IES NATIONAL CENTER FOR EDUCATION STATISTICS
Institute of Education Sciences

Statistics in Brief

May 2010

CTE Statistics

Science Achievement and Occupational Career/Technical Education Coursetaking in High School: The Class of 2005

U.S. Department of Education
NCES 2010-021

Authors

Karen Levesque
Jolene Wun
Caitlin Green
MPR Associates, Inc.

Contents

For more information, contact Lisa Hudson, National Center for Education Statistics, (202) 502-7358, lisa.hudson@ed.gov

Introduction

Since 1990, federal legislation has encouraged states and local programs to improve the academic achievement of students who participate in career/technical education (CTE).[1] This focus on academics is intended, in part, to provide high school students with rigorous content needed to prepare for further education and careers in current or emerging professions (2006 Perkins Act, Section 3(5)(A)(i)). Since enactment of this federal mandate to improve the academic achievement of CTE participants, related research has focused on tracking trends in the academic performance of CTE participants and analyzing the "value added" of CTE participation to academic achievement (Silverberg et al. 2004). Researchers have measured academic performance in two main ways, analyzing trends in both the academic coursetaking and tested achievement of CTE participants. These analyses have shown that, since 1990 and earlier, both the amount and rigor of CTE participants' academic coursetaking have increased and the percentage of public high school graduates combining rigorous academic coursework with concentrated CTE coursework has also increased (Tuma and Burns 1996; Levesque et al. 2000; Levesque 2003b; Silverberg et al. 2004; Levesque et al. 2008). Other analyses have shown that the academic achievement of CTE participants as measured by standardized tests has increased over time, particularly in reading and math (Silverberg et al. 2004). Moreover, these studies have shown that gaps in academic coursetaking and achievement between CTE participants and their non-participating classmates have narrowed.

In addition to analyzing trends in the academic performance of CTE participants, researchers have also examined the "value added" of CTE coursetaking to students' academic achievement. Descriptive analyses typically find that greater CTE coursetaking is associated with lower academic achievement at the end of high school (McCormick and Tuma 1995; Levesque et al. 1995). While this lower achievement may be due, in part, to differences in the amount and types of academic courses that CTE participants take, differences in student characteristics also play a role, including the historically lower prior academic achievement of CTE participants compared with non-participants (Levesque et al. 2000; Agodini, Uhl, and Novak 2004). Analyses that account for differences in various student characteristics have consistently shown a neutral effect of CTE coursework on academic achievement (Rasinski 1994; Plank 2001; Agodini et al. 2004; Bae et al. 2007). These latter analyses typically group CTE participants into a single category, comparing CTE participants overall with their non-participating peers. Other analyses suggest, however, that both initial and subsequent academic achievement in high school vary by the type of CTE coursework that students take and that CTE students are not a homogeneous group with respect to a variety of characteristics that are related to academic achievement (Levesque 2003a; Levesque 2003b; Levesque et al. 2008).

Focus of This Statistics in Brief

The definition of CTE used by the National Center for Education Statistics (NCES) includes, at the high school level, family and consumer sciences education, general labor market preparation, and occupational education (Bradby and Hoachlander 1999; Bradby

[1] See the Carl D. Perkins Vocational and Applied Technology Education Act of 1990 (Public Law 101-392); the Carl D. Perkins Vocational–Technical Education Act Amendments of 1998 (Public Law 105–332); and the Carl D. Perkins Career and Technical Education Improvement Act of 2006 (Public Law 101-392); referred to as the 1990, 1998, and 2006 Perkins Acts.

and Hudson 2007). Most researchers—including those cited in the introduction to this Statistics in Brief—focus on occupational education courses (including courses in agriculture, business, and health sciences, among other fields) when examining the relationship between CTE and key outcomes (Silverberg et al. 2004). This emphasis reflects the fact that occupational courses represent the majority of CTE coursetaking (Levesque 2003b; Levesque et al. 2008; Hudson and Laird 2009) and studies suggest this is the part of the CTE curriculum most strongly related to employment and earnings outcomes, which are the ultimate goals of CTE (Boesel et al. 1994; Bishop and Mane 2004).

This Statistics in Brief also focuses on students who participate in occupational education, comparing the science coursetaking and achievement of public high school graduates of the class of 2005 who concentrated in occupational education with graduates who did not. While the Brief includes a comparison between occupational concentrators overall and nonconcentrators, the primary focus here is on comparing concentrators in 13 different occupational program areas with nonconcentrators. This Brief provides new information on the academic achievement of CTE participants by focusing on science achievement and describing this achievement for CTE concentrators in different occupational programs.[2]

The Brief also examines the science achievement of CTE participants who earned similar numbers of science credits, and looks at how the level and types of science courses taken differ among participants. These analyses are useful because previous studies have found that achievement gaps may be linked to the differing levels and types of academic coursework that students take (Plank 2001; Levesque 2003b; Silverberg et al. 2004), and because academic coursetaking is relatively amenable to policy action. Although this Brief cannot examine the causal impact of coursework on achievement, the analysis shows the varying relationships between science coursework and achievement for concentrators in different occupational programs and suggests areas for further research. The reader is cautioned that many additional factors—such as students' prior academic achievement, aptitudes, and interests, and varying curricular and teaching quality—can influence science achievement. This Brief does not examine the effects of such factors on student achievement.

Data and Definitions

As mentioned above, CTE at the high school level encompasses family and consumer sciences education (which is intended to prepare students for roles outside the paid labor force), general labor market preparation (which teaches general employment skills, such as keyboarding, basic computer applications, and introductory technology skills), and occupational education (which teaches technical skills required in specific occupations or occupational clusters). This Brief focuses on coursetaking in occupational education, encompassing the 13 occupational program areas listed in table 1.

Coursetaking patterns were analyzed using data from the National Assessment of Educational Progress (NAEP) High School Transcript Study (HSTS) of 2005. Transcripts provide information on the courses that the 2005 graduates took in grades 9 through 12, and this Brief describes graduates' cumulative coursework during high school. HSTS researchers assigned codes to each course on a transcript according to the Classification of Secondary School Courses (CSSC) (U.S. Department of Education website). The analysis for this Brief then used the revised Secondary School Taxonomy (SST) to classify these codes into broader course groupings (Bradby and Hudson 2007). In addition to the name of a course, transcripts also provide the number of credits a student earned for each course. Credits have been standardized across schools, so that 1.0 credit is equivalent to completing a course that meets one period per day for an entire school year, or the equivalent instructional time (120 hours of classroom instruction), which is also equivalent to a standard Carnegie unit. For simplicity's sake, this Brief refers to credits rather than Carnegie units.

Table 1. Percentage of public high school graduates and of concentrators in each occupational program area in high school: 2005

Program area	Percent of all graduates	Percent of concentrators
Concentrators, total[1]	**37.6**	**100.0**
Agriculture	4.8	12.9
Business finance	1.4	3.8
Business support and management	5.7	15.2
Communications and design	5.5	14.7
Computer and information science	3.8	10.2
Construction and architecture	2.1	5.7
Consumer services	2.1	5.7
Culinary arts	1.5	4.0
Engineering technology	2.6	6.8
Health science	3.4	9.2
Manufacturing, repair, and transportation	7.2	19.3
Marketing	2.4	6.3
Public services	1.4	3.8

[1] Concentrators earned 2.0 or more credits in the program area indicated. The total concentrator row includes graduates who earned 2.0 or more credits in at least one of the 13 program areas listed.
NOTE: Details may sum to greater than the total, because some graduates concentrated in more than one occupational program area. Standard errors can be found in appendix B.
SOURCE: U.S. Department of Education, National Center for Education Statistics, 2005 High School Transcript Study (HSTS) and National Assessment of Educational Progress (NAEP) 2005 12th-grade science assessment.

[2] See Silverberg et al. (2004), Stone et al. (2006), and Bae et al. (2007) for studies that examine the reading and mathematics performance of CTE participants overall.

Science achievement was analyzed using the 12th-grade NAEP science assessment that was linked to the 2005 HSTS. The 12th-grade NAEP science test covers earth, physical, and life sciences with equal emphasis (National Assessment of Educational Progress 2006). NAEP science results are reported on a 0–300 scale. Public high school graduates were included in the analysis if they graduated in 2005 with a regular or honors diploma, possessed complete transcripts (defined as containing 16 or more total credits and a positive number of English credits),[3] and had valid NAEP science test scores.

This Statistics in Brief uses the revised CTE section of the Secondary School Taxonomy (Bradby and Hudson 2007) to define 13 occupational program areas deemed relevant for an analysis of science achievement.[4] The study also uses a definition of occupational concentrator that first appeared in Hudson and Laird (2009), which requires that students earn 2.0 or more credits in an occupational program area. Studies of CTE participation have used a variety of definitions of CTE participants over the years; see the Methodology and Technical Notes section for more information. This Brief uses the 2-credit concentrator definition, because the Technical Review Panel for the NCES CTE Statistics program has recommended that NCES examine different definitions of occupational concentration, including earning 2.0 or more credits in an occupational program area, as this definition is in line with recent state practice. As of 2004–05, the final year of high school for the students described in this Brief, one of the most common state definitions of a concentrator for federal accountability purposes was earning 2.0 or more credits in an occupational program area (U.S. Department of Education 2007). Although a uniform definition of "occupational concentrator" is typically used for national transcript analyses of CTE in order to measure national trends (see, e.g., Levesque et al. 2008; Silverberg et al. 2004; and Levesque 2003b), the reader is cautioned that this uniform definition does not reflect the variability that exists in state and local CTE practices.

Approach

This Brief begins by comparing public high school graduates in terms of their average credits earned in core science coursework (biology, chemistry, and physics) and their average scores on the NAEP 12th-grade science assessment. Core science coursework—rather than total science coursework[5]—is examined, because *The Nation's Report Card: Science 2005* focused on core science coursetaking for 12th-graders (National Assessment of Educational Progress 2006). The Brief then examines in a crosstabular format the relationship between NAEP composite science scores and core science credits earned, for concentrators in the 13 occupational program areas and for nonconcentrators.

While not the focus of this Brief, it is important to note that 2-credit concentrators and nonconcentrators differ on a variety of background characteristics. For example, a greater percentage of 2-credit concentrators than nonconcentrators in grade 12 are White (70 vs. 67 percent), male (56 vs. 44 percent), and disabled (10 vs. 8 percent).[6] Conversely, a smaller percentage of concentrators than nonconcentrators in grade 12 are Hispanic (11 vs. 13 percent) and limited English proficient (2 vs. 4 percent). In terms of high school coursework, a smaller percentage of concentrators than nonconcentrators took high-level mathematics (geometry, algebra II, or higher) in grade 9 (29 vs. 35 percent) or completed 4-year college preparatory coursework by the end of high school (41 vs. 53 percent). While CTE participants may differ from non-participants in a variety of ways, a recent study found that concentrating in CTE was related to three main factors: low prior academic achievement—low educational aspirations, and low socioeconomic backgrounds—and that most other differences could be explained by these factors (Agodini, Uhl, and Novak 2004).

Students who concentrate in specific program areas also differ from nonconcentrators in their background characteristics. For example, a greater percentage of agriculture concentrators than nonconcentrators are male (67 vs. 44 percent), while a greater percentage of health science concentrators than nonconcentrators are female (82 vs. 56 percent). Similarly, while there are no measurable differences between concentrators in communications and design and nonconcentrators in the percentage who took high-level mathematics in grade 9, a smaller percentage of construction and architecture concentrators compared with nonconcentrators took such coursework. As a descriptive analysis, this Brief does not account for these differences in background characteristics.

Findings

Thirty-eight percent of public high school graduates from the class of 2005 concentrated (earned 2.0 or more credits) in at least one of the 13 occupational program areas shown in table 1. These occupational concentrators earned, on average, fewer credits in core science subjects (biology, chemistry, and physics) than their nonconcentrating classmates (2.2 vs. 2.6 credits) (table 2). As shown in table 2, occupational concentrators overall also scored lower than nonconcentrators on the 12th-grade NAEP science assessment (a score of 143 vs. 150). These overall patterns

[3] NCES guidelines for conducting transcript analyses can be found in Alt and Bradby (1999).

[4] See exhibit 1 in the Methodology and Technical Notes section. While it is probable that CTE courses across the nation are heterogeneous, both overall and within program areas, other studies have shown that there are significant and meaningful differences in means across some program areas with regard to the academic relatedness of CTE courses (see, for example, Levesque 2003b).

[5] Total science coursework includes survey science, earth science, physical science, and engineering, in addition to the core subjects of biology, chemistry, and physics.

[6] These and other statistics on the background characteristics of concentrators and nonconcentrators are tabulated on the NCES CTES website at http://nces.ed.gov/surveys/ctes.

Table 2. For public high school graduates, average credits earned in core science courses, average 12th-grade NAEP science scale score, and average 12th-grade NAEP science scale score of graduates who were within each range of core science credits, by occupational concentrator status and program area: 2005

Concentrator status and program area	Credits earned in core science courses	NAEP science score, overall	NAEP science score, by core science credit range			
			0.00 to 1.00 credit	1.01 to 2.00 credits	2.01 to 3.00 credits	More than 3.00 credits
Total, all graduates	**2.4**	**148**	**126**	**140**	**155**	**171**
Concentrator status[1]						
Nonconcentrators	2.6	150	123	141	157	173
Concentrators, total	2.2*	143*	129*	140	152*	165*
Agriculture	1.9*	148	136*	147*	160	176
Business finance	2.5	147	‡	143	150	‡
Business support and management	2.2*	138*	130*	134*	143*	154*
Communications and design	2.4*	149	128	145	158	164*
Computer and information science	2.6	155*	142*	146	154	176
Construction and architecture	1.6*	139*	131	138	158	‡
Consumer services	1.9*	131*	121	127*	149	‡
Culinary arts	1.7*	126*	107*	137	‡	‡
Engineering technology	2.4	154	138*	146	162	172
Health science	2.4*	141*	119	138	147*	162*
Manufacturing, repair, and transportation	1.8*	138*	130*	139	148*	161
Marketing	2.1*	141*	129	140	146*	‡
Public services	2.1*	140*	122	142	147	‡

* Concentrators were measurably different from nonconcentrators in the same column (using unrounded estimates), $p < .05$.
‡ Reporting standards not met.
[1] Concentrators earned 2.0 or more credits in the program area indicated. The total concentrator row includes graduates who earned 2.0 or more credits in any of the 13 program areas listed; the nonconcentrator row includes graduates who did not concentrate in any program area.
NOTE: Core science includes biology, chemistry, and physics. NAEP science scores range from 1 to 300. The average science score for all graduates in this analysis (148) has a standard deviation of 32 scale points. Standard errors can be found in appendix B.
SOURCE: U.S. Department of Education, National Center for Education Statistics, 2005 High School Transcript Study (HSTS) and National Assessment of Educational Progress (NAEP) 2005 12th-grade Science Assessment.

are consistent with previous descriptive studies of the academic achievement of CTE participants (McCormick and Tuma 1995; Levesque et al. 1995; Tuma and Burns 1996; Levesque et al. 2000; Levesque 2003b; Silverberg et al. 2004; Levesque et al. 2008). However, these overall patterns varied across occupational program areas.

Science Credits and Test Scores by Area of Concentration

Compared with nonconcentrators, there was no measurable difference in the number of core science credits earned by concentrators in the areas of business finance, computer and information science, and engineering technology (2.6 vs. 2.4–2.6 credits) (table 2). These three concentrator groups also scored higher than or not measurably different from nonconcentrators on the NAEP science assessment. Specifically, compared with their nonconcentrating classmates, there was no measurable difference in the science scores earned by concentrators in the areas of business finance and engineering technology, while computer and information science concentrators scored higher than nonconcentrators (a score of 155 vs. 150). Two other groups of concentrators—those in agriculture and in communications and design—also had science scores that were not measurably different from the scores of nonconcentrators. These five areas included 45 percent of all occupational concentrators in 2005.[7]

Test Scores by Science Credits Earned

As noted earlier, the lower academic achievement of CTE participants has been shown to be related to differences in the amount and types of academic courses that CTE participants take (Plank 2001; Levesque 2003b; Silverberg et al. 2004). To examine how the science achievement of occupational concentrators compares with that of nonconcentrators who take similar amounts of science, the Brief attempts to control for the number of science courses students took.[8] The right-hand side of table 2 shows the NAEP science scores for graduates earning 0.00–1.00 credit, 1.01–2.00 credits, 2.01–3.00 credits, and more than 3.00 credits in core science coursework during high school. For both concentrators and nonconcentrators, science test scores increased as the range of core science credits earned

[7] Data are not shown in tables. This percentage differs from what would be obtained by summing the relevant program areas in table 1, because graduates can concentrate in more than one program area.

[8] Although this analysis attempts to compare concentrators and nonconcentrators who earned a similar number of core science credits, appendix table S1 shows that concentrators and nonconcentrators who fell in the same range of credits sometimes differed in the average number of credits they earned. For example, concentrators overall who earned more than 3.00 core science credits earned an average of 4.0 such credits, while nonconcentrators within this same credit range earned an average of 4.2 credits.

increased. For example, concentrators earning 1.01–2.00 core science credits scored 11 points higher on the NAEP science assessment than concentrators earning 0.00–1.00 core science credit (a score of 140 vs. 129). Similarly, nonconcentrators earning 1.01–2.00 core science credits scored 18 points higher on the NAEP science assessment than nonconcentrators earning 0.00–1.00 core science credit (a score of 141 vs. 123).

How well concentrators performed on the NAEP science test compared with nonconcentrators varied in relation to the number of core science credits that graduates earned. Among graduates earning the fewest core science credits (0.00–1.00 credit), concentrators overall scored higher than nonconcentrators (a score of 129 vs. 123), while among graduates earning 1.01–2.00 core science credits, there was no measurable difference in the science scores of concentrators and nonconcentrators (scores of 140–141) (table 2). In contrast, among graduates earning 2.01–3.00 core science credits and more than 3.00 core science credits, concentrators overall scored lower than nonconcentrators (scores of 152 vs. 157 and 165 vs. 173, respectively).[9]

The pattern of concentrators scoring higher than or not measurably different from nonconcentrators at lower core science credit levels (0.00–1.00 and 1.01–2.00 credits)—and scoring lower than or not measurably different at higher core science credit levels (2.01–3.00 and more than 3.00 credits)—was observed across most occupational program areas. For example, among graduates earning 0.00–1.00 core science credit, concentrators in five occupational program areas (agriculture; business support and management; computer and information science; engineering technology; and manufacturing, repair, and transportation) scored higher on the NAEP science test than nonconcentrators (scores of 130–142 vs. 123), and the scores of concentrators in six areas (communications and design; construction and architecture; consumer services; health science; marketing; and public services) were not measurably different from the scores of nonconcentrators (scores of 119–131) (table 2). In only one case (culinary arts) did concentrators earning 0.00–1.00 core science credit score lower than nonconcentrators earning the same range of core science credits (a score of 107 vs. 123).[10]

Looking further along the credit distribution, among graduates earning 2.01–3.00 core science credits, concentrators in four occupational program areas (business support and management; health science; manufacturing, repair, and transportation; and marketing) scored lower on the NAEP science assessment than nonconcentrators (scores of 143–148 vs. 157), and the scores of concentrators in eight areas (agriculture; business finance; communications and design; computer and information science; construction and architecture; consumer services; engineering technology; and public services) were not measurably different from the scores of nonconcentrators (scores of 147–162) (table 2).[11]

Types and Levels of Science Coursework

The analysis presented above describes the NAEP science scores for students who earned similar numbers of core science credits. However, the observed relationships between science coursetaking and science achievement may be related to the type, level, and quality, not just the amount, of core science coursework taken by concentrators (Plank 2001; Levesque 2003b; Silverberg et al. 2004). Tables 3 and 4 show how the types and levels of courses taken differ for concentrators and nonconcentrators. This section examines these differences for selected groups of concentrators to illustrate different patterns in the relationship between science coursetaking and achievement among concentrators in different program areas compared with nonconcentrators.

Table 3. Average credits earned by public high school graduates in each core science course, by occupational concentrator status and program area: 2005

Concentrator status and program area	Biology	Chemistry	Physics
Total, all graduates	**1.3**	**0.8**	**0.4**
Concentrator status[1]	1.4	0.8	0.4
Nonconcentrators	1.2*	0.6*	0.3*
Concentrators, total	1.1*	0.6*	0.2*
Agriculture	1.3	0.8	0.4
Business finance	1.3	0.7*	0.3*
Business support and management	1.3	0.7*	0.3
Communications and design	1.2*	0.9	0.5*
Computer and information science	1.0*	0.4*	0.2*
Construction and architecture	1.2*	0.5*	0.2*
Consumer services	1.1*	0.5*	0.2*
Culinary arts	1.2*	0.7*	0.5*
Engineering technology	1.5	0.7*	0.3*
Health science	1.1*	0.4*	0.2*
Manufacturing, repair, and transportation	1.2*	0.7*	0.3*
Marketing	1.2	0.7*	0.3
Public services	1.4		3.8

* Concentrators earned a measurably different number of credits than nonconcentrators in the same column (using unrounded numbers), $p < .05$.
[1] Concentrators earned 2.0 or more credits in the program area indicated. The total concentrator row includes graduates who earned 2.0 or more credits in any of the 13 program areas listed; the nonconcentrator row includes graduates who did not concentrate in any program area.
Standard errors can be found in appendix B.
SOURCE: U.S. Department of Education, National Center for Education Statistics, 2005 High School Transcript Study (HSTS) and National Assessment of Educational Progress (NAEP) 2005 12th-grade Science Assessment.

[9] Only in the highest category (more than 3.00 credits) did nonconcentrators earn more average core science credits than concentrators (4.2 vs. 4.0 average credits). There was no measurable difference in the average core science credits earned by concentrators and nonconcentrators in the first three core science credit ranges (appendix table S1).

[10] Too few business finance concentrators earned 0.00–1.00 core science credits to permit a comparison of these concentrators with nonconcentrators.

[11] Too few culinary arts concentrators earned 2.01–3.00 core science credits to permit a comparison of these concentrators with nonconcentrators.

Table 4. Average credits earned by public high school graduates in core science courses at each level of coursework, by occupational concentrator status and program area: 2005

Concentrator status and program area	Level of coursework: Advanced or AP	Regular	Basic	Specialized
Total, all graduates	**0.4**	**1.5**	**0.3**	**0.3**
Concentrator status[1]				
Nonconcentrators	0.5	1.5	0.3	0.3
Concentrators, total	0.3*	1.3*	0.3	0.2*
Agriculture	0.3*	1.1*	0.3	0.2*
Business finance	0.5	1.5	0.3	0.2
Business support and management	0.3*	1.4*	0.3	0.3
Communications and design	0.4	1.5	0.3	0.2
Computer and information science	0.6	1.6	0.3	0.2*
Construction and architecture	0.1*	1.1*	0.3	0.1*
Consumer services	0.2*	1.2*	0.3	0.2
Culinary arts	0.2*	1.0*	0.4	0.2
Engineering technology	0.4	1.5	0.3	0.2
Health science	0.5	1.3*	0.3	0.4*
Manufacturing, repair, and transportation	0.1*	1.1*	0.3	0.2*
Marketing	0.2*	1.4	0.3	0.2
Public services	0.3*	1.4	0.3	0.2

* Concentrators earned a measurably different number of credits than nonconcentrators in the same column (using unrounded estimates), $p < .05$.
[1] Concentrators earned 2.0 or more credits in the program area indicated. The total concentrator row includes graduates who earned 2.0 or more credits in any of the 13 program areas listed; the nonconcentrator row includes graduates who did not concentrate in any program area.
NOTE: Core science includes biology, chemistry, and physics. "Basic" includes remedial or below-grade level courses in biology, chemistry, and physics. "Advanced or AP" level courses include locally defined honors courses, as well as the College Board's Advanced Placement (AP) courses and International Baccalaureate (IB) courses in the relevant subjects. "Regular" courses are non-basic, non-advanced, grade-level courses. Specialized core science courses include biochemistry, anatomy and physiology, organic chemistry, and astronomy, among others. Standard errors can be found in appendix B.
SOURCE: U.S. Department of Education, National Center for Education Statistics, 2005 High School Transcript Study (HSTS) and National Assessment of Educational Progress (NAEP) 2005 12th-grade Science Assessment.

The types of coursework examined in table 3 include biology, chemistry, and physics. In each of these subjects, the following levels of coursework are possible, as summarized in table 4: "Basic" includes remedial or below-grade level courses in biology, chemistry, and physics. "Advanced or AP" level courses include locally defined honors courses, as well as the College Board's Advanced Placement (AP) courses and International Baccalaureate (IB) courses in the relevant subjects. "Regular" courses are non-basic, non-advanced, grade-level courses. Specialized courses include biochemistry, anatomy and physiology, organic chemistry, and astronomy, among others.[12]

As seen in table 2, engineering technology concentrators scored higher than or not measurably different from nonconcentrators on the NAEP science test, when taking into account the amount of core science coursework completed. Table 3 shows they also took different core science courses. Engineering technology concentrators on average earned more credits in physics than nonconcentrators (0.5 vs. 0.4 credits), but earned fewer credits in biology (1.2 vs. 1.4 credits) and chemistry (0.7 vs. 0.8 credits) than nonconcentrators.

In contrast, health science concentrators generally scored lower than or not measurably different from nonconcentrators who earned similar numbers of core science credits (table 2). Although there was no measurable difference in the average number of biology credits that health science concentrators and nonconcentrators earned, health science concentrators earned fewer chemistry and physics credits than nonconcentrators (0.7 vs. 0.8 credits and 0.3 vs. 0.4 credits, respectively) (table 3). Moreover, while there was no measurable difference between health science concentrators and nonconcentrators in the average number of core science credits they earned at the advanced or AP level (0.5 credits each) and at the basic level (0.3 credits each), health science concentrators earned fewer credits in regular core science courses (1.3 vs. 1.5 credits) and more credits in specialized core science courses (0.4 vs. 0.3 credits) than nonconcentrators (table 4).

As seen in table 2, agriculture concentrators scored higher than or not measurably different from nonconcentrators, when taking into account the number of core science credits earned. However, agriculture concentrators earned fewer credits than nonconcentrators in each core science subject (table 3), and in advanced or AP level core science courses (0.3 vs. 0.5 credits), regular core science courses (1.1 vs. 1.5 credits), and specialized core science courses (0.2 vs. 0.3 credits) (table 4). In addition, there was no measurable difference in the core science credits earned

[12] Course-level classifications—basic, regular, advanced or AP, and specialized—were made when students' transcripts were coded into the HSTS data file. See Bradby and Hoachlander (1999) for a detailed description of the courses included in the categories in tables 3 and 4.

by agriculture concentrators and nonconcentrators at the basic level (0.3 credits each) (table 4).

Summary

Among the public high school graduating class of 2005, occupational concentrators overall earned, on average, fewer credits in core science subjects (biology, chemistry, and physics) and scored lower on the 12th-grade NAEP science test than nonconcentrators. Patterns varied across occupational program areas, however, with graduates who concentrated in agriculture, business finance, communications and design, computer and information science, and engineering technology scoring higher than or not measurably different from nonconcentrators.

When comparing students who earned similar numbers of core science credits, occupational concentrators generally scored higher than or not measurably different from nonconcentrators at lower credit levels (2.00 core science credits or fewer, in 22 out of 25 possible comparisons), and generally scored lower than or not measurably different from nonconcentrators at higher credit levels (more than 2.00 credits, in 19 out of 19 possible comparisons). In addition to differences in the number of science courses taken, occupational concentrators sometimes differed from nonconcentrators in terms of the types and levels of core science courses they took.

Three examples illustrate different patterns in the relationship between science coursetaking and achievement for concentrators in different program areas compared with nonconcentrators. In the first example, engineering technology concentrators scored higher than or not measurably different from nonconcentrators on the NAEP science test, when taking into account the amount of core science coursework completed, and they earned more physics credits and fewer biology and chemistry credits than nonconcentrators. In the second example, health science concentrators generally scored lower than or not measurably different from nonconcentrators who earned similar numbers of core science credits, and they earned fewer chemistry and physics credits, fewer credits in regular core science courses, and more credits in specialized core science courses than nonconcentrators. In the final example, agriculture concentrators scored higher than or not measurably different from nonconcentrators who earned similar numbers of core science credits, and they earned fewer credits in each core science subject and in advanced or AP level core science courses, regular core science courses, and specialized core science courses than nonconcentrators.

While differences in the types and levels of core science coursework taken may contribute to the observed achievement patterns, they may not fully explain those patterns. Self-selection on the part of students with different abilities, interests, and aptitudes into different types of coursework—both academic and CTE coursework—may also be a factor, as may the science content of some CTE courses.[13]

Methodology and Technical Notes

The 2005 HSTS was used in this Brief to examine occupational and academic coursetaking. The HSTS periodically collects information about courses completed and credits and grades earned during high school by 12th-graders, including those sampled for the NAEP tests. The 2005 HSTS sample was designed to yield a nationally representative sample of all students in public and private schools in the United States who were enrolled in 12th grade in 2004–05 and who graduated in 2005. NAEP is a nationally representative periodic assessment of what students know and can do in various subjects. The 2005 NAEP included mathematics and science assessments that were administered in schools from January to March 2005. Further information about the NAEP science assessment is available at http://nces.ed.gov/nationsreportcard/science/.

Further details on the methodology for the HSTS 2005 is available in Shettle et al. (2008), Shettle et al. (2007) and at http://nces.ed.gov/nationsreportcard/hsts/.

Target Population, Sampling, and Analysis Sample

The target population for this Brief is public school graduates of the class of 2005. Public school graduates are targeted because CTE is more prevalent in public than in private high schools (Levesque et al. 2008), and because the federal interest in CTE is focused on public schools. For public schools, the HSTS sample was the 12th-grade public school sample for the 2005 NAEP mathematics and science assessments; that is, the HSTS sample included every eligible sampled NAEP 2005 12th-grade public school that was contacted, whether or not the school participated in the NAEP assessments.

Within schools, only those 12th-graders who had graduated by early fall of 2005 had their transcript data included in the HSTS. Students excluded from the study included ineligibles, non-graduates, and students having incomplete transcripts (Shettle et al. 2007). For each graduate, transcript information was collected for the 9th through the 12th grade. Transcripts were collected from over 25,000 students in about 640 public schools, representing approximately 2.5 million 2005 high school graduates.

For this analysis, the sample was restricted to public high school graduates who earned regular or honors diplomas,[14] earned 16 or more total credits in high school, and earned more than zero credits in English. See Alt and Bradby (1999) for more information on these transcript criteria. After applying these selection criteria, the HSTS

[13] Previous studies have addressed the issue of selection bias as related to participation in CTE and subsequent outcomes (Agodini et al. 2004; Agodini, Uhl, and Novak 2004; Bishop and Mane 2004).

[14] Alternative completers, dropouts, and students who earned a GED were excluded from the analysis.

analysis sample included about 24,000 public high school graduates of the class of 2005. This sample was further restricted based on NAEP 12th-grade science score availability, which reduced the analytic sample to about 9,000 public high school graduates. There was no measurable difference in the proportion of occupational concentrators in the overall HSTS sample and in the NAEP-restricted analytic sample.

Over the years, studies of outcomes associated with CTE participation have used a variety of definitions of CTE participants. These include CTE "specialists" earning 4.0 or more credits in occupational fields with 2.0 or more of these credits at the advanced occupational level (Boesel et al. 1994; McCormick and Tuma 1995; Levesque 1995); various definitions of CTE "concentrators" earning 3.0 or more credits in any of 7 to 18 occupational fields (Tuma and Burns 1996; Plank 2001; Levesque et al. 2000; Levesque 2003b; Agodini, Uhl, and Novak 2004; Bae et al. 2007; Levesque et al. 2008); the proportion of credits earned in CTE and the ratio of CTE to academic credits earned (Rumberger and Daymont 1982; Plank 2001); among other coursetaking measures (Levesque 2003b; Bishop and Mane 2004). This Brief uses an occupational concentrator definition that first appeared in Hudson and Laird (2009), which requires that students earn 2.0 or more credits in an occupational program area.

Response Rates

For this analysis, which required information from both the transcript study and the NAEP assessment for each student, the weighted within-school response rate for public school graduates was 69.9 percent and the weighted public school level response rate was 81.8 percent. The combined response rate was 57.2 percent (Shettle et al. 2008).

To ensure unbiased samples, NCES has established participation rate standards for national studies that must be met in order for the results to be reported without a nonresponse bias analysis. Participation rates for the original HSTS sample needed to be at least 85 percent for both schools and graduates. Because the overall public and private response rate in the total HSTS sample fell below the NCES standard of 85 percent, a nonresponse bias analysis was conducted as part of the HSTS to determine whether the school characteristics from nonresponding schools showed significant differences from the responding schools. Among public schools, the characteristics analyzed included region, school location, grade enrollment, school minority status (high/low), and percent minority for different race groups. Significant differences were found in region, school location, and percent minority. In the NAEP science assessment, grade 12 public school student response rates fell below 85 percent. A nonresponse bias analysis showed significant differences between responding and nonresponding students in terms of gender, race/ethnicity, age, and English language learner status. For both the HSTS and NAEP samples, nonresponse weighting adjustments were used to correct for differences between respondents and nonrespondents; however, these adjustments may not completely account for the differences.

Weighting

All estimates were weighted using sample weights to provide unbiased estimates of the national population. The HSTS includes two weights: a NAEP-linked weight and an HSTS sample weight. The NAEP-linked weight, FINLNKWT, was used in this analysis, as it is designed for analyses that include NAEP assessment scores.

Occupational Program Areas

The transcripts collected for the HSTS were coded using the Classification of Secondary School Courses (Bradby and Hoachlander 1999). The coded courses were then aggregated using the 2007 revision to the Secondary School Taxonomy (Bradby and Hudson 2007), which includes 21 occupational program areas. As shown in exhibit 1, these 21 occupational program areas were further aggregated into 13 areas that were deemed relevant for an analysis of science achievement.

Statistical Procedures

Comparisons of means and proportions were tested in this Brief using Student's *t* statistic. Differences between estimates were tested against the probability of a Type I error[15] or significance level. The statistical significance of each comparison was determined by calculating the Student's *t* values for the differences between each pair of means or proportions and comparing these with published tables of significance levels for two-tailed hypothesis testing.

Student's *t* values were computed to test the difference between independent estimates with the following formula:

$$t = \frac{E_1 - E_2}{\sqrt{se_1^2 + se_2^2}} \qquad (1)$$

where E_1 and E_2 are the estimates to be compared and se_1 and se_2 are their corresponding standard errors.

There are hazards in reporting statistical tests for each comparison. First, comparisons based on large *t* statistics may appear to merit special attention. This can be misleading since the magnitude of the *t* statistic is related not only to the observed differences in means or percentages but also to the number of respondents in the specific categories used for comparison. Hence, a small difference compared across a large number of respondents would produce a large (and thus possibly statistically significant) *t* statistic.

[15] A Type I error occurs when one concludes that a difference observed in a sample reflects a true difference in the population from which the sample was drawn, when no such difference is present.

Exhibit 1. Aggregation of Secondary School Taxonomy occupational program areas into 13 areas

Secondary School Taxonomy Occupational Program Area	Aggregated Occupational Program Area
Agriculture	Agriculture
Business finance	Business finance
Business management	Business support and management
Business support	
Communications and design	Communications and design
Computer and information science	Computer and information science
Construction	Construction and architecture
Architecture	
Consumer services	Consumer services
Culinary arts	Culinary arts
Engineering technology	Engineering technology
Health science	Health science
Manufacturing	Manufacturing, repair, and transportation
Mechanics and repair	
Transportation	
Marketing	Marketing
Education	Public services
Legal services	
Library science	
Protective services	
Public administration	

SOURCE: The Secondary School Taxonomy is described in Bradby and Hudson (2007).

A second hazard in reporting statistical tests is the possibility that one can report a "false positive" or Type I error. In the case of a *t* statistic, this false positive would result when a difference measured with a particular sample showed a statistically significant difference when there is no difference in the underlying population. Statistical tests are designed to control this type of error, denoted by alpha. The alpha level of .05 selected for findings in this Brief indicates that a difference of a certain magnitude or larger would be produced no more than 1 time out of 20 when there was no actual difference between the quantities in the underlying population.[16] When analysts test hypotheses that show alpha values at the .05 level or smaller, they treat this finding as rejecting the null hypothesis that there is no difference between the two quantities. Failing to detect a difference, however, does not necessarily imply the values are the same or equivalent.

Standard Deviation of Test Scores. The NAEP science test scores range from 1 to 300. The mean science score for the sample used in this analysis was 148 with a standard deviation of 32 scale points. The standard deviation of the mean provides a measure of the dispersion of actual test score values around the mean value. In contrast, the standard error of the mean provides a measure of the precision of the estimated mean and depends on both sample design and size. Because of NAEP's complex sampling design, the standard deviation cannot be directly converted using standard formulas into the standard error for statistical testing or confidence intervals. Standard errors are provided in separate tables. All differences reported are significant at the 0.05 level. The term "significant" is not intended to imply a judgment about the absolute magnitude of the educational relevance of the differences. It is intended to identify statistically dependable population differences.

[16] Adjustments were not made for multiple comparisons.

References

Agodini, R., Deke, J., Novak, T., and Uhl, S. (2004). *Vocational Education and Postsecondary Outcomes: Eight Years After High School.* Princeton, NJ: Mathematica Policy Research, Inc.

Agodini, R., Uhl, S., and Novak, T. (2004). *Factors That Influence Participation in Secondary Vocational Education.* Princeton, NJ: Mathematica Policy Research, Inc.

Alt, M.N., and Bradby, D. (1999). *Procedures Guide for Transcript Studies.* (NCES 1999-05). National Center for Education Statistics, U.S. Department of Education. Washington, DC.

Bae, S.H., Gray, K., and Yeager, G. (2007). A Retrospective Cohort Comparison of Career and Technical Education Participants and Non-Participants on a State-Mandated Proficiency Test. *Career and Technical Education Research, 32*(1): 9–22.

Bishop, J.H., and Mane, F. (2004). The Impacts of Career-Technical Education on High School Labor Market Success. *Economics of Education Review, 23*(4): 381–402.

Boesel, D., Hudson, L., Deich, S., and Masten, C. (1994). *National Assessment of Vocational Education, Final Report to Congress. Volume II: Participation in and Quality of Vocational Education.* Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.

Bradby, D., and Hoachlander, G. (1999). *The 1998 Revision of the Secondary School Taxonomy* (NCES Working Paper No. 1999-06). National Center for Education Statistics, U.S. Department of Education. Washington, DC.

Bradby, D., and Hudson, L. (2007). *The 2007 Revision of the Career—Technical Education Portion of the Secondary School Taxonomy* (NCES 2008-030). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Hudson, L., and Laird, J. (2009). *New Indicators of High School Career/Technical Education Coursetaking: Class of 2005* (NCES 2009-038). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Levesque, K., Premo, M., Vergun, R., Emanuel, D., Klein, S., Henke, R., and Kagehiro, S. (1995). *Vocational Education in the United States: The Early 1990s* (NCES 95-024). National Center for Education Statistics, U.S. Department of Education. Washington, DC.

Levesque, K., Lauen, D., Teitelbaum, P., Alt, M., and Librera, S. (2000). *Vocational Education in the United States: Toward the Year 2000* (NCES 2000-029). National Center for Education Statistics, U.S. Department of Education. Washington, DC.

Levesque, K. (2003a). *Public High School Graduates Who Participated in Vocational/Technical Education: 1982–1998* (NCES 2003-024). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Levesque, K. (2003b). *Trends in High School Vocational/ Technical Coursetaking: 1982–1998* (NCES 2003-025). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Levesque, K., Laird, J., Hensley, E., Choy, S.P., Cataldi, E.F., and Hudson, L. (2008). *Career/Technical Education in the United States: 1990 to 2005* (NCES 2008-035). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

McCormick, A.C., and Tuma, J. (1995). *Vocational Course Taking and Achievement: An Analysis of High School Transcripts and 1990 NAEP Assessment Scores* (NCES 95-006). National Center for Education Statistics, U.S. Department of Education. Washington, DC.

National Assessment of Educational Progress. (2006). *The Nation's Report Card: Science 2005* (NCES 2006-466). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Plank, S. (2001). *Career and Technical Education in the Balance: An Analysis of High School Persistence, Academic Achievement, and Postsecondary Destinations.* Columbus, OH: National Dissemination Center for Career and Technical Education, Ohio State University.

Rasinski, K.A., and Pedlow, S. (1994). Using Transcripts to Study the Effectiveness of Vocational Education. *Journal of Vocational Education Research, 19*(3): 23–43.

Rumberger, R.W., and Daymont, T.N. (1982). The Impact of High School Curriculum on the Earnings and Employability of Youth. In R.E. Taylor, H. Rosen, and F.C. Pratzner (Eds.), *Job Training for Youth.* Columbus, OH: National Center for Research in Vocational Education, Ohio State University.

Shettle, C., Roey, S., Mordica, J., Perkins, R., Nord, C., Teodorovic, J., Lyons, M., Averett, C., Kastberg, D., and Brown, J. (2007). *America's High School Graduates: Results From the 2005 NAEP High School Transcript Study* (NCES 2007-467). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, Washington, DC.

Shettle, C., Cubell, M., Hoover, K., Kastberg, D., Legum, S., Lyons, M., Perkins, R., Rizzo, L., Roey, S., and Sickles, D. (2008). *The 2005 High School Transcript Study User's Guide and Technical Report* (NCES 2009-480). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Silverberg, M., Warner, E., Fong, M., and Goodwin, D. (2004). *National Assessment of Vocational Education: Final Report to Congress*. Office of the Under Secretary, Policy and Program Studies Service, U.S. Department of Education. Washington, DC.

Stone, J.R., Alfeld, C., Pearson, D., Lewis, M.V., and Jensen, S. (2006). *Building Academic Skills in Context: Testing the Value of Enhanced Math Learning in CTE*. Columbus, OH: National Dissemination Center for Career and Technical Education, Ohio State University.

Tuma, J., and Burns, S. (1996). *Trends in Participation in Secondary Vocational Education: 1982–1992* (NCES 96-004). National Center for Education Statistics, U.S. Department of Education. Washington, DC.

U.S. Department of Education (2007). *Carl D. Perkins Vocational and Technical Education Act of 1998, Report to Congress on State Performance, Program Year 2004–05*. Office of Vocational and Adult Education, Washington, DC.

U.S. Department of Education, National Center for Education Statistics. *High School Transcript Studies (HSTS), CSSC Courses/Course Codes*. Retrieved January 21, 2010, from http://nces.ed.gov/surveys/hst/courses.asp.

For more information on the National Assessment of Educational Progress High School Transcript Studies (HSTS), visit http://nces.ed.gov/nationsreportcard/hsts. To order additional copies of this Statistics in Brief or other NCES publications, call 1-877-4ED-PUBS or visit http://www.edpubs.org. NCES publications are also available on the Internet at http://nces.ed.gov.

Appendix A. Supplemental Table

Table S1. Average credits earned in core science courses among public high school graduates who were within each range of core science credits, by occupational concentrator status and program area: 2005

Concentrator status and program area	Average core science credits earned, by credit range: Up to 1.00 credit	1.01 to 2.00 credits	2.01 to 3.00 credits	More than 3.00 credits
Concentrator status[1]				
Nonconcentrators	0.8	1.9	2.9	4.2
Concentrators, total	0.8	1.9	2.9	4.0*
Agriculture	0.8	2.0	2.9	4.1*
Business finance	0.9	1.9	2.9	3.9*
Business support and management	0.9	2.0	2.9*	4.0*
Communications and design	0.9	2.0*	2.9	4.0*
Computer and information science	0.9	2.0	2.9*	4.2
Construction and architecture	0.7*	1.9*	2.8	3.8
Consumer services	0.8	1.9	2.9	3.8*
Culinary arts	0.8	1.9	2.9	4.1
Engineering technology	0.9*	1.9	3.0*	4.1
Health science	0.9	2.0*	2.9*	4.2
Manufacturing, repair, and transportation	0.8	1.9	2.8*	3.8*
Marketing	0.8	2.0	2.9	4.0*
Public services	0.7	2.0	3.0	4.1

* Concentrators earned a measurably different number of credits than nonconcentrators in the same column (using unrounded estimates), $p < .05$.
[1] Concentrators earned 2.0 or more credits in the program area indicated. The total concentrator row includes graduates who earned 2.0 or more credits in any of the 13 program areas listed; the nonconcentrator row includes graduates who did not concentrate in any program area.
NOTE: Core science includes biology, chemistry, and physics. Standard errors can be found in table B-S1.
SOURCE: U.S. Department of Education, National Center for Education Statistics, 2005 High School Transcript Study (HSTS) and National Assessment of Educational Progress (NAEP) 2005 12th-grade Science Assessment.

Appendix B. Standard Error Tables

Table B-1. Standard errors for Table 1: Percentage of public high school graduates and of concentrators in each occupational program area in high school: 2005

Program area	Percent of all graduates	Percent of concentrators
Concentrators, total	**0.87**	**†**
Agriculture	0.37	0.95
Business finance	0.19	0.47
Business support and management	0.43	1.11
Communications and design	0.34	0.82
Computer and information science	0.33	0.86
Construction and architecture	0.17	0.43
Consumer services	0.21	0.53
Culinary arts	0.20	0.51
Engineering technology	0.23	0.58
Health science	0.24	0.58
Manufacturing, repair, and transportation	0.38	0.93
Marketing	0.25	0.62
Public services	0.26	0.70

† Not applicable.
SOURCE: U.S. Department of Education, National Center for Education Statistics, 2005 High School Transcript Study (HSTS) and National Assessment of Educational Progress (NAEP) 2005 12th-grade science assessment.

Table B-2. Standard errors for Table 2: For public high school graduates, average credits earned in core science courses, average 12th-grade NAEP science scale score, and average 12th-grade NAEP science scale score of graduates who were within each range of core science credits, by occupational concentrator status and program area: 2005

Concentrator status and program area	Credits earned in core science courses	NAEP science score, overall	NAEP science score, by core science credit range: 0.00 to 1.00 credit	1.01 to 2.00 credits	2.01 to 3.00 credits	More than 3.00 credits
Total, all graduates	**0.03**	**0.7**	**1.2**	**0.9**	**1.0**	**1.2**
Concentrator status						
Nonconcentrators	0.03	0.9	1.7	1.2	1.2	1.2
Concentrators, total	0.03	0.9	1.4	1.1	1.4	2.1*
Agriculture	0.06	1.9	2.5	2.5	3.6	6.1
Business finance	0.14	3.4	‡	5.1	5.3	‡
Business support and management	0.06	1.7	3.0	2.7	3.3	5.4*
Communications and design	0.06	1.6	3.6	2.2	2.4	4.0*
Computer and information science	0.12	1.9	4.4	3.1	3.3	4.9
Construction and architecture	0.09	2.7	3.8	4.1	5.8	‡
Consumer services	0.08	2.7	3.5	3.6	6.0	‡
Culinary arts	0.09	4.0	5.5	3.3	‡	‡
Engineering technology	0.09	2.6	5.2	4.6	3.8	5.1
Health science	0.07	2.1	3.5	3.3	2.8	3.6*
Manufacturing, repair, and transportation	0.06	1.7	2.3	2.5	3.8	6.9
Marketing	0.06	2.5	5.2	3.8	4.2	‡
Public services	0.20	2.7	5.4	3.8	5.7	‡

‡ Reporting standards not met.
SOURCE: U.S. Department of Education, National Center for Education Statistics, 2005 High School Transcript Study (HSTS) and National Assessment of Educational Progress (NAEP) 2005 12th-grade Science Assessment.

Table B-3. Standard errors for Table 3: Average credits earned by public high school graduates in each core science course, by occupational concentrator status and program area: 2005

Concentrator status and program area	Biology	Chemistry	Physics
Total, all graduates	**0.02**	**0.01**	**0.01**
Concentrator status			
Nonconcentrators	0.02	0.02	0.02
Concentrators, total	0.02	0.02	0.02
Agriculture	0.04	0.04	0.03
Business finance	0.08	0.06	0.06
Business support and management	0.04	0.04	0.03
Communications and design	0.04	0.03	0.03
Computer and information science	0.04	0.06	0.06
Construction and architecture	0.05	0.04	0.03
Consumer services	0.05	0.04	0.03
Culinary arts	0.07	0.05	0.06
Engineering technology	0.04	0.05	0.05
Health science	0.05	0.04	0.03
Manufacturing, repair, and transportation	0.03	0.03	0.02
Marketing	0.04	0.04	0.03
Public services	0.09	0.09	0.10

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2005 High School Transcript Study (HSTS) and National Assessment of Educational Progress (NAEP) 2005 12th-grade Science Assessment.

Table B-4. Standard errors for Table 4: Average credits earned by public high school graduates in core science courses at each level of coursework, by occupational concentrator status and program area: 2005

	Level of coursework			
Concentrator status and program area	Advanced or AP	Regular	Basic	Specialized
Total, all graduates	**0.02**	**0.03**	**0.02**	**0.01**
Concentrator status				
Nonconcentrators	0.02	0.03	0.02	0.01
Concentrators, total	0.02	0.03	0.02	0.01
Agriculture	0.04	0.06	0.04	0.03
Business finance	0.09	0.11	0.06	0.05
Business support and management	0.03	0.05	0.04	0.03
Communications and design	0.04	0.06	0.04	0.03
Computer and information science	0.12	0.08	0.05	0.03
Construction and architecture	0.02	0.08	0.05	0.03
Consumer services	0.03	0.07	0.06	0.04
Culinary arts	0.04	0.10	0.09	0.05
Engineering technology	0.07	0.08	0.05	0.04
Health science	0.04	0.06	0.05	0.04
Manufacturing, repair, and transportation	0.02	0.04	0.03	0.02
Marketing	0.03	0.08	0.06	0.03
Public services	0.06	0.21	0.07	0.06

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2005 High School Transcript Study (HSTS) and National Assessment of Educational Progress (NAEP) 2005 12th-grade Science Assessment.

Table B-S1. Standard errors for Table S1: Average credits earned in core science courses among public high school graduates who were within each range of core science credits, by occupational concentrator status and program area: 2005

Concentrator status and program area	Average core science credits earned, by credit range			
	Up to 1.00 credit	1.01 to 2.00 credits	2.01 to 3.00 credits	More than 3.00 credits
Concentrator status				
Nonconcentrators	0.02	0.01	0.01	0.03
Concentrators, total	0.02	0.01	0.01	0.04
Agriculture	0.04	0.01	0.02	0.05
Business finance	0.06	0.03	0.03	0.12
Business support and management	0.04	0.01	0.01	0.10
Communications and design	0.04	0.01	0.02	0.06
Computer and information science	0.06	0.01	0.02	0.15
Construction and architecture	0.05	0.03	0.07	0.23
Consumer services	0.05	0.03	0.03	0.16
Culinary arts	0.07	0.03	0.04	0.12
Engineering technology	0.04	0.04	0.02	0.13
Health science	0.04	0.01	0.01	0.13
Manufacturing, repair, and transportation	0.02	0.02	0.04	0.05
Marketing	0.07	0.03	0.04	0.09
Public services	0.16	0.02	0.04	0.10

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2005 High School Transcript Study (HSTS) and National Assessment of Educational Progress (NAEP) 2005 12th-grade Science Assessment.

www.ed.gov

ies.ed.gov