2019

An Overview of High School Science Coursetaking to College STEM in Washington State

ERDC
Education Research & Data Center

AUTHOR

Vivien W. Chen

Education Research and Data Center

ABOUT THE ERDC

The research presented here uses data from the Education Research and Data Center, located in the Washington Office of Financial Management. ERDC works with partner agencies to conduct powerful analyses of learning that can help inform the decisionmaking of Washington legislators, parents, and education providers. ERDC's data system is a statewide longitudinal data system that includes de-identified data about people's preschool, educational and workforce experiences.

This study was completed as part of a larger program funded primarily by federal grant CFD #84.372A NCES 15-01 awarded by the Institute for Education Science in the US Department of Education to the state of Washington's Office of the Superintendent of Public Instruction and carried out by the Office of Financial Management's Education Research and Data Center. The total program cost is $7,300,000. Ninety-five percent point seven percent (95.7%) ($6,992,452) of the total cost of the program is financed with this Federal grant money, and 4.3% ($307,548) by the state of Washington.

ADDRESS

Education Research and Data Center
106 11th Ave SW, Suite 2200
PO Box 43124
Olympia, WA 98504-3113

PHONE

360-902-0599

FAX

360-725-5174

EMAIL

erdc@ofm.wa.gov

Executive Summary

This study uses five years of student administrative records to explore 9th graders' science course-taking patterns through high school years, from 2012-13 to 2015-2016,; and examines the association between those patterns and college STEM success. Major findings are addressed below:

- About 31 percent of the 9th grader cohort went beyond the state's high school graduation requirements by earning more than 2 course credits in core science, including biology, physics or chemistry.
- Students earning more than 2 core-science credits in high school are more likely to earn STEM course credits in the first year of college.
- More high school credits earned in physics or chemistry than in biology are predictive of earning college STEM credits.
- College STEM outcomes differ across student demographics and family income status.
    - A higher proportion of females than males earn college STEM credits, especially among those going through high school coursework concentrating on biology.
    - Holding high school science coursework constant, racial/ethnic differences exist in the regard to proportion of earning college STEM credit. In general, Asians hold the highest proportion of earning college STEM credit, followed by Whites.
    - Disparity in college STEM outcomes by family income status is found among students with the same science coursework patterns. The gap is larger among students who earned science credits with concentration in either physics or chemistry.

Introduction

The high demand but low supply for STEM (science, technology, Engineering, and Mathematics) workforce has been a striking issue in Washington state.[1] Government agencies, business, non-profit organizations have been dedicated to initiating effective policies in an attempt to improve STEM human capital cultivation.[2] The policy scope ranges from K-12 STEM innovation, transition to postsecondary education, to degree completion and connection to workforce. The concept of a STEM pipeline highlights the fact that STEM cultivation is not a one-time effort, but a longitudinal STEM trajectory.

Among various factors associated with STEM pipeline[3], this study focuses on the transition from high school science course-taking to STEM success in college.[4] The goals of this study are: (1) to analyze high school science course-taking patterns and their association with college STEM learning; and (2) to provide baseline information for future research related to the STEM pipeline at the state and school district level, especially in regard to the use of the statewide longitudinal data system (SLDS). Three research questions are specifically addressed:

- What are the science coursework patterns of students in Washington public high schools?
- What is the association between science course-taking patterns and college STEM outcomes?
- Does the association between science course-taking patterns and college STEM differ by student demographics and family socioeconomic status?

The following sections summarize the data and analytic approaches used for analysis, provide a brief description and visual presentation of the main findings, and conclude with a discussion of findings and limitations to inform future research.

1 U.S. Chamber of Commerce Foundation. https://www.uschamberfoundation.org/enterprising-states/#WA Retrieved on June 10, 2019.

2 Most plausible effort formed by the legislature is the initiation of the Governor's STEM Education Innovation Alliance, through the Engrossed Second Substitute House Bill 1872 (E2SHB 1972) passed in 2013.

3 Hinojosa, T., Rapaport, A., Jaciw, A., LiCalsi, C., & Zacamy, J. (2016). "Exploring the foundations of the future STEM workforce: K–12 indicators of postsecondary STEM success (REL 2016–122)." Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Southwest.

4 This study is the second of a serial study on the association between STEM coursework and college STEM degree completion, funded by the U.S. Department of Education's Statewide Longitudinal Data System (SLDS) grant. The first study examines the association between mathematics course-taking in four high school years and college STEM outcome. A report briefing research findings can be accessed here [ADD hyperlink after it gets published].

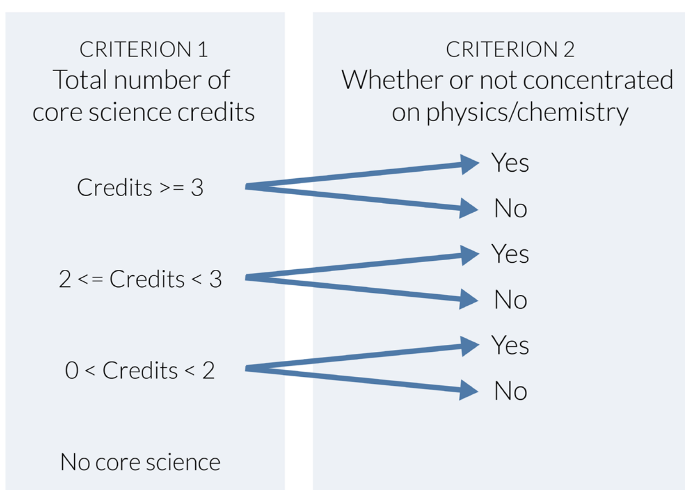
Study Cohort and Data

This study focuses on a high school cohort for which the most complete student science course data are available for 9th to 12th graders. The study cohort includes 9th graders who ever enrolled in Washington public high schools in the 2012-13 school year and who are expected to graduate in the 2015-16 school year (namely, the Class of 2016). Their records in high school years, from 2012-13 through 2015-16[5], are used for analysis.

The source data is based on students' longitudinal administrative records across sector- from high school (2013-2016) to postsecondary education (2017). The major data source is the Comprehensive Education Data and Research System (CEDARS) from the Office of Superintendent of Public Institution (OSPI), which provides students' demographics, high school enrollment, course grade history, and completion. The information about high school graduates' college going and college STEM learning in Washington public higher education institutions comes from two resources: (1) Washington's Public Centralized Higher Education Enrollment System (PCHEES); and (2) the State Board for Community and Technical College (SBCTC).[6] The key measurements include:

- *Science coursework patterns* summarize students' overall coursework features in four high school years. The coursework classification is based on three criteria. First, the total number of course credits in core science (biology, physics, or chemistry) earned through high school years is used to identify whether a student meets state high school graduation requirement by completing two science credits[7].

Figure 1. Coursework classification criteria



5 The selection of this cohort is based on the suggestion from OSPI that confirmed high school course data quality improved greatly by 2013.

6 The National Student Clearinghouse data does not provide college course information. Thus, the analysis of college-level STEM outcomes is limited to only students enrolled in Washington public institutions.

7 According to [WAC 180-51-067](), students in the Class of 2016 are required to take two science credits with at least one lab credit in order to graduate from high school. The preliminary findings of this study indicate the number of credits in core science is highly correlated with a student's likelihood of

Second, by Washington state education law, to receive a high school diploma, most students in the class of 2016 were required to pass a biology end-of-course assessment.[8] Thus, whether or not a student's science coursework goes beyond biology and concentrates on the other non-biology core science courses is the third criterion. Seven categories of science coursework patterns shown in Figure 1 are used for this study.

- *College STEM course outcomes* include two measures- a flag identifying whether a student earned any college-level STEM course credit during the 2016-2017 academic year, and the GPA achieved from any college-level STEM course.

Analytic Approaches

This study uses descriptive analysis to portray 9th graders' STEM pipeline from high school science coursework to college STEM learning outcomes in the first year after high school graduation. T-statistics are used to test the differences in means between groups, and Z-statistics testing is used to test differences in proportions. No causal inference is drawn from the results shown in the following sections.

Summary of Findings

Part 1. What science courses do students take in high school?

In their freshmen year (9th grade in 2013), a majority of students took physics, chemistry, or other non-core science courses (see Figure 1). In 10th grade, most students took biology, which might be due to the fact that Washington requires high school students to pass a biology state assessment for graduation, and the biology test is implemented in 10th grade for students in the class of 2016. In 11th grade (2015 school year), about 40 percent did not take any science courses while 35 percent took physics or chemistry and 15 percent took biology. In their senior year, over half of students did not take any science course, and those taking physics or chemistry constituted the majority of students who did take a science course.

To study over-time patterns of each individual student's science course-taking patterns during the high school years, student coursework records are categorized into seven patterns. As shown in Figure 3, about 59 percent of students earned two or more course credits in core science subject- biology, physics, and chemistry. The majority of credits earned in core science concentrates in biology, and less in physics or chemistry.

earning college STEM credit. The measurements thus focus on coursework of core science subjects.

8 Washington State Graduation Requirements 2012 to 2017, retrieved from the Washington State Board of Education on June 4, 2019.

Figure 2. Percent distribution of science coursetaking in high school years for 2013 9th graders. (See also Table B1-1 in Appendix B.)

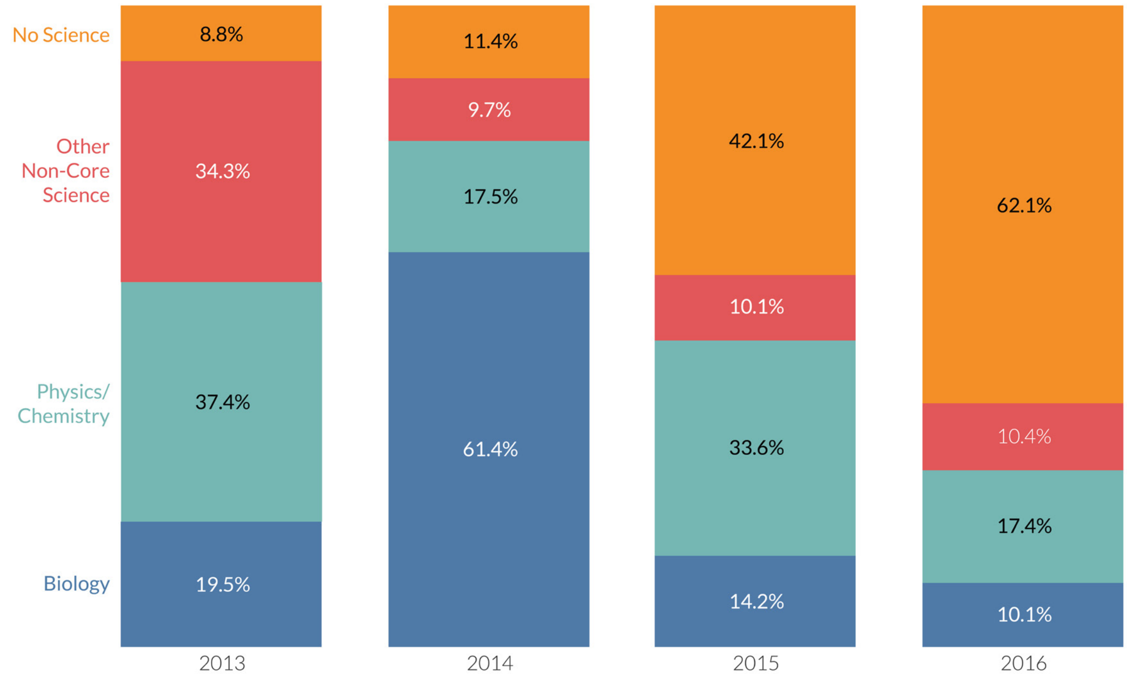
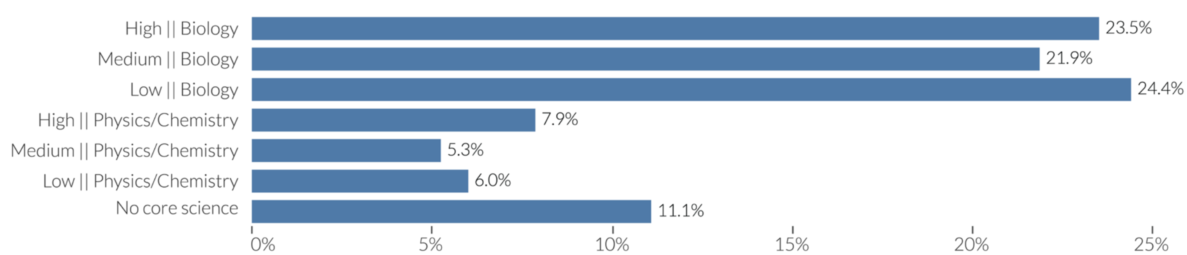


Figure 3. Percent of science coursework patterns for 2013 9th graders, from 2013-2016. (See also Table B2 in Appendix B.)



Part 2. Science coursework patterns and college course outcomes

How do the high school science coursework patterns pave the way to college STEM coursework outcomes? Figure 3 shows about half of those who enrolled in college in 2017 (one year after high school graduation) earned college STEM credit. Two crucial factors of high school science coursework are associated with the likelihood of earning college STEM credits – number of science courses and whether the coursework is concentrated in physics or chemistry. Students in the following three high school science course patterns have higher proportions of earning college STEM credit than average: earning more than three core science credits concentrating on physics or chemistry (about 76.9 percent), followed by those earning more than three high school credits with combination on biology (about 60.8 percent), and those with two to three credits concentrating on physics or chemistry (51.9

Figure 4. Percent earning WA public institution STEM credit in 2017, by high school science coursework patterns. (See also Table B2 for more details.)

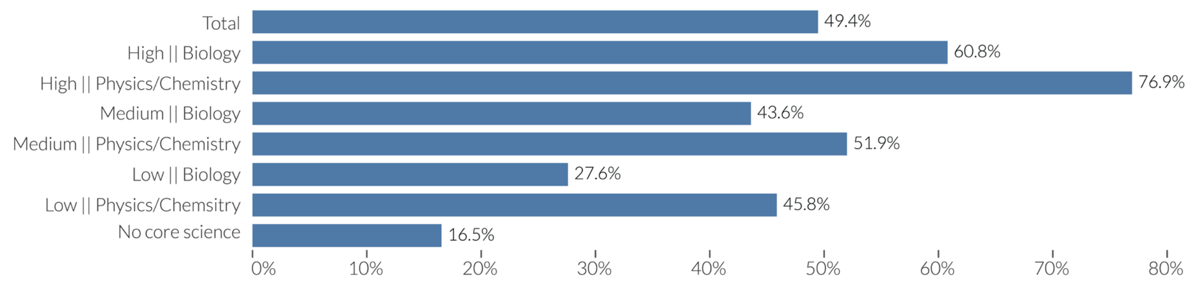
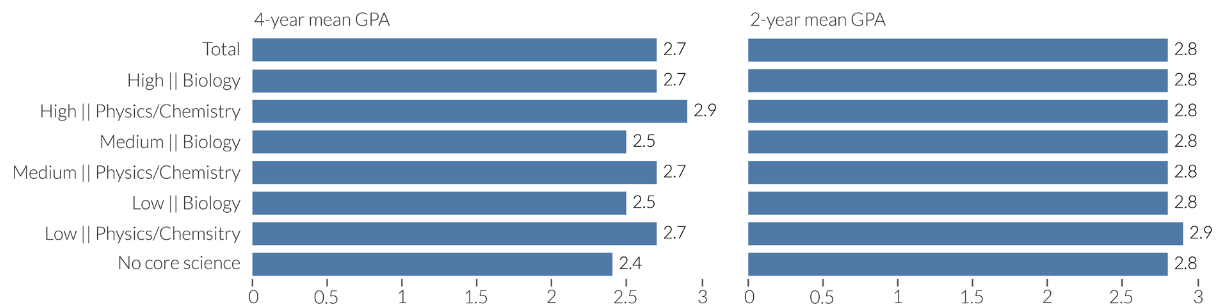


Figure 5. Mean GPA from college STEM courses taken in WA public institutions in 2017, by science coursework patterns. (See also Table B2 for more details.)



percent).

Another indicator of college STEM outcomes is the GPA earned from college STEM courses taken. As shown in Figure 5, among students enrolling in public 4-year institutions, those who earned more credits in physics or chemistry earned slightly higher GPAs than those with biology concentration. Among those enrolling in public 2-year institutions, the GPA difference is not so evident (see Figure 5). The rest of this report focuses on the analysis of earning college STEM credits.

Part 3. High school science coursework patterns and college course outcomes by student demographics and family income status

In general, a higher proportion of females earn college STEM credits, regardless of high school science coursework patterns (see Figure 6). The gender difference is more profound among students going through low-core science patterns (see Appendix B Table B4).

As to racial/ethnic differentials in college STEM outcomes, Asians hold the highest proportions earning college STEM credit, regardless of which science course patterns were taken. In contrast, the other racial/ethnic minorities have lower proportions earning college STEM credits compared to Whites. The racial/ethnic gaps seem to be smaller among those high achievers (those who completed more than 3 core science credits in high school).

In addition to demographic characteristics, family income status also plays a role in the variation in students' STEM pipeline patterns.[9] In this study, the measure of student family income status is whether a student is eligible for free- or reduced-price lunch (FRPL). Figure 8 shows the difference in the percentage of students earning college STEM credit by family income status, within each science coursework pattern. Disparity by income status exists across students' science coursework patterns. For students who experienced a similar science course pattern, those from a more affluent family (non-FRPL) are more likely to earn college STEM credit than those from a low-income family (FRPL). The income status gaps seem to be smaller among high achievers, as well as among those with a course portfolio concentrated on biology.

Conclusion and Future Research

It is well known that high school course-taking impacts college outcomes, but little is known about what forms of coursework pathways over the high school years contribute to those outcome differentials in STEM fields. Findings of this study sketch an overall picture of the relationship between science coursework patterns in high school and college STEM outcomes, by taking student demographics and socioeconomic status into consideration.

For the cohort of 2013 9th graders enrolling in Washington public schools, about two-thirds fulfilled and even exceeded Washington's high school graduation requirement for science course-taking.[10] Earning more than two core science credits concentrating on physics or chemistry is found to be associated with higher proportions of earning college STEM credits. Compared to those with physics/chemistry concentration, students whose science portfolio concentrated on biology show a lower proportion of earning college STEM credits. One possible explanation is that the measure of college STEM credit does not include the credits earned in life or health sciences, which require heavy course loads related to biology. Gaining more high school credits in biology, thus, does not seem to help earn college credits from STEM courses. Instead of lumping subjects together, if data is available, a future study may analyze STEM pipeline by distinctive science concentration and major in college.

In addition, using only one year of post-secondary data is not sufficient to measure college STEM course-taking outcomes, nor does it allow for the prediction of choosing a STEM major. However, at the time this study was conducted, the most recent college data available is from academic year 2017. Using more years of college STEM course outcomes, choice of majors and degree completion could provide a better picture of

9 Sass, T. (2015). "Understanding the STEM pipeline." Working paper of National Center for Analysis of Longitudinal Data in Education Research, retrieved on May 25, 2019.

10 For the Class of 2016, most students had to earn two science credits (with one lab credit). It is also worth noting that, regardless of graduation class, districts have local requirements that my exceed state requirements in accommodating students' needs.

STEM pipeline.

Although students earning more core science credits in physics/chemistry are more likely to gain college STEM credits, the proportion of high school students who took more physics/chemistry is far less than those taking more biology courses. This could be a result from the state accountability policy which requires the Class of 2016 to take an End-of-Course (EOC) biology assessment in 10th grade. The state accountability policy could impact high school students' science course-taking portfolio in three ways: (1) requiring minimum course credits for graduation; (2) requiring students to meet the standards of state assessments; (3) providing alternative graduation pathways. In the last five years, based on multiple state bills coming out of the state legislature, students of different graduation classes might have experienced some impacts from the changing accountability requirements. For example, beginning with the graduating class of 2019, the required graduation credit for science increased from 2 to 3. For graduating class of 2017 and 2018, the science assessment transitioned from biology EOC to Washington Comprehensive Assessment of Science (WCAS), aligned with the Next Generation Science Standards.[11] To what extent do federal and state accountability requirements impact students' high school course-taking and long-term academic achievement and attainment is worth further investigation.

This study reveals a gender difference in science course-taking. Overall, females are more likely to earn college STEM credit one year after high school graduation. This difference is greatest among those whose coursework concentrates in biology. The extent to which high school science course choice explains gender differences in choice of college major and earnings[12] is beyond the scope of this study. As more years of postsecondary education data become available, future studies might contribute to filling this knowledge gap.

Across racial/ethnic groups, holding high school science course patterns constant, Asians consistently outperform the other groups in earning college STEM credits. Among high science achievers, in terms of earning more core science credits in high school, racial/ethnic differences in completing college STEM credits are present, but the gaps do not vary as much as those among lower achievers.

In addition, variation in earning college STEM credits is consistently found across family income statuses. Differentials by students' family income status are present no matter what high school science patterns students went through. The impact of family income on college STEM outcomes is another area that needs further examination, especially for policies related to financial aid.

This descriptive study demonstrates Washington high school students' STEM pipelines

11 For more details about state accountability policy changes over time, see Washington State Board of Education graduation requirement history and OSPI state testing overview.

12 Weeks, G.and Paterson, T. 2018. "The earning premium of Washington Higher Education: gender deficit in earnings among Washington college graduates." Education Research and Data Center, State of Washington. WA: Olympia.

from 9th grade through the first year in college. The findings reveal questions for future study. However, before delving into further mechanisms explaining variation in STEM pipeline, some data issue needs to be addressed to prevent researchers from running into a dead end.

First, K12 coursework records are not available for each student. Currently, the data is available and better for high school students enrolling in 2012-2013 school year and forward. Second, data on the level and sequence of courses for each subject matter is not collected, therefore, course information could not be easily classified. Lack of such information poses challenges for research aiming to analyze the effect of course rigor. One supplemental option is to use advanced course designation, such as Advanced Placement, International Baccalaureate, or other dual credit courses. However, those advanced courses are not offered at every school and, furthermore, the same course title/code may not reflect the same course level. Third, course records may not be complete among districts through all available years of course data. The reason for data incompleteness vary[13], and it could be time consuming to diagnose missing data. Lastly, coursework might not be coded consistently across schools over time, even for the same course. These are fundamental issues that need to be addressed before creating valid and reliable measurements for further analysis.

13 Chen, V., Pyle, K. and Weller, A. 2018. "A Data Quality Evaluation of Administrative Data." Education Research and Data Center, State of Washington. WA: Olympia.

Appendix A. Technical Notes

Sample

The initial sample for this study includes all 9th graders who enrolled in the 2012-2013 school year in Washington public schools. The total number of students is 86,579. Because course-taking patterns through all high school years is the key measurement of a student's trajectory over time, this study removed those students who only enrolled in one school year between 2013 and 2016. The resulting sample size for analysis of course-taking patterns is 81,349 students.

Variable definition

Science course category groups students' science coursework in each year, starting from 9th grade in 2013 to 2016. Four major categories of science course credit earned are identified:

- Enrolled, but no science: enrolled, but did not earn any science credit in the school year;
- Biology: earned at least one biology credit;
- Physics or chemistry: earned either a physics or chemistry credit;
- Other non-core science: earned a science credit that is neither biology, physics, nor chemistry.

Science coursework pattern consists of seven categories, based on three science coursework features in high school years: (1) whether a student earned two science credits; (2) whether a student earned core science credits; (3) whether a student's coursework concentrated in biology or physics/chemistry. Seven categories are described below.

Science course pattern	Description
No core science credit	No credit earned in biology, physics, or chemistry.
Low core science: concentrate on physics/ chemistry	Total core science credits earned < 2, with number of credits in physics/chemistry > (mean + 1 standard deviation)
Low core science: concentrate on biology	Total core science credits earned < 2, with number of credits in biology > (mean + 1 standard deviation)
Medium core science: concentrate on physics/ chemistry	Total core science credits earned >=2 and <3, with number of credits in physics/chemistry > (mean + 1 standard deviation)
Medium core science: concentrate on biology	Total core science credits earned >=2 and <3, with number of credits in biology > (mean + 1 standard deviation)
High core science: concentrate on physics/ chemistry	Total core science credits earned >=3, with number of credits in physics/chemistry > (mean + 1 standard deviation)
High core science: concentrate on biology	Total core science credits earned >=3, with number of credits in biology > (mean + 1 standard deviation)

Non-core science course refers to science courses that are neither biology, physics, nor chemistry

College STEM course credit. This variable is constructed by several approaches and differs by institution sector. First, remedial courses are removed from students' postsecondary coursework profiles. Second, the identification of STEM courses from public 2-year institutions is based on guidelines from SBCTC, and the data is mainly from CTC Student Class and Student Transcript files. The STEM course data from public 4-year institutions comes from PCHEES data elements field of study and concentration. Once a STEM course is identified, a credit earned flag from each data system is used to indicate whether a student earned any course credit from a college-level STEM course in 2016-17 academic year.

College STEM GPA. Grade point average is calculated for a STEM course once the course grade is identified as GPA-eligible and the course credit is earned.

Race/ethnicity. Student race/ethnicity is extracted from OSPI CEDARS student enrollment data, and the racial/ethnic categories follow federal rollup described in CEDARS data manual.

Gender. Student gender is extracted from OSPI CEDARS enrollment data, defined as male or female.

Family income status. A dichotomous flag identifying whether or not a student is eligible for free- or reduced-price lunch in 2012-2013 school year is used to indicate a student's family income status. This is the only indicator available from CEDARS to proxy a student's socioeconomic status.

Appendix B. Tables for Figures

Table B1-1. Percent high school science courses taken by 2013 9th graders, by school year

	School year								
Science course category		2013		2014		2015		2016	Total
Enroll but no science	7,532	8.8%	9,734	11.4%	35,828	42.1%	52,527	62.1%	31.0%
Biology	16,629	19.5%	52,340	61.4%	12,077	14.2%	8,514	10.1%	26.3%
Physics or Chemistry	31,975	37.4%	14,925	17.5%	28,619	33.6%	14,738	17.4%	26.5%
Other non-core science	29,251	34.3%	8,241	9.7%	8,597	10.1%	8,750	10.4%	16.1%
Total	85,387	100.0%	85,240	100.0%	85,121	100.0%	84,529	100.0%	100.0%

Note: The total number of observations in this table is the count of science coursework while students enrolled in each school year. Students with only one year of enrollment are removed from the sample. Total headcount ends up with 81,349.

Table B1-2. Percent high school science courses taken by 2013 9th graders over time, by science course category

	School year								
Science course category		2013		2014		2015		2016	Total
Enroll but no science	7,532	7.1%	9,734	9.2%	35,828	33.9%	52,527	49.7%	105,621
Biology	16,629	18.6%	52,340	58.4%	12,077	13.5%	8,514	9.5%	89,560
Physics or Chemistry	31,975	35.4%	14,925	16.5%	28,619	31.7%	14,738	16.3%	90,257
Other non-core science	29,251	53.3%	8,241	15.0%	8,597	15.7%	8,750	16.0%	54,839
Total	85,387	25.1%	85,240	25.1%	85,121	25.0%	84,529	24.8%	340,277

Note: The total number of observations in this table is the count of science coursework while students enrolled in each school year. Students with only one year of enrollment are removed from the sample. Total headcount ends up with 81,349.

Table B1-3. Percent of students who completed more than one high school science course credit in each school year, by science course category

	School year								
Science course category		2013		2014		2015		2016	Total
Biology	10	0.8%	364	29.6%	337	27.4%	520	42.2%	1,231
Physics or Chemistry	1	0.1%	122	7.1%	632	36.5%	975	56.4%	1,730
Other non-core science	54	5.9%	137	15.1%	218	24.0%	500	55.0%	909
Total	65	1.7%	623	16.1%	1,187	30.7%	1,995	51.6%	3,870

Note: The total number of observations in this table is the count of science credits completed while students took more than one science course in each school year. Total headcount is 938.

Table B2. Summary distribution of high school science coursework and college STEM outcomes, from 2013 to 2017

			2017 College enrollment (N=80,336)			Earned college STEM credit in 2017 (N=32,292)		2017 STEM GPA by sector (N=16,410)			
Science course-work patterns, from 2013-2016	Total		No college (N=48,044)	4-year (N=13,486)	2-year (N=18,806)	No (N= 16,349)	Yes (N= 15,943)	4-year (N=11,954)		2-year (N=4,456)	
	N	Col_%	Row_%	Row_%	Row_%	Row_%	Row_%	Mean	Col_%	Mean	Col_%
No core science credit	8,912	11.1%	82.8%	1.8%	15.4%	83.5%	16.5%	2.4	1.0%	2.8	3.1%
Low core science: concentrate on physics/chemistry	4,828	6.0%	63.8%	13.2%	23.1%	54.2%	45.8%	2.7	4.5%	2.9	6.4%
Low core science: concentrate on biology	19,608	24.4%	72.1%	5.7%	22.2%	72.4%	27.6%	2.5	7.4%	2.8	15.0%
Med. core science: concentrate on physics/chemistry	4,227	5.3%	51.5%	21.1%	27.4%	48.1%	51.9%	2.7	6.6%	2.8	6.8%
Med. core science: concentrate on biology	17,559	21.9%	56.1%	16.0%	27.9%	56.4%	43.6%	2.5	19.7%	2.8	25.2%
High core science: concentrate on physics/chemistry	6,333	7.9%	43.6%	38.9%	17.4%	23.1%	76.9%	2.9	19.5%	2.8	10.7%
High core science: concentrate on biology	18,869	23.5%	45.9%	28.7%	25.5%	39.2%	60.8%	2.7	41.3%	2.8	32.9%
Total	80,336	100.0%	59.8%	16.8%	23.4%	50.6%	49.4%	2.7	100%	2.8	100%

Table B3. Percent distribution of high school science coursework patterns, by student demographics and family income level

Science coursework patterns, from 2013-2016	College going	Gender		Race/ethnicity						FRPL eligibility	
	Total	Male	Female	American Indian	Asian	Black	Hispanic	White	Other	No	Yes
No core science credit	4.7%	5.1%	4.3%**	12.5%**	3.3%	9.3%**	7.1%**	3.8%	5.0%**	3.3%	7.4%**
Low core science: concentrate on physics/chemistry	5.2%	5.6%	5.2%**	4.7%	4.9%*	5.3%+	4.7%	5.6%	6.1%*	5.5%	5.3%**
Low core science: concentrate on biology	17.0%	16.5%	17.2%**	22.3%	10.4%**	19.6%**	21.4%**	16.6%	15.4%**	14.3%	21.9%**
Med. core science: concentrate on physics/chemistry	6.4%	6.7%	6.0%**	6.5%	6.4%	6.4%+	5.8%	6.6%	5.9%	6.9%	5.2%**
Medium core science: concentrate on biology	23.9%	21.9%	25.7%**	21.7%**	18.1%**	21.0%**	23.8%**	25.3%	22.7%**	23.9%	23.8%**
High core science: concentrate on physics/chemistry	11.1%	13.7%	8.7%**	4.2%**	20.1%**	11.3%	7.2%**	10.7%	10.9%	12.8%	7.8%**
High core science: concentrate on biology	31.6%	30.4%	32.9%**	28.2%*	36.8%**	27.2%	30.0%**	31.4%	34.0%+	33.3%	28.6%**
N	32,292	15,418	16,773	337	3,453	1,446	5,663	19,241	2,051	21,096	11,095

Notes: “FRPL” refers to whether a student is eligible for free- or reduced-price lunch program in school. “N/A” refers to those cells with number of observations less than 10 that could not be reported for FERPA compliant. Z statistics are used to test proportional difference across group within each science pathways. The reference group for race/ethnicity is White. Significant level: + p<0.1, * p<0.05, ** p<0.01.)

Table B4. College STEM outcomes in 2017, by 2013-16 high school science coursework patterns and student gender

Science coursework patterns, from 2013-2016	Earned college STEM credit		STEM GPA in 4-year		STEM GPA in 2-year	
	Male	Female	Male	Female	Male	Female
	(N=15,418)	(N=16,773)	(N=5,485)	(N=6,456)	(N=2,144)	(N=2,299)
No core science credit	15.5%	17.7%	2.4	2.4	2.9	2.7
Low core science: concentrate on physics/chemistry	41.0%	50.7%**	2.7	2.6	2.9	2.9
Low core science: concentrate on biology	24.1%	30.9%**	2.4	2.5+	2.7	2.8
Medium core science: concentrate on physics/chemistry	50.4%	53.4%	2.7	2.8	2.7	2.8+
Medium core science: concentrate on biology	41.3%	45.5%**	2.5	2.6	2.7	2.8**
High core science: concentrate on physics/chemistry	77.6%	75.7%	2.9	2.9	2.8	2.9*
High core science: concentrate on biology	58.8%	62.6%**	2.7	2.8**	2.7	2.8
Total	48.0%	50.8%	2.7	2.7	2.7	2.8

Note: Z statistics are used to test proportional difference between gender within each science pattern, and t-statistics are applied to test difference in mean GPA. Significance level: + $p<0.1$, * $p<0.05$, ** $p<0.01$.)

Table B5. College STEM outcomes in 2017, by 2013-16 high school science coursework patterns and student race/ethnicity

Science course-work patterns, from 2013-2016	Earned STEM course credit						STEM GPA in 4-year						STEM GPA in 2-year					
	AI	AS	BL	HIS	WT	Other	AI	AS	BL	HIS	WT	Other	AI	AS	BL	HIS	WT	Other
No core science credit	4.8%*	36.3%**	8.2%**	9.8%**	18.8%	21.4%	N/A	2.2	N/A	2.5	2.3	2.8	N/A	2.6	N/A	2.7	2.9	2.8
Low core science: concentrate on physics/chemistry	25.0%	65.9%**	39.5%	32.8%**	45.9%	52.4%	N/A	2.8	2.3	2.8	2.7	2.5	N/A	2.9	2.6	2.7	2.9	3.0
Low core science: concentrate on biology	13.3%**	44.7%**	16.3%**	22.2%**	29.4%	26.0%	N/A	2.5	1.7+	2.2	2.6	2.4	N/A	2.9	2.8	2.7	2.8	2.9
Med. core science: concentrate on physics/chemistry	31.8%*	70.6%**	23.7%**	42.3%**	54.2%	44.6%**	N/A	2.9	1.9**	2.5**	2.8	2.7	N/A	2.7	2.4	3.0	2.7	2.7
Med. core science: concentrate on biology	35.6%+	55.6%**	33.0%**	35.6%**	45.3%	41.1%**	2.4	2.6+	2.1**	2.4*	2.6	2.4	2.6	2.9	2.5+	2.6*	2.8	2.8
High core science: concentrate on physics/chemistry	64.3%	86.3%**	65.0%**	67.1%**	77.0%	73.1%	N/A	3.1**	2.5**	2.5**	2.9	2.8	N/A	2.8	2.7	2.6**	2.9	2.8
High core science: concentrate on biology	51.6%+	78.7%**	50.0%**	52.9%**	60.4%	58.7%	2.6	2.9**	2.3**	2.5**	2.7	2.6*	2.4	2.9*	2.6	2.7+	2.8	2.8
Total	31.8%	70.0%	35.4%	38.6%	50.4%	48.2%	2.5	2.9	2.2	2.5	2.7	2.6	2.7	2.9	2.6	2.7	2.8	2.8
N	107	2,416	512	2,187	9,707	988	76	1,915	405	1,572	7,208	765	36	598	151	691	2,764	263

Note: Z statistics are used to test proportional difference between group within science pathway, and t-statistics are applied to test difference in mean GPA. The reference group is White. Significance level: + p<0.1, * p<0.05, ** p<0.01. "N/A" refers to those cells with number of observations less than 10 that could not be reported for FERPA compliant.)

Table B6. College STEM outcomes in 2017, by 2013-16 high school science coursework patterns and student family income status

Science coursework patterns, from 2013-2016	Earned college STEM credit		STEM GPA in 4-year		STEM GPA in 2-year	
	Non-FRPL (N=20,096)	FRPL (N=11,059)	Non-FRPL (N=8,841)	FRPL (N=3,100)	Non-FRPL (N=3,073)	FRPL (N=1,370)
No core science credit	24.0%	10.3%**	2.4	2.4	2.9	2.7
Low core science: concentrate on physics/chemistry	50.7%	36.4%**	2.7	2.5	2.9	2.9
Low core science: concentrate on biology	33.4%	20.7%**	2.6	2.3+	2.8	2.7
Medium core science: concentrate on physics/chemistry	56.6%	40.0%**	2.8	2.4	2.8	2.8*
Medium core science: concentrate on biology	47.0%	37.3%**	2.6	2.3	2.8	2.7**
High core science: concentrate on physics/chemistry	80.1%	66.7%**	3.0	2.5	2.9	2.7*
High core science: concentrate on biology	64.3%	53.2%**	2.8	2.5**	2.8	2.7
Total	55.2%	38.6%	2.8	2.5	2.8	2.7

Note: Z statistics are used to test proportional difference between group within science pathway, and t-statistics are applied to test difference in mean GPA. The reference group is White. Significance level: + $p<0.1$, * $p<0.05$, ** $p<0.01$.)

ERDC
Education Research & Data Center

Office of Financial Management
Better information. Better decisions. Better government. Better Washington.