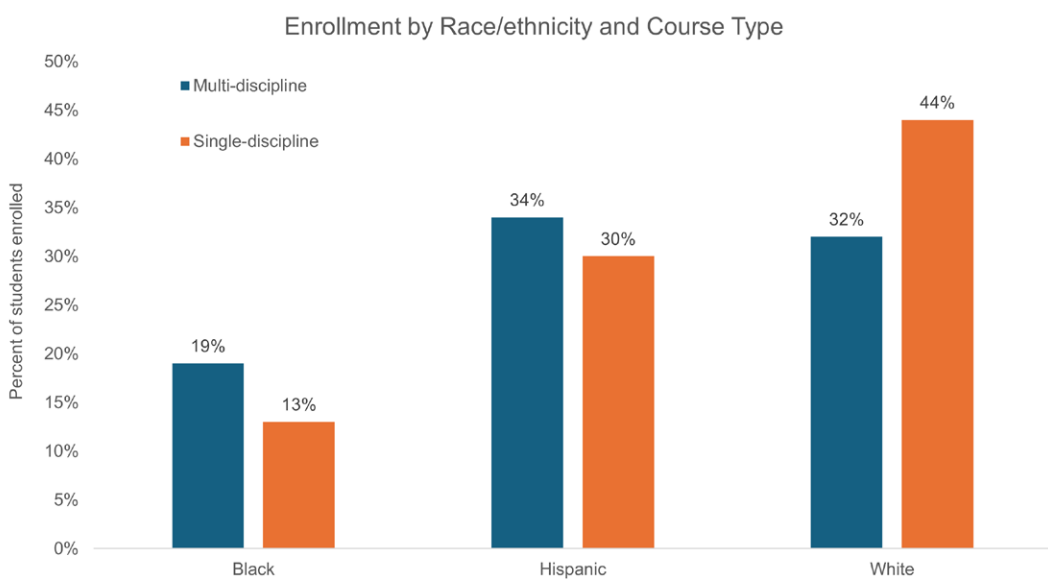
Note. A value of 1 indicates the course is offered; 0 indicates it is not. % honors multidiscipline is the share of schools in the combination offering honors multidiscipline science. Honors discipline-specific is the share of schools in the combination offering honors discipline-specific (life, earth/science, or physical). Percentages are calculated out of the full school sample; total number of schools is 2,199.

Students who enroll in single-discipline courses are different from those in multidiscipline courses in terms of race/ethnicity and baseline achievement.

Thus far, our analyses have examined the full sample—considering science course-offering patterns for all NWEA middle schools. But our second and third research questions involved uncovering differences in enrollment and achievement for students enrolled in single-discipline courses versus multidisciplinary courses. An unbiased analysis requires that we take into account the school-level factors that contribute to achievement. For this reason, we used a subset of our sample, including only those schools that offered both types of courses. This subset is smaller than the full sample, consisting of just 106,614 students across 318 schools.

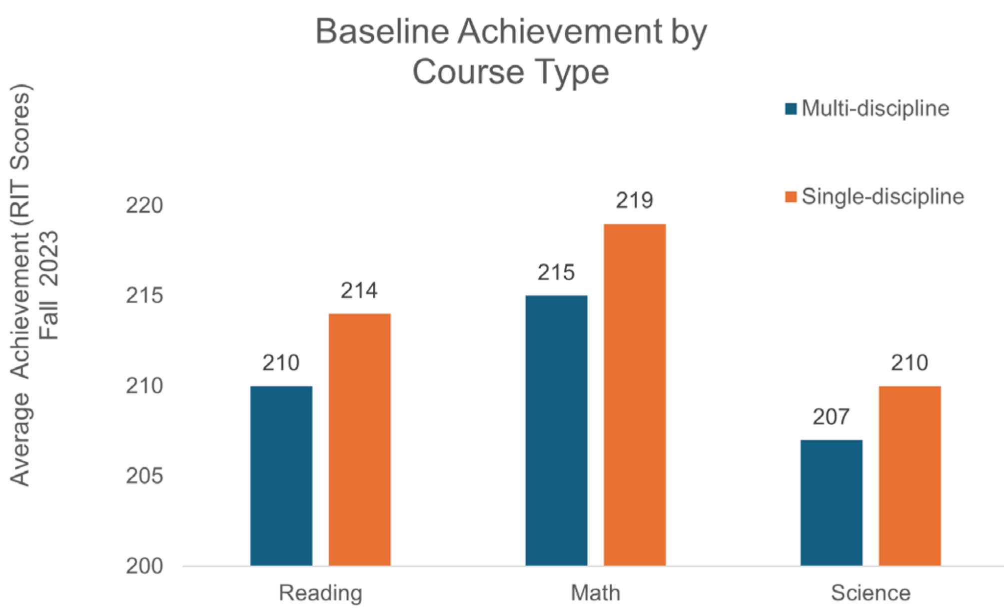
Figure 3 summarizes the differences in course enrollment by student race/ethnicity for schools that offer both multidiscipline and single-discipline courses. We found important differences. Greater proportions of Black and Hispanic students are enrolled in multidiscipline courses, whereas more White students are enrolled in single-discipline courses. Gender differences in students enrolled in single versus multidiscipline course types appear to be negligible.

Figure 3. Proportion of students enrolled in single versus multidiscipline science courses by race/ethnicity.



We also examined if students taking single-discipline courses differ from those in multidiscipline courses in terms of baseline achievement as determined by their RIT scores on the fall 2023 Math, Reading, and Science MAP Growth assessments. As shown in Figure 4, students in single-discipline courses scored typically three or four points higher on average on all subjects. Three or four points is equivalent to approximately a full year of growth in reading and science, and half a year's growth in mathematics. In other words, students enrolled in single-discipline science courses appear, on average, to be much higher-achieving at the start of the school year than their peers enrolled in multidiscipline science courses. This finding necessitated controlling for prior and baseline achievement in our prediction of science overall and subscore growth in the final analytic models discussed in the next section. But it is also a finding in its own right suggesting that when schools do offer both types, it may be in an effort to provide advanced students with differentiated learning opportunities

Figure 4. Baseline math, reading, and science achievement differences by course type.



Students enrolled in single-discipline science courses *perform just as well* as their peers on the multidiscipline MAP Growth Science assessment, net of prior achievement.

Results from the four separate regression models predicting overall science growth, and life, Earth/space, and physical science subscore growth are presented in Table 4. To control for prior achievement, these models draw on a subsample of students who, in addition to having science course enrollment and test score data for academic year 2023–24, also have complete math and reading test score data for 2022–23 (n = 62,328). We hypothesized that, given greater misalignment between instruction and assessment, students enrolled in single-discipline courses would underperform on the overall science score for the multidiscipline science assessment.

Accounting for prior reading, math, and science achievement as well as whether the science course was flagged as honors or not, students enrolled in a single-discipline course had positive residual growth on the overall science assessment. Simply put, single-discipline course takers grew more than expected in science overall during the 2023–24 academic year. Although this effect is positive, it is not statistically significant and therefore suggests that single-discipline course-takers' growth is not meaningfully different from that of students enrolled in multidiscipline science courses. In other words, students in single-discipline science courses perform just as well as their peers despite our hypothesis that they would underperform on the multidiscipline assessment. This pattern remained consistent across the models predicting life, Earth/space, and physical science subscore growth with positive, nonsignificant coefficients indicating no meaningful difference between single- and multidiscipline science course-takers' growth. Although not a focus of this study, it is worth noting the honors course indicator was positive and highly significant ($p < 0.001$) suggesting students in honors courses demonstrated greater than expected science growth. When honors course designation is accounted for, once again, the performance between single- versus multidiscipline course takers is similar. We discuss this in more detail in the discussion in conjunction with the previous finding that single-discipline course takers have higher baseline achievement.

Table 4. Results of regression analyses for the subset of schools that offer both single- and multidiscipline science courses.

	Dependent Variable (Growth)			
	Overall Science (SE)	Physical Science (SE)	Life Science (SE)	Earth/Space Science (SE)
Focal Independent Variable				
Single-Discipline Science Course	0.19	0.37	0.06	0.24
	(0.19)	(0.23)	(0.24)	(0.20)
Controls (included in all models)				
Honors Course Indicator	Yes	Yes	Yes	Yes
Fall 2023 Math RIT	Yes	Yes	Yes	Yes
AY22–23 Math Gain	Yes	Yes	Yes	Yes
Fall 2023 Reading RIT	Yes	Yes	Yes	Yes
AY22–23 Reading Gain	Yes	Yes	Yes	Yes
School $\times$ Grade Fixed Effects	Yes	Yes	Yes	Yes
Standard Errors Clustered by School $\times$ Grade	Yes	Yes	Yes	Yes
Observations	62,328	62,328	62,328	62,328
R^2	0.107	0.131	0.113	0.112
Within R^2	0.048	0.069	0.057	0.065

Note. The single-discipline science course indicator equals 1 for any course focused on a single science domain (e.g., physical, life, or earth/space science) and 0 for general or integrated science courses. Standard errors are clustered by school x grade. Domain-specific dependent variables are subscores from the larger assessment.

Discussion and limitations

NWEA sample diverges from 2018 national sample

We found that while Horizon's 2018 national sample showed roughly 40% of schools offered single-discipline courses, our 2024 NWEA sample included only 3% of such schools. One explanation could be that schools have drastically moved away from single-discipline science course sequences since 2018. We do see the beginning of that trend from 2012 to 2018 in Horizon's data, but we lack data from a national sample to confirm the trend through 2026.

Given the stark differences, we wonder whether schools that elect to administer MAP Growth Science differ from Horizon's national sample *because* the MAP Growth Science test is a multidiscipline science test. It is logical to assume that schools offering only single-discipline science courses might choose not to administer MAP Growth Science because it doesn't align well with their instructional pattern.

Access to the complete discipline-specific course sequence is rare

In our exploration of science course sequencing at NWEA schools, we found most schools that offer single-discipline courses do so in addition to offering a multidiscipline course. Just under 1% of schools in the full sample offer all three single-discipline courses, with or without multidiscipline science. In other words, in schools administering NWEA's MAP Growth Science assessment in middle school, access to the complete discipline-specific course sequence is an anomaly.

Upon first review, it seems like this "anomaly" is actually consistent with the direction science education has taken in recent decades away from the disciplinary siloed approach that was common in the mid-twentieth century. While our sample does not have access to complete discipline-specific course sequences (i.e., life, Earth/space, and physical science all being offered within the same school), the science instruction of students in NWEA partner schools is largely integrated or multidisciplinary, or composed of a combination of multidisciplinary and discipline-specific instruction.

Meaningful differences between single- versus multidiscipline course-takers

We also found that, at the start of the academic year, students in single-discipline courses on average had higher reading, math, and science scores than students in multiple-discipline courses. Given how little other contextual information we have about these students and their schools, we are limited in our capacity to make an argument for why students in single-discipline courses are higher achieving at the start of the year. However, that we accounted for such differences when modeling science growth through the inclusion of prior reading and math gains and starting RIT score increases confidence in the finding that single-discipline course-takers perform just as well as their peers on the multidiscipline assessment. We also accounted for unobserved school and grade-level effects with the inclusion of the compound school-grade fixed effect which limited our comparison to students within the same school and grade-level.

As shown in Table 3, multi- and single-discipline courses have an "honors" designation at similar rates. But students enrolled in single-discipline courses are higher-achieving than students in multidiscipline courses. The contrast leads us to suspect that schools are offering single-discipline courses as a form of differentiated instruction for higher achieving students, without necessarily calling out the single-discipline courses as "honors." The scarcity of NWEA partner schools offering a complete sequence of single-discipline science courses raises questions about comprehensiveness, if single-discipline courses are in fact serving as differentiated learning opportunities for advanced students. In rare cases (approximately 1% of students), students are enrolled in both a multidiscipline course and a single-discipline course within the same academic year; these students may be receiving enriched science instruction that supports exposure to the full range of standards. In contrast, about 5% of students are enrolled exclusively in single-discipline courses, even though very few schools offer the full sequence of disciplinary courses across grades. While we expected some schools to offer both multi- and single-discipline courses, we did not anticipate that students enrolled in only single-discipline courses would lack access to the complete disciplinary sequence.

Although not a central focus of this paper, we found greater proportions of Black and Hispanic students enrolled in multidiscipline courses, with more white students enrolled in single-discipline courses. Enrollment differences based on race/ethnicity have a long history in school systems. Some research has even pointed to racial discrepancies in early algebra that occur above and beyond differences that can be explained by students' test scores. If our suspicions are correct and single-discipline courses are offered as a form of differentiated instruction for higher achieving students, the racial disparities in enrollment are concerning. Differential enrollment trends by race/ethnicity in middle school science warrants further investigation.

Alignment between elements of the educational system

There is a strong argument that standards, curriculum, instruction, and assessment should all be aligned, with multiple approaches identified to measure that alignment. Such alignment would support improved educational outcomes, and lack of alignment would, at best, make it difficult to measure if educational outcomes had improved. After all, it is impossible to know if students understand ideas in domain X if they receive instruction in domain Y and are assessed in domain Z. We found that the majority of NWEA schools offer multidiscipline science instruction that aligns well with their use of the multidiscipline MAP Growth Science assessment. While only 3% of NWEA schools offer only single-discipline science courses and 14% offer both, these values do not seem as small when we consider the actual counts of schools they represent. To examine the growth of students in single-discipline courses assessed by a multidiscipline exam, we looked within schools that offered both course types. This represents a substantial sample of 318 NWEA partner schools serving over 100,000 students. Using a subsample within those schools of over 62,000 students with complete assessment data for two academic years, our analyses indicate that students enrolled in single-discipline courses perform as well as their peers enrolled in multidiscipline courses, despite an apparent mismatch between instruction and assessment—a surprising result. This finding runs counter to prevailing assumptions about the importance of alignment and raises important questions about how instructional structures are operating in practice.

Our analyses uncovered additional surprises that deepen this puzzle and point to unresolved questions about course-taking patterns and access to standards-based content. Are schools using single-discipline courses as a form of differentiated instruction for high-achieving students? Are students enrolled in single-discipline courses for just one or two years, but not all three, getting access to the full suite of middle school science standards? For that matter, what evidence do we have that students in multidiscipline courses are getting access to the full suite of middle school science standards? These are important questions that our data are not able to fully answer.

Middle school is a time for students to develop their emerging interest in science and strengthen their identity as people who can do science. Provision of a robust science instructional sequence that addresses all standards—whether multidisciplinary or some permutation of life, Earth/space, and physical science, should be an important goal for middle schools nationwide. Our analyses raise questions about students' access to that robust instructional sequence.

Limitations

Limitations in identifying general and domain-specific course types from course names with our data must be acknowledged. Course names on rosters submitted to NWEA are not clean or standardized, and can consequently include abbreviations, teacher names, and other details specific to the school that provided the data. Our iterative filtering strategy attempted to parse, clean, and recode this information into useful categories for analysis, but the filters are only successful insofar as there is sufficient information to extract. Specifically, we have no way to determine if schools offering "sixth-grade science," "seventh-grade science," and "eighth-grade science" are actually offering Earth/space, life, and physical science, with schools and teachers understanding them to be domain-specific, but with course names that are opaque to this reality. Another limitation is the lack of data on discipline-specific courses in elementary school. It may be that students enrolled in discipline-specific courses in middle school were also enrolled in a discipline-specific course in fifth grade. Our lack of course data in elementary school and subsequent focus on course-taking in grades 6–8 prevents us from examining this possibility.

Appendix

Table A1. String filtering strategy used for courses in roster data with subject "NA."

Course Label	Filtering Strings
Step 1: Identify and filter science courses	
Science	`"science|stem|sci"`
Math	`"math|alg|geom"`
English/Language Arts	`"lang|read|english|ela"`
Social Studies	`"soc|government|govt|hist"`
Physical Education	`"phys| pe |weight|sport"`
Business, Technology, Entrepreneurship	`"bus|comp|tech|entre"`
Music	`"music"`
Art	`"art"`
Homeroom	`"attendance|homeroom"`
Step 2: Categorize science courses by course type *(String filters for courses with subject "Science")*	
Life Science	`"life|bio|env|living|ag|botany|hortic"`
Earth/Space Science	`"earth|space|climate|erth|spa"`
Physical Science	`"phys|force|motion|matter|chem|phy"`

Table A2. Demographic comparison of analytic sample of NWEA middle schools compared to US public middle school enrollment.

	NWEA	United States	Representation Index
% Asian	3.06	5.65	0.54
% Black	15.45	14.89	1.04
% Hispanic	29.16	29.36	0.99
% White	45.68	43.84	1.04

Note. US public school enrollment percentages were calculated from count data drawn from the Digest of Education Statistics *table 203.65 Enrollment in public elementary and secondary schools, by level, grade, and race/ethnicity: Fall 2023.*

Table A3. School counts and proportions by course sequence by grade.

Grade	MS	LS	ES	PS	Schools	% of Schools
6	1	0	0	0	1516	92.72
6	1	1	0	0	66	4.04
6	0	0	1	0	20	1.22
6	1	0	1	0	10	0.61
6	0	1	0	0	8	0.49
6	1	0	0	1	6	0.37
6	0	0	0	1	2	0.12
6	0	0	1	1	2	0.12
6	1	1	0	1	2	0.12
6	0	1	1	0	1	0.06
6	1	0	1	1	1	0.06
6	1	1	1	0	1	0.06
7	1	0	0	0	1497	87.44
7	1	1	0	0	107	6.25
7	0	1	0	0	55	3.21
7	1	0	0	1	16	0.93
7	0	0	0	1	14	0.82
7	1	0	1	0	8	0.47
7	0	0	1	0	4	0.23
7	1	1	0	1	4	0.23
7	1	1	1	0	3	0.18
7	0	1	0	1	2	0.12
7	0	1	1	0	1	0.06
7	1	0	1	1	1	0.06
8	1	0	0	0	1385	83.89
8	1	1	0	0	82	4.97
8	1	0	0	1	60	3.63
8	0	0	1	0	35	2.12
8	0	0	0	1	33	2.00
8	1	0	1	0	21	1.27
8	0	1	0	0	9	0.55
8	1	1	0	1	9	0.55
8	0	1	1	0	6	0.36
8	1	0	1	1	4	0.24
8	1	1	1	0	4	0.24
8	0	1	0	1	2	0.12
8	0	1	1	1	1	0.06

Note. MS = multidiscipline science; LS = life science; ES = earth/space science; PS = physical science. A value of 1 indicates the course is offered; 0 indicates it is not.

Authors

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Dr. Naomi Duran is a research scientist at NWEA. Her research utilizes quantitative methods and large-scale, linked data to examine neighborhoods, schools, and equity in access to educational opportunities important for fostering student engagement and educational success. Prior to joining NWEA, she worked at the Learning Policy Institute and the American Institutes for Research. Dr. Duran holds an MS and PhD in human development and family studies from the University of Illinois Urbana-Champaign.

Dr. Susan Kowalski

Dr. Susan Kowalski is a lead research scientist at NWEA. Her research focuses on the intersection of educational policy and science instruction in the United States. She employs quantitative and descriptive methods to explore the impact of state and district decisions on science education, including curriculum development and professional learning experiences. Before joining NWEA, she was a high school physics and physical science teacher and a senior research scientist and director of research at BSCS Science Learning. Dr. Kowalski received a PhD in curriculum and instruction from the University of Minnesota.

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