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The Influence of High School Academics on Freshman College Mathematics and Science Courses at SUNY Oswego

Tolga Hayali
Seton Hall University

THE INFLUENCE OF HIGH SCHOOL ACADEMICS ON FRESHMAN COLLEGE MATHEMATICS AND SCIENCE COURSES AT SUNY OSWEGO.

TOLGA HAYALI

Dissertation Committee

Gerard Babo, Ed.D., Mentor
James Caufield, Ed.D.
Yildiray Yildirim, Ph.D.
Fehmi Damkaci, Ph.D.

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APPROVAL FOR SUCCESSFUL DEFENSE

Doctoral Candidate, **Tolga Hayali,** has successfully defended and made the required modifications to the text of the doctoral dissertation for the **Ed.D.** during this **Summer Semester 2013.**

DISSERTATION COMMITTEE
(please sign and date beside your name)

Mentor:
Dr. Gerard Babo

Committee Member:
Dr. James Caulfield

Committee Member:
Dr. Yildiray Yildirim

Committee Member:
Dr. Fehmi Damkaci

The mentor and any other committee members who wish to review revisions will sign and date this document only when revisions have been completed. Please return this form to the Office of Graduate Studies, where it will be placed in the candidate's file and submit a copy with your final dissertation to be bound as page number two.

ABSTRACT

THE INFLUENCE OF HIGH SCHOOL ACADEMICS ON FRESHMAN COLLEGE MATHEMATICS AND SCIENCE COURSES AT SUNY OSWEGO

This study examined the relationship between 2011 freshman college mathematics and science grades and freshman students' high school academics and demographic data, exploring the factors that contribute to the success of first-year STEM majoring freshman students at State University of New York at Oswego. The variables were Gender, Race, SES, School Size, Parent with College Education, High School Grade Point Average (HSGPA), Transfer Credit, SAT Composite Score, and New York State Regents Exam results, based on data from 237 freshman students entering college immediately following high school. The findings show HSGPA as a significant predictor of success in freshman College Mathematics and Sciences, Transfer Credit as a significant predictor in College Mathematics and College Chemistry, SES as a significant predictor in College Biology and College Chemistry, Parent with College Education as a significant predictor in College Biology and New York State Chemistry Regents Exam as a significant predictor in College Chemistry. Based on these findings, guidance counselors, science educators, and education institutions can develop a framework to determine which measurements are meaningful and advise students to focus on excellent performance in the Chemistry Regents Exams, take more college courses during high school, and maintain a high grade point average.

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INTRODUCTION

Background

Over the course of U.S. history, when Americans repeatedly turned to secondary education to solve profound economic, social, and political problems, they differed in their diagnoses and solutions. Opinions differed regarding what should be taught to all high school graduates, based on educators' and policymakers' beliefs (Tyack & Cuban, 1995). A postsecondary degree is viewed as the most feasible method for addressing Americans' problems and achieving the American dream. Today's American high school students have higher educational aspirations than ever before, with around 80% now expecting to participate in some form of postsecondary education (Allensworth, 2006; United States Department of Education, 2002). These high aspirations are shared across different race-ethnic groups and across income strata (Nagaoka et al., 2009). College education has become a panacea for economic, social, and political problems for American immigrants and student visa holders alike.

While 80% of high school students aspire to complete college, statistics pertaining to this goal are a cause for dismay. Many researchers have found a lack of young Americans participating in higher education and obtaining degrees. In the United States, the young adult age group (25-34) now ranks just seventh in the world in the rate of college degrees (Lee & Rawls, 2010). Developments in science and technology, and especially in computer fields, have changed the required skill sets employers need from college graduates. Employers' requirements for higher technological skill levels exacerbate the problem of having fewer qualified candidates. Friedman (2005) indicated

that "with each advance in technology and increase in the complexity of services, you need an even higher level of skills to do the new jobs" (p. 290). A student who is ill equipped to enter college is now perceived as ill equipped to enter any desirable job in the work force.

In today's rapidly changing job market, a college education is essential not only to remain competitive but, in many cases, to acquire a job at all. According to a U.S. government job prospects analysis released in 2004, while more jobs are available for people with only a high school diploma than those with a college diploma (an estimated 42 million jobs), the median income is below the national average of $27,000, with most of these jobs paying below $20,000 annually (Crosby & Moncarz, 2004). A study released in June 2012 by Rutgers researchers Horn et al. supports this predictive analysis. Horn found that in cohorts graduating from high school between 2006 and 2011, three in ten high school graduates acquired full time employment, whereas nearly six in ten college graduates succeeded in doing so.

The educational downturn, and the need to reverse this trend, is evident at the highest levels of government. As President Obama recently noted, in a global economy where the most valuable skill you can sell is your knowledge, a good education is no longer just a pathway to opportunity; it is a prerequisite (Obama, 2009). For generations, the American economy created large numbers of low-skill jobs that required no college education. However, because of technological innovations and globalization, these jobs are rapidly disappearing, and graduation from high school is no longer a sufficient qualification for most jobs (Allensworth, 2006). The percentage of the workforce requiring some college or above grew from 29% in 1973 to 59% in 2007. Furthermore,

by 2018, the requirement for college education is expected to reach 62% (Carnevale et al., 2010). Consequently, in order to meet the needs of a global economy that demands an increasingly well-trained workforce to fill jobs that are more complex than jobs in the past, it is crucial that a greater percentage of the U.S. college-age population be enrolled and retained in the postsecondary education system. However, while the need for a college education appears clear, the pathway to address this need is not.

The result of this lack of clarity is that many students will fall short in making their comprehension of the need for a college education a reality in their own educational outcomes. While there is great aspiration towards postsecondary education, many problems arise in fulfilling these aspirations. Students who pursue a college education have to start with good academic preparation, select the appropriate college, find financial assistance through scholarships and grants, and work to complete the degree (Green, 2006).

The research of Symonds et al. (2011) reports that the passport to the American dream in the 21st century is education beyond high school. Therefore, the journey begins with enrolling in a postsecondary education program. However, even though there is an increase in college enrollment, in 2010, for every 100 students enrolled in college, only 73 returned for a second year, and only half graduated within five years (ACT, 2010). For four-year institutions, the national five-year graduation rate has remained relatively stable over the past 20 years, with overall graduation rates of 52.3 % in 2010 (ACT, Inc., 2010). It can be seen that entering college does not necessarily equate to successfully graduating from college (The National Center for Public Policy and Higher Education, 2010), which

means that seeking the relationships between secondary school factors and persisting in college is critical.

Research also reveals that college eligibility is not the same as college readiness. "College ready" is not a term that is associated only with students' ability to enter college; it includes successfully continuing in and graduating from the college. Conley's (2007) research on high school courses has determined that the nature and quality of the courses students complete do not include qualities that will help students succeed in college. The job market demands and emphasizes teamwork and collaboration and developing problem-solving skills rather than memorization of facts (Smith et al., 2004). Federal statistics show that one remedial course is needed by approximately 40% of admitted students, and remediation is one of the key indicators that a student will not graduate (Conley, 2007). Thus, high schools have a strong duty to make sure their students are ready for college by providing rigorous college preparatory courses.

In this regard, the buzz phrase "college readiness for all students" has recently gripped both federal and state policymakers (Conley, 2010; Paulson, 2010). The firm grip of this concept is readily apparent in the adoption of nearly all-encompassing national standards for English and mathematics for k-12 students. The Common Core State Standards, adopted by 45 states and 3 American provinces as of July 2012, are formulated around this concept of college readiness, which has been defined as "the knowledge and skills students need to succeed in an entry-level college course from a post-secondary institution that offers a baccalaureate degree or transfers to a baccalaureate program without remediation" (Achieve, 2009; Conley, 2007). Over the past three decades, many colleges throughout the United States offered non-credit bearing

courses to students wishing to begin their baccalaureate without the proper preparedness. David Conley (2007), founder of the Educational Policy Improvement Center (EPIC), defines college success as "completing the entry-level course with a level of proficiency and understanding, which enables the student to move to the next level in the course sequence" (p. 5).

The idea that high schools should prepare their students to be ready for college is by no means new. What is new is the notion that all students should be prepared to be capable of pursuing formal learning opportunities beyond high school (Conley, 2010). School administrators and teachers alike are given this fantastic goal; and educational think tanks, charter schools, magnet schools, and leaders within the field are scrambling to present viable pathways and solutions. Given the vast array of students' challenges, there is no one-size-fits-all answer to college readiness expectations.

As Conley (2010) indicates, not only should postsecondary education at a two- or four-year postsecondary program of study be available to all students, but students should also be equipped to succeed in such a program if they make the decision to apply. A student who picks the college option in his or her senior year may be severely limited by his or her lack of effort and dedication to education from preschool onward. It appears, however, that the decision to go to college must be made at an earlier and earlier age, by both the student and his or her parents. Nowadays, college preparation does not even start in middle school, but at the elementary level. Many middle-class families' expectations for their children concerning college-going culture start in kindergarten and continue through college. Since one or both parents often have a college degree, they have the knowledge of how to be involved and what opportunities exist within college; even being

able to obtain the information gives them an upper hand in terms of preparing and guiding their children towards college. Cynthia G. Wagner reported from the University of Wisconsin–Madison that their Pre-College Enrichment Opportunity Program for Learning Excellence (PEOPLE), launched in 1999, has seen 92% of its participants enroll in college. Though initially designed for high schoolers, the program soon expanded to middle-school students and, in fall 2005, to students as early as second grade.

The report released by the Institute for Higher Education Policy (2007), *From Aspirations to Actions*, indicated that parents can play an important role in helping their child while he or she is studying in middle school to prepare for college. Yet this report has indicated that most parents lack knowledge and information about scholarships, grants, and taking the steps to prepare to send their children to college.

Weaknesses in college preparation are measured in other ways as well. Readiness can be determined by the strength with which a student starts a degree program and the time it takes him or her to finish it (i.e., 4 years). Freshman year retention is widely viewed as being of particular importance. Research on the retention of college students has demonstrated that the highest risk of dropping out of college occurs during the freshman year for a wide variety of reasons, including a lack of academic preparation leading to an inability to succeed in college level courses, a lack of focus on the academic aspects of college, or a lack of funding to continue college (Astin 1993; Lee and Rawls 2010; Schneider 2010; Tinto 1987). To combat this trend, there are college programs in place such as On Point (Syracuse) that serves inner city Syracuse area youth by opening doors to higher education, helps to overcome the barriers that hinder potential students from entering college; and provides support that empowers them to succeed (Donohue,

2012). On Point accomplishes all of the above by encouraging them, pointing them towards services they need, or assisting them in completing financial information (Donohue, 2012). Research indicates that students who succeed during their first year of college are less likely to drop out during their second year, and the likelihood of dropping out declines sharply with each successive year of attendance. Aughinbaugh (2008) reported that of those who complete their first year of college at either a two- or four-year institutions, at least 60% go on to complete their degree. Fogg (2010) points out that the need to focus on retention is becoming more important as college enrollment increases. Therefore, it is vital that policymakers and educators understand the influence of high school (pre-college) academic and social factors to predict students' success and persistence in college in order to implement policies and practices to prepare students to succeed.

Since the mid-1990s, colleges are recognizing and taking steps to rectify the disproportionate number of socioeconomically disadvantaged students who are not able to persist in completing a college degree through a series of special programs and interventions, which includes addressing the transition from high school to college (Engstrom & Tinto, 2008; Green, 2006).

Academic and social transition and support are provided by colleges and universities to incoming freshman through programs such as Upward Bound, Upward Bound Math/Science Program, Talent Search, Educational Opportunity Centers, Student Support Services, the Ronald E. McNair Post Baccalaureate Achievement Program, and the Staff and Leadership Training Authority (Maggio, White, Molstad & Kher, 2005).

The need for bridge programs to help at-risk college freshmen is evident. Low-income and minority populations are making up greater percentages of incoming freshman classes each year, necessitating that colleges address the growing need to see these students through to the completion of their degrees (Seidman, 2005). A large gap still exists, however, between middle and upper income students who complete a bachelor's degree at a rate of 56%, while low-income students are averaging a 26% graduation rate (Engstrom & Tinto, 2008).

Statistics indicate that there is a higher attrition rate for minority and low-income students, and these rates have far-reaching ramifications for American society, ranging from increased welfare and subsidies to a vast underutilization of the country's citizenry.

One such model bridge program is underway at the University of Texas at El Paso. Through the successful implementation of its bridge program, this university raised its graduation rates in STEM disciplines by nearly 50% and more than doubled the number of STEM baccalaureate degrees awarded to Hispanics. The program's success makes the university the largest producer of Mexican-American STEM graduates in the country. Its bridge programs included building a community of support for STEM students, increasing students' research opportunities, and re-evaluating teaching practices (Gates & Mirkin, 2012).

Bridge programs are part of the equation that must be addressed to meet the U.S. STEM graduate need. A report issued by the President's Council of Advisors on Science and Technology (2012), concluded that if the United States is to maintain its historic pre-eminence in the STEM fields--science, technology, engineering, and mathematic--and gain the social, economic, and national security benefits that come with such pre-

eminence, it must produce approximately one million more workers in these fields over the next decade than it is now on track to turn out.

Renick (2006) identified some of the factors contributing to the challenge of producing one million additional STEM program graduates:

• Almost all high school sophomores report having college ambitions, but only about half (51 %) indicate being enrolled in a college preparatory program. Too many students arrive on campus without the prerequisite skills, which results in not graduating from any postsecondary institution (p. 22).

• Even though students might have the academic capability to study and most probably graduate, the lack of clear information and guidance about college choice and financial assistance prevents them to pursue a college education (p. 22).

• Many families with a low income have too many difficulties with their financial resources to consider having their children apply to college. Additionally, when low-income students are in college already, they have difficulty graduating. Renick (2006) shares that attending colleges has started to be less affordable to middle-income Americans, and research indicates that as many as 4 million qualified high school graduates will not be able to afford to attend college over the next decade (p. 22).

• 40 % of the total student population is nontraditional students who work full time, have dependents, and are single parents. Many of these nontraditional students face difficulties with re-entry, scheduling, and a rarity of degree programs that can fit their career needs (p. 22).

Statement of the Problem

To assess its educational policy and the relative ranking of its student achievement on an international assessment in comparison with peer nations, the U.S. participates in and analyzes test results from the *Programme for International Student Assessment* (PISA), which measures 15-year-olds' capability to read literature and to apply scientific and mathematical concepts and skills. The 2006 PISA results show the average combined science literacy scale score for U.S. students to be lower than the average calculated by the Organization for Economic Co-Operation and Development (OECD) (NSTA, 2009). Based on the executive summary of the OECD (2010) PISA 2009 results, the mathematics scale score for U.S. students was lower than the OECD average, while the science scale score was the same. These results dismay the American policymakers who backed the No Child Left Behind and other educational endeavors as measures that would diminish educational performance gaps and reestablish educational leadership.

As the January 2011 NAEP science results showed, fewer than half of all students are proficient in science. Stephen Pruitt, Vice President for Content, Research, and Development at Achieve (2011), indicated that today's statistics on large, urban school districts paint an even grimmer picture of the inequitable distribution of quality science education across the country.

After the Sputnik challenge, there was a great effort to improve school laboratories, revise curricula, and institute college and university scholarships for students majoring in the sciences. The generation of scientists and engineers that was produced during that time has now entered their retirement years. "These individuals are

not being replaced as needed if an economy like that of the United States is to remain at the head of the pack" (Friedman, 2005, p. 256).

Today, the policymakers must look for new initiatives to motivate American students, since a Sputnik-like threat is not inspiring the new American generation to pursue an education in STEM fields. The next step is also to encourage students to graduate with a degree in a STEM field major. The persistence factors that influence the success of college students in the sciences is critical, not only because the number of students majoring in the sciences has dropped in previous years, but also because the United States is facing a shortage of scientists prepared for the twenty-first century (Council on Competitiveness, 2005).

The 2006 report of the National Academies of Science describes student interest in science as lower in the United States than in previous years and shows that the number of students deciding to major in science in college and universities across the U.S. continues to decline. In November 2011, the *Wall Street Journal* reported that American students are gravitating toward liberal arts degrees, knowing that the pay and prospects for employment are lower, and it noted that in 2011 the number of students choosing to major in information sciences decreased by 14%. Therefore, the number of college students declaring science as a major area of study or completing a science-related degree is decreasing. Based on the 2012 report of the President's Council of Advisors on Science and Technology (2012), 60 % of students who enter college with the goal of majoring in a STEM subject end up graduating in a non-STEM field.

In his *Global Achievement Gap* publication, Wagner (2008) reported that only about one third of U.S. high school seniors graduate ready for college, while

approximately forty% of all students who enter college are required to take remedial courses. He further states, "[W]hile no hard data are readily available, it is estimated that one out of every two students who start college never completes any kind of postsecondary degree" (p. xix).

Patrick Callan, president of the National Center for Educational Statistics, reported that since the early 1990s, the rate of completion of certificates and associate and baccalaureate degrees has improved only slightly. Not only are students hurting themselves by making career choices that lead to decreasing job prospects in a struggling economy, but also they are contributing to the poor economy by not preparing for leadership and entrepreneurial roles in areas that the economy needs most. President Callan claimed that low college completion rates, along with the declining rate of high school completion, deprive the United States of college-educated and trained workers needed to keep America competitive globally (National Center for Public Policy and Higher Education, 2009).

An ACT policy report, *Developing the STEM Education Pipeline* (2006), revealed that only 26% of high school graduates taking the ACT in 2005 achieved or exceeded the ACT College Readiness Benchmark in Science. According to the 2008 ACT National Profile Report, 28 percent of all 2008 graduates taking the ACT met the science benchmarks score (ACT News, 2008). In 2012, based on the ACT report, 67% of all ACT-tested high school graduates met the English College Readiness Benchmark, while only 25% met the College Readiness Benchmarks in all four subjects. In the same report, 52% of graduates met the Reading Benchmark and 46% met the Mathematics Benchmark. Just under one in three (31%) met the College Readiness Benchmark in

Science (ACT, 2012). In sum, slightly higher percentages of students met the Mathematics or Science Benchmark in 2012 than in 2007. Within a subject area, graduates who took at least a core curriculum in high school were more likely to meet the corresponding ACT College Readiness Benchmark in 2012 than graduates who took less than a core curriculum (defined as four years of English and three years each of mathematics, science, and social studies). ACT (2007) released the report *Rigor At Risk: Reaffirming Quality in the High School Core Curriculum*, showing the percentage of ACT-tested graduates in three states enrolled in remedial math during their first year of college by high school math course sequence (Figure 1).

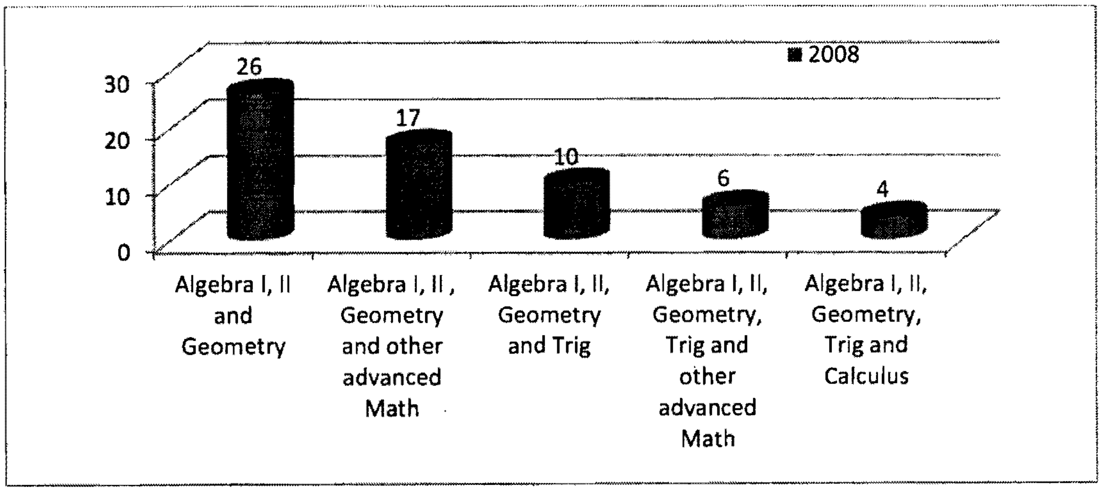

Figure 1. *Percentage of ACT-Tested Graduates in Three States Enrolled in Remedial Math During Their First Year of College by High School Math Course Sequence.*

Source: ACT.(2007) *Rigor At Risk: Reaffirming Quality in the High School Core Curriculum*

In 2010 the College Board released a report, *College-Bound Seniors Total Group Profile*, that showed the mean SAT mathematics score, by years of math taken in high school and indicated that the more the students took mathematics, including AP and honors courses, the higher the SAT mathematics mean score they receive (Figure 2).

Student admissions to colleges and universities are mainly based on students' high school grade point averages, high school class ranking, advanced placement course grades, and SAT or ACT scores. One of the major concerns among college and university faculty and administration is the readiness of incoming classes, which affects the successful completion of programs. Therefore, to combat dropout rates and increase the graduation rate, colleges have created remedial courses to support students who are not ready. However, while these courses help to prepare students for college, they do not count for credit towards graduation, which means these students have to spend more than four years to graduate. College professors who teach these remedial courses raise concerns about high school academic preparation, since this impacts the success rate for passing college-level courses, the retention of students, and the completion of student degree programs.

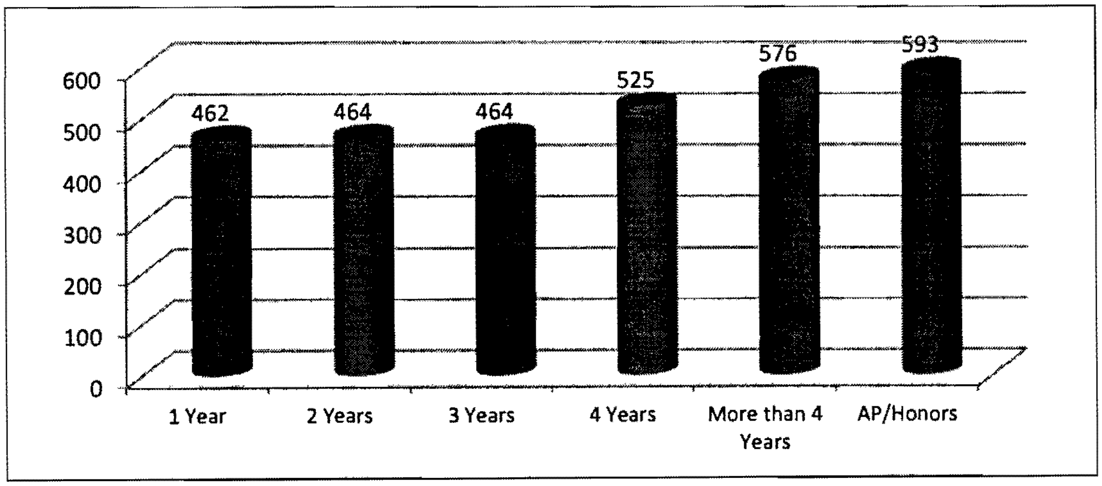

Figure 2. Mean SAT Mathematics Score by Years of Math Taken in High School. Source: *College-Bound Seniors Total Group Profile* Report, 2010

Not only are postsecondary outcomes in the United States faltering from a solely domestic standpoint, but the country is also slipping behind internationally (Symonds et

al., 2011). Between 1995 and 2007, the United States dropped from Rank 2 to Rank 14 on the OECD's international comparison of postsecondary graduation rates (OECD, 2009).

In 2011 a report released by the New York State Department of Education, Administrative Data Department, indicated that students taking remedial courses in their first year of college are less likely to persist in higher education. Figure 3 and Figure 4 show the amount of remedial work taken during the first semester of the 2007-2008 academic year at New York State universities.

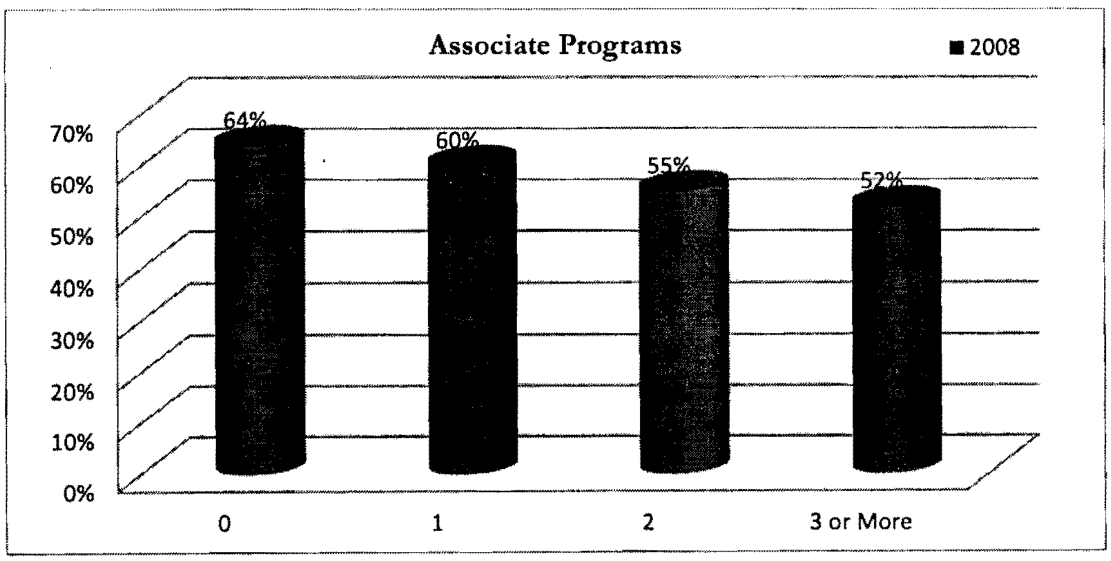

Figure 3. Amount of Remedial Work Taken during the First Semester in Associate Programs

Source: NYSED Administrative Data Department

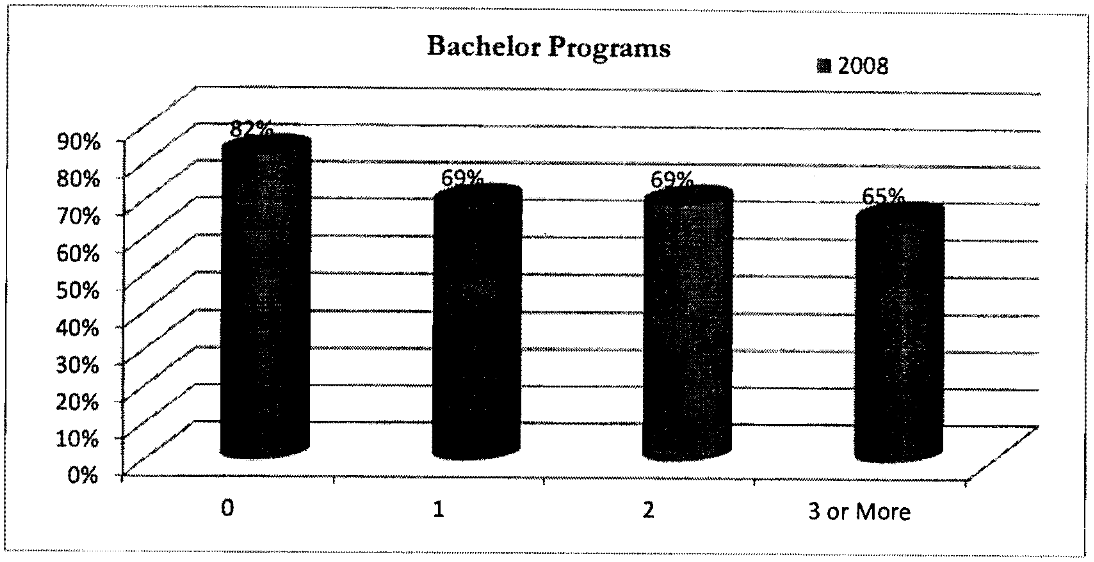

Figure 4. Amount of Remedial Work Taken during the First Semester in Bachelor Programs

Source: NYSED Administrative Data Department

The NYSED Administrative Data and the CUNY Office of Institutional Research and Assessment (2011) shared the results of New York State first-time students taking remedial coursework by type of institution, 1998-2007. Almost a quarter of students in all New York State two- and four-year institutions of higher education take remedial coursework. In 2007, 24 % of students took remedial coursework in all institutions (44% in two-year and 13 % in four-year institutions (see Figure 5).

Dropout rates at the end of the freshman year at four-year colleges are currently around one-quarter to one-third, while they stand at more than 40% at two-year colleges (Aughinbaugh, 2008; Walton et al., 2010). Retention of first-year students remains a prolonged social and economic issue, and institutions struggle with how to address the complex interactions of factors affecting it in order to promote student persistence and graduation. There continues to be a disconnect in institutional commitment to these students at many colleges and universities (Kezar, Eckel, Contreras-McGavin, & Quaye,

2007) as seen through a lack of retention program development. Completing an undergraduate degree, which has been estimated to take somewhere between five to six years, has become a growing concern. As a consequence, within six years of college entry, less than 60% of students who enter four-year institutions today earn bachelor's degrees, and only about 25% of community college students complete either an associate's or a bachelor's degrees (Walton et al., 2010).

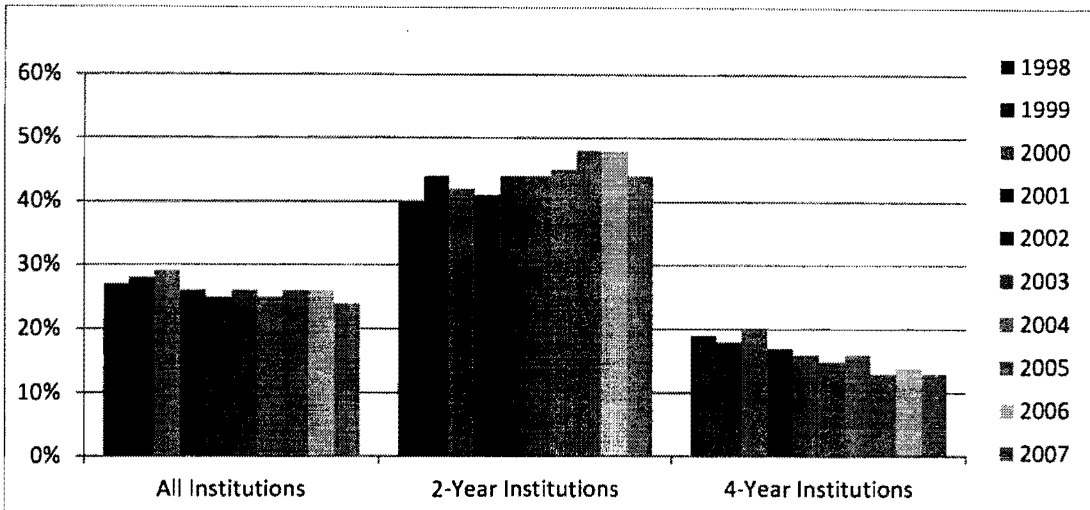

Figure 5. New York State First-Time Students Taking Remedial Coursework by Type of Institution, 1998-2007.

Source: NYSED Administrative Data, CUNY Office of Institutional Research and Assessment

This study was completed to determine whether the common indicators for college entry are successful at forecasting the achievement of students at the freshman level in colleges or universities. The 2011 freshman class of SUNY Oswego was studied to observe whether students' college credits earned during high school years (Transfer Credit), New York State Regents Exam scores, high school grade point averages, SAT test scores and demographic factors serve as effective measures of success for students'

first year at SUNY Oswego. This research will assist not only the SUNY Oswego Admissions Office in determining how much emphasis should be assigned to these indicators when deciding whether to admit a student to SUNY Oswego, but also policy-makers, practitioners, and educators at the secondary school level, who are interested in ensuring that high school students are ready for college and seeing that their postsecondary access and persistence rates improve.

The common indicators used in this study were high school grade point average (HSGPA), New York State Regents Exam scores (on the exit exam for each subject in the core curriculum at the high school level), Transfer Credit, Parent with College Education, Race, School Size, SES, Gender, performance in advanced placement courses, college placement test results on the SAT, first-year college math and science course grades, and STEM retention based on second-semester freshman college enrollment data. This study was conducted to determine the relationship between the performance of freshman students in math and science courses and high school academics and demographics.

In response to colleges' complaints about high school graduates' lack of preparedness for college rigor, the New York State Education Department (NYSED) revised its standards. Beginning with the 2004 cohort (2008 graduates), NYSED increased its high school graduation requirements for all students. All non-Regents Competency Test (RCT) eligible students (students who do not have IEPs) now need to pass all five Regents examinations in order to graduate from high school. No local diplomas are to be issued. NYSED also increased passing levels for ELA and math for Grades 3-8, beginning in 2010. Having succeeded in persuading state-level education departments across the nation to increase their educational expectations from the

elementary level upwards, in 2012 many colleges across the nation dropped remedial courses from their offerings, stating that students need to be ready for college-level work upon entry.

Purpose of the Study

The purpose of this research is to examine the influence of high school academic performance on freshman-level math and science course performance at SUNY Oswego, while controlling for the demographic factors affecting New York students. Additionally, a secondary purpose will be to identify the potential factors, if any, at the secondary school level that best predict and explain a student‘s chances of being successful and persisting in college freshman STEM major courses at SUNY Oswego.

Conceptual Framework

The National Science Board (2010) reports a strong correlation between students who take advanced science and math courses in high school and their enrollment and success in four-year college institutions. Similarly, there is also a strong correlation between high school students who do not take advanced courses (and typically do not enroll in four-year college institutions), and those who often need remedial support courses.

Tinto is one of the pioneers in the area of creating an interactionalist model of student persistence. Tinto (1993) indicated that the freshman year in college is the pivotal point in a student's academic career. In his more recent work, Tinto has explored the efficacy of learning communities for promoting retention among academically underprepared students (Tinto, 1997).

The student demographic that is related to the school demographic will predict students' high school performance and their SAT and Regents score. The eventual outcome (which is based on their freshman mathematics and science course grades and their cumulative college GPA) can be predicted by the state exit (Regents) exams, high school academic performance, and SAT scores.

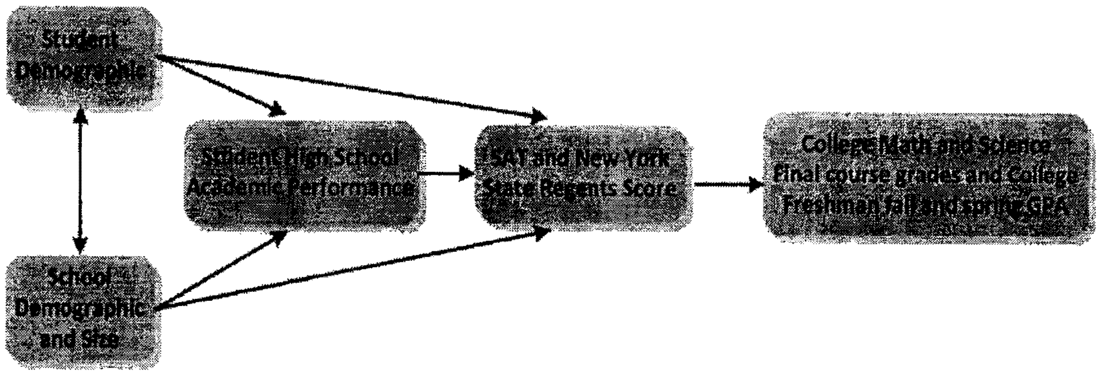

Figure 6. Conceptual Framework

There is a relationship between student demographics and school demographics in which they both have an impact on a student's academic performance, SAT scores, and New York State Regents scores. Combining those two academics performances creates a predictive value in competence in college level math and science courses.

Research Question

There is one overarching research question explored in this study: What is the nature of the relationship between New York State High School students' academic performance and final grades in college mathematics and freshman science courses at SUNY Oswego when controlling for student and high school demographic factors?

Subsidiary Research Questions

Based on the overarching research question stated above, the following subsidiary research questions (SRQ) will be investigated and the following null hypotheses tested:

- SRQ 1: What influence, if any, do the factors of first-time college attendees right after high school and the student mutable variables of SES, gender, race, and high school typology (large population, small population) have on student performance in college freshman math and science courses at SUNY Oswego?
- SRQ 2: What high school academic factors indicate first-year students' academic success in STEM disciplines?
- SRQ3: What pre-college factors indicate first-year student retention (from the first fall of enrollment to the beginning of the first spring semester) in STEM disciplines?
- SRQ4: What is the nature of the relationship between New York State high school students' overall high school GPA and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for?
- Null Hypothesis: There is no statistically significant relationship between New York State high school students' overall GPA and their final grades in college freshman mathematics and science courses at SUNY Oswego when student mutable demographic variables are controlled for.
- SRQ 5: What is the nature of the relationship between students' overall high school New York State Regents Exam scores and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for?

- Null Hypothesis: There is no statistically significant relationship between students' New York State Regents Exam scores and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for.
- SRQ 6: What is the nature of the relationship between students' transfer credit (college credits which they earned during high school) and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for?
- Null Hypothesis: There is no statistically significant relationship between students' transfer credit (college credits which they earned during their high school) and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for.
- SRQ 7: What is the nature of the relationship between New York State high school students' SAT scores and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for?
- Null Hypothesis: There is no statistically significant relationship between New York State high school students' SAT scores and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for.

- SRQ 8: When controlling for demographic mutable variables, which model best accounts for the greatest proportion of explained variance in college biology performance?
- SRQ 9: When controlling for demographic mutable variables, which model best accounts for the greatest proportion of explained variance in college chemistry performance?
- SRQ 10: When controlling for demographic mutable variables, which model best accounts for the greatest proportion of explained variance in college mathematics performance?

Study Design and Methodology

All the data sources used in this research were shared with the Office of Institutional Research and Assessment at SUNY Oswego. Data for students enrolled in the Fall 2011 semester were extracted from the student enrollment database. These included information on enrollment, gender, race/ethnicity, class levels, SAT score ranges (SAT Math and SAT Verbal), high school grade point average ranges, academic standing, cumulative grade point averages, cumulative credit hours earned by Fall 2011 and by Spring 2012, the number of transfer credits, New York State Regents scores, advanced placement scores, age, expected family contribution, students' ethnicity, SES, first-generation college attendance and retention by the end of the fall or spring semester.

A total population of 237 first-year students was studied. To protect students' anonymity, no personally identifiable information was included in the Data Sheet and all data were first screened by staff from the Office of Institutional Research to ensure that no extra student information was included.

I conducted hierarchical and multiple regression analyses on data involving a variety of student inputs and educational environments (independent/predictor variables) and first-year retention and GPA (dependent/outcome variables), in an attempt to determine which, if any, input, variables, and outcomes were significantly related to each other. Another important statistical technique used was logistic regression. These variables are predicted to be related to student achievement in college level courses.

Significance of the Study

The transition from high school to college presents social and educational challenges for many students, and these challenges are especially difficult for economically and educationally disadvantaged students. The academic success or failure of students depends upon the characteristics they bring with them to college and their experiences while attending. This study explored the significance of high school academics and demonstrated their relationship to the transition to college during the freshman year mathematics and science courses of STEM majors.

Many studies have used students' high school transcripts to gather information on state exam scores, high school overall grade point averages, and SAT and/or ACT scores. The comprehensive study *Factors Contributing to the Success of Undergraduate Business Students in Management Science Courses* examined transcripts for SAT scores, college GPAs, and college calculus and statistics grades and found GPA to be the most significant predictor for the course grade (Brookshire & Palocsay, 2005).

The results of their study can be utilized by high school administrators, math and science teachers, and guidance counselors to better understand the long-term impact of high school mathematics and science achievement. The results can also be used to shape

advice that should be distributed to students and their parents to guide them in preparing schedules or to motivate them to try their best when they see that their efforts can have long-term effects. The findings of this study have the potential to help high school students who will major in STEM programs better prepare for college before leaving home/high school. Results can be used to aid in future recruiting and advising students and planning first-year curriculum. Additionally, the results of this study will provide data useful to SUNY Oswego and similar New York State universities in developing effective interventions to increase first-year persistence. Administrators may use the findings in developing policies and procedures for establishing STEM major program development.

Results from this study can guide college readiness and college persistence policies at school, district, and state levels. At the school level, guidance counselors and mentors should make sure students are given coursework that leads to college readiness from seventh grade onward. Beginning challenging coursework, such as Regents Algebra 1 and Regents Living Environment as early as seventh grade will allow the students to fill their schedules with college preparatory and dual registration courses throughout high school. Based on finding in this study, and supported by many other studies, students who transfer dual-registered college credits are more likely to perform well during their freshman year of college and persist through graduation. Therefore, high schools should partner with local two-year and four-year colleges to provide as many entry-level courses as possible.

In addition, parents, guidance counselors, teachers and administrators should help students to understand the correlation between high HSGPA and increased potential for

success in college. While many studies make the point that HSGPA can be very subjective, a high HSGPA indicates that the student consistently takes the responsibility for those classes. HSGPA is a significant predictor for all other dependent variables in determining success and persistence in college. A high HSGPA indicates a longitudinally sustained underlying work ethic throughout a student's high school years. Conversely, studies, including this one, have pointed out that a student with an SAT score of 1460 had a freshman fall semester GPA of 2.77 and freshman spring, which in turn indicates a lower potential of persistence. Therefore, policymakers, guidance counselors, and administrators should encourage disciplined, consistent study habits through incentives, recognition, and message focus.

Wherever and whenever possible, it is also to high school students' advantage to participate in college summer bridge programs that include college visits with exposure to staying overnight to familiarize themselves with college life. Studies have shown that creating a sense of belonging in the collegiate environment is tied to persistence in degree completion. In conjunction, as part of college persistence programs, studies demonstrate the effectiveness of establishing support groups for incoming freshmen so that they have a mentorship program for a successful freshman year, as the research indicates that a successful freshman year leads to degree completion.

With the correlation between Regents performance in chemistry and successful course completion in freshman chemistry, the state should work to hone its Regents exams so that each exam is a reliable predictor of success in related freshman-level college coursework. Additionally, New York State should revert to its statewide incentive policy for high performing Regents scholars by awarding mastery level Regents

performers meaningful Regents scholarships that will significantly help to defray the cost of college.

Limitations of the Study

Universities and colleges serve different demographic student populations. This study is limited to the Northern New York State region, specifically the freshman class enrolled at SUNY Oswego during the Fall 2011 semester. Consequently, the findings presented in this study may not be generalizable to all students majoring in science and math, since results are based on freshman students attending SUNY Oswego, a mid-sized, four-year public university in the northeastern section of the United States. However, findings from this study may be applicable to students in similar settings or in conditions similar to those of the Northern New York State region.

Some indicators could not be provided by the SUNY Oswego Admissions Office for all admitted students. This and other considerations that might skew the data are as follows:

- All high school GPAs are assumed to be objective.
- This study included only subjects who remained enrolled for the entire academic year 2011-2012.
- High school grade point averages are determined in different ways and can be very subjective. Some high schools operate on a 100 scale; others, on a 4.0 scale. Some high schools also table advanced placement (AP) courses as weighted courses, allowing for point totals above 4.0.

Delimitations of the Study

This study focuses on 2011 Fall semester freshman students within STEM majors at SUNY (State University of New York) Oswego, which is a medium-sized New York State public university governed under the SUNY system. All freshman students are required to stay on campus.

Assumptions

- SAT scores are nationally recognized standardized test results; the analysis here was based on the SAT mathematics and verbal tests given prior to 2005, with a scoring maximum of 1600.
- All New York State Regents exams accurately measure a student's knowledge in a given subject
- All professors' grading rubrics and policies are assumed to be of high quality and reliability, and therefore valid.

Definitions

Advanced Placement Program: A program designed to prepare students to take the advanced placement examinations given by the Educational Testing Service (ETS). Based on their scores, students who pass these tests may be given college credit and/or exempted from college course requirements (Klopfenstein & Thomas, 2005)

American College Testing (ACT): A non-profit organization providing assessment, research, information, and professional development for education (ACT, 2006).

ACT Exam: America's most widely accepted college entrance exam, assessing general educational development and the ability to complete college-level work. The

exam covers four skills areas: English, mathematics, reading, and science (ACT, 2006).

Cohort: Research participants from the high school's 1999 graduating class who subsequently attended SUNY Oswego.

College Success Rate: The percentage of students in the cohort attending SUNY Oswego who return for a second year (retention rate). College success is defined as a student's completing the first year of college with an overall 2.5 GPA and persisting in college to the second year (ACT 2007).

Dual Enrollment Courses: Courses that are part of an enrichment program in which high school students are given the opportunity to take college courses in their own schools through local two- or four-year institutions of higher education. A dual enrollment course is taught by an instructor who has the degree and credentials to teach at a community college. Upon successful completion of a dual enrollment course, a student is awarded college credit, in addition to high school credit (Chen, 2008).

Economically Disadvantaged: Coming from a family that faces major financial constraints (Renick, 2006).

Grade Point Average (GPA): The mean of the total grades of a student.

New York State High School Regents Exam: The high school exit exam in New York State requires students to pass a minimum of five subject areas (Mathematics, Global II, U.S. History, Science, and English) in order to receive a Regents diploma. The Regents exams were (and are) unique in the nation. The New York State Department of Education was proud of studies done in the 1920s and 1930s,

which indicated that high scores on the exams were good predictors of success in college. In 1996, the Regents designated the exams as the general testing standard for high school graduation.

No Child Left Behind Act: A federal law passed in 2001 reauthorizing funds for federal programs that aim to improve performance in American primary and secondary schools (U. S. Department of Education, 2005).

Pre-college Program. A transition or outreach program completed by a student prior to his or her fall semester of college.

Remedial Education: A set of educational strategies designed to enable academically lower performing students to catch up with their higher-performing peers.

Retention: The state of remaining or being held somewhere; a college's or university's capability to keep students enrolled for consecutive semesters.

Socioeconomic Status: The level of family income or the household income.

Scholastic Achievement Test (SAT): A college entrance exam sponsored by the College Board (College Board, 2006).

Traditional Curriculum: A curriculum that includes four English courses, three or four mathematics courses, three or four science courses, and three or four courses in the social studies, required for high school graduation. This is often termed a *college preparatory curriculum.*

Transcript: A student's secondary school record, containing data on courses taken, grades, graduation status, and attendance. It may include state and national assessment scores.

Underrepresented: Refers to a subpopulation of students that is inadequately represented in higher education, given their proportion in the overall population.

Summary

How should the United States address its needs for a well-educated citizenry with a strong focus in STEM fields? As the United States and the world progress into the twenty-first century, one fact is inescapable: science and technology are driving forces in industry, agriculture, research, and medicine. However, our students do not seem to understand the importance of science and, unfortunately, many have the feeling it is an unnecessary subject of study. In 2009, the Program for International Student Assessment (PISA) Results indicated the following:

- 12 of the 33 other industrialized countries had higher average science literacy scores than the United States.
- Only 29% of U.S. students scored at or above Level 4 on the science literacy scale ranging from Level 1 to Level 6
- The U.S. average score in science literacy in 2009 was average compared to the scores of the other member countries of the Organization for Economic Cooperation and Development.

Friedman (2005) believes that America's competitive edge in this "flat world," as well as its strength and versatility, depends on an educational system capable of producing young people and productive citizens who are well prepared in science and mathematics.

President Obama's expectation of what students should know in preparation for college and career persists; henceforth, a more rigorous and uniform standard is being

formed under the new administration (Paulson, 2010). Coupling the secondary curriculum, assessments and graduation requirements with post-secondary knowledge and the skills needed for students to succeed in entry-level college courses (without remediation) would contribute to the potential for student success beyond high school (Achieve, 2009b; Conley, 2005; Conley, 2010; Roderick, Nagaoka, & Coca).

Organization of the Study

An introduction and conceptual framework for this study is included in Chapter I, along with a brief discussion of the research that has been conducted on the influence of New York students' demographic factors and high school academic performance on grades in freshman-level mathematics and science courses at SUNY Oswego. Chapter II discusses the pertinent literature and previous research related to factors like ethnicity, first-generation college attendance, gender, SES, high school GPA, NY State Regents exams, and SAT and AP courses and their potential impact on college grades in freshman-level mathematics and science, on college GPAs, and on first- to second-year retention. Chapter III outlines the research design and describes the participants, instruments, procedures, and data analysis used in this study. Chapter IV presents an analysis and summary of the data collected and analyzed and describes the research findings of this study. Chapter V includes a summary and conclusions on the results, with recommendations for further research and practice.

Chapter II

REVIEW OF RELATED LITERATURE

The purpose of this chapter is to build a foundation upon which the hypotheses can be constructed and answered. Other educational researchers explored similar concerns regarding student achievement from related angles, and the literature supported the development of my hypotheses. Testing the hypotheses provided a basis for determining the impact of such factors as SAT scores, high school academics, and demographics on STEM students' success in the college mathematics and science courses.

Literature Overview

This literature overview focuses on material that addresses several factors related to the topic at hand: (1) high school academics, high school GPAs, rigorous curricula, SATs or ACTs, transfer credits--pre-college (bridge) programs, and New York State Regents exams, (2) retention of first- and second-semester college freshmen, (3) demographic factors, race, socioeconomic status (SES), gender, parent with college education, and size of a student's high school.

Beginning with the Soviet Union's launch of the "Sputnik" satellite in 1957, many people began to criticize mathematics and science education in the United States. To regain the technological ground apparently lost to the Soviets, U.S. political leaders enacted reforms in engineering and science education (Powell, 2007). In the article titled "How Sputnik Changed U.S. Education," Powell (2007), reporting on the educational impact of the Sputnik launch, observed, "Sputnik woke the nation up, serving as a focusing event that put a spotlight on a national problem . . . in this case, the problem was

science education" (Powell, 2007, p. 1). It is interesting to note that whatever measures were enacted during this time of national crisis, the programs either eventually ceased to be effective or were discontinued, resulting in a downward trend in American student science performance that continues to the present day. This downward trend is supported by different studies indicating that many American students are not adequately prepared with the scientific and mathematical skills needed to participate in a highly technological society (ACT College Readiness, 2005; ACT Policy Report, 2006; American Diploma Project Network, 2006; Wagner, 2008).

"One of the goals of science education in the United States is to produce citizens who are scientifically literate; that is, able to understand and contribute to discussions of the uses of scientific knowledge so that they can help make science socially responsible" (Lederman, 2004, p. 1). Economists estimate that the nation's economy could grow by four and one-half percentage points over the next twenty years if we can catch up with world leaders in science education (*U.S. News & World Report*, 2008). The potential for individual and national gains should be a motivating factor in reigniting students' and parents' interest in STEM degrees and careers. Consequently, improving students' performance in the sciences is one of the key challenges faced by the nation's schools in their attempt to prepare students to compete in the global workforce of the future (The National Academies of Science, 2006). However, based on a *U.S. News & World Report* study (2008) the United States now is far behind other countries; out of 30 industrialized nations, it ranks twenty-first in science education. To remedy this situation, every aspect of education should be explored to address this gap, from preschool to collegiate levels, perhaps with an eye to what motivational and persistence methods work well in other

nations. In 2006, feeling that American leadership in technology and science was in doubt, the U.S. Chamber of Commerce announced that new and greater efforts must be put in place at the high school level to prepare a new generation of American mathematicians, scientists and engineers.

College Preparation and Readiness

Politicians and bureaucratic educational offices have sought to define high school success in preparing students for college by defining parameters for "college readiness." College readiness is most typically defined as the grades students received in particular courses or on particular statewide or national examinations. As part of a variety of recent legislative reformation proposals, the Obama administration, National Governors' Association, and Council of Chief State School Officers all agree that college readiness should be defined in terms of academic standards and aligned assessments in mathematics and English (Paulson, 2010).

One response to the nation's need to prepare students for postsecondary study and produce a strong, STEM-based workforce lies within high school curricula. While teachers are striving to increase the level of academic rigor in their courses, guidance counselors are encouraging students to enroll in more challenging courses. These more challenging courses range from dual-enrollment courses, to advanced placement (AP), college preparatory, honors level, or other means of earning college credit during high school (National Science Board, 2006). The 2004 ACT Policy Report indicated that certain courses, such as biology, chemistry, physics, and advanced math courses beyond second-year algebra, have a significant impact on student achievement and college preparedness (Lotkowski, Robbins, & Noeth, 2004). This indicates that high schools need

to strengthen their curriculums and align them to prepare students for college-level courses. Moreover, schools should make every effort to encourage students not to aim low, fulfilling only the minimum number of requirements needed for graduation, but instead to challenge themselves academically. Research indicates that students who complete a core curriculum during high school have a much greater chance of success in college than students who do not complete core curriculum coursework (ACT Newsroom, 2000). A "college preparatory curriculum" has been defined by the High School Transcript Study as one semester of computers; two years of foreign language; three years of math, science, and social studies; and four years of English. The study also reported that only 14% of students took advanced placement (AP) or international baccalaureate (IB) programs and received mathematics or science credit. Academic performance and aptitude assessment information indicate that students attending college now have a broader range of preparation (NCES, 2004) than their predecessors due to high schools implementing efforts to improve course offerings, graduation requirements, and curricula.

To regulate the quality and rigor of their assessments and standards, The American Diploma Project (ADP) plans to develop national high school graduation benchmarks for all states to use. After interviewing college professors and employers from around the United States, the ADP discovered that the skills for success in freshman level courses in two- and four-year institutions are identical to the skills needed for success in living-wage entry level careers and jobs (American Diploma Project Network, 2006). Most students and parents do not appear to be aware of the connection between academically challenging high school courses and success in college and career.

Students and parents need to look beyond the mere attainment of a high school diploma to the content of that diploma. Providing students more options and being college-ready requires them to take challenging courses in high school. As times and expectations have changed, what used to be called a "college prep" education is now the essential level of education for any student wanting to experience success at college or in the workplace, (American Diploma Project Network, 2006).

In his research on college remediation, Wagner discovered that 40% of all students entering college require remedial courses. Based on this remediation, and noting that the United States' college completion rate for 25- to 44-year-old students ranks tenth among industrial nations, Wagner estimates that 50% of students who start college do not complete a postsecondary degree (2008). Also, in 2004, a report by the Strong American Schools project (2008) provided data regarding students needing remediation in the nation's two- and four-year public colleges. According to the report, 43% of all students in two-year institutions enrolled in at least one remedial course, while 29% of students in four-year institutions enrolled in a remedial course (Strong American School's Project, 2008).

Recently proposed definitions of college readiness are constructed solely with scores on national tests and high school courses taken and grades received. Some educators argue that a broader range of attributes is needed to succeed in college and that any true measurement of college readiness must also include the non-academic attitudinal and behavioral attributes that successful college students tend to possess (Conley, 2007; Paulson, 2010).

High School Academics

High School Grade Point Average (HSGPA)

Having studied nearly 80,000 students entering the California university system as freshmen from 1996 to 1999, Geiser and Santelices determined that high school grades were far better predictors of students' college success than standardized test scores (Geiser & Santelices, 2007). By following students throughout their college careers, Geiser and Santelices discovered that high school grades not only served as reliable predictors of first-year college grades, but were also as reliable a predictor of cumulative four-year college grades. Therefore, they concluded that since SAT scores tend to be intertwined with students' socioeconomic status, high school grades appear to be a more fair, equitable, and meaningful basis for admissions decision-making. Allensworth (2006) found that a student's chance of enrolling in college can be most accurately predicted by analyzing that student's high school grade point average (HSGPA). Also, Astin (1993) and Seidman (2005) found that HSGPA was the most significant pre-college characteristic for predicting attainment of a college degree. However, because of variances in school policies, students' grade point averages can be very subjective, depending on each school's and each district's curricula, course offerings, and grading standards. Since there are no common grading standards across schools or even across courses within the same school, the College Board argues that a student's academic performance should not be determined by such an unreliable measure as the student's GPA.

Hunt (1987) found that the total years spent on high school mathematics, the number of semesters of high school mathematics, and high school mathematics GPAs

were highly correlated with grades in college algebra. Moreover, Helmick (1983) indicated that good predictors of success in College Mathematics were the overall HSGPA and the number of semesters of high school mathematics. In contrast, Hutson (1999) found no significant relation between high school mathematics GPAs and grades in college algebra, although there was some correlation with overall high school GPAs.

Students with low high school GPAs have a higher departure ratio (DeBerard, Spielmans & Julka, 2004). Jamelske (2009) found for every point increase in the ACT, there was a 0.018-point increase in college GPA. He also found that an increase of 10% in high school ranking correlated with a college GPA increase of 0.22 points. Furthermore, students who matriculated with college course credits added 0.151 to their college GPA (Jamelske, 2009). Prior educational experiences play a role in the initial commitment students have toward their education, ultimately influence their academic and social integration, and form the basis for models of persistence (Jamelske, 2009; Johnson, 2008; Murtaugh, Burns & Schuster, 2009).

The educational background of a student includes high school performance measures such as high school GPA, scores on the New York State Regents Exam (for public school and New York residents), and SAT/ACT scores. Johnson's (2008) research indicates that the highest percentage of students who were more likely to persist in college were from high schools where 50%-70% of the students took the SATs.

Rigorous Curriculum

Recent empirical literature and research have suggested that a high school student's academic preparation is one of the most--if not the single most--important predictors of whether he or she will enroll in college, more so than demographic and

socioeconomic variables (Adelman, 1999; Alexander et al., 1982; Cabrera & La Nasa, 2002; Perna, 2004; Thomas et al., 1979). High school performance may create new opportunities for the student; that is, students with good academic records may be likely to receive more encouragement from teachers, family, and friends to continue their education. They may not only receive more college advising from their school counselors, but also be offered more generous financial aid and college scholarship packages (Chapman, 1981).

Among all the pre-college factors, a rigorous high school curriculum is one of the most significant elements for preparing students for college; once a student's academic capability is no longer in question, the remaining barriers to college education (e.g., finances, parental background and race) are diminished. Adelman (2006) indicated that completing a rigorous high school curriculum was the greatest pre-college indicator of completing a bachelor's degree, and the impact was greater among African American and Hispanic students. To provide an educational environment that is conducive to college enrollment, high schools need to provide a rigorous academic curriculum, have a strong academic culture (Adelman, 2006; MacDonald & Dorr, 2006) and focus on learning rather than performance (Watkins, 2010). With such an educational environment, students are able to develop and transfer their skills and knowledge from postsecondary ambitions into reality (Allensworth, 2006). Moreover, a rigorous high school mathematics curriculum prepares students for college success. Achieve (2005) research shows that there is a strong correlation between the math level taken in high school and success in college. Researchers, including Adelman (2006) and Sadler et al. (2010), have

argued that it is not surprising that students who enroll in challenging academic courses seems likely to enroll in college.

A 2002 report by the NSF supports Adelman's findings; it states that more than 20% of students who wanted to major in a science or engineering field self-reported that they needed remedial work in mathematics. Students are often unable or underprepared to begin with the preferred collegiate mathematical coursework at the start of their degree program: calculus. Alting and Walser (2006) found that as much as 39% of freshman engineering students began their mathematics studies with algebra and college algebra, which is considered a remedial math course at the college level.

Research shows that a fourth year of math improves students' college readiness (ACT, Inc., 2007). In 2006, the *College-Bound Seniors Total Group Profile Report* noted the following:

- Only 16% of students who took three years of high school mathematics met the ACT readiness benchmarks, while 62% of students who took four years of high school math met the benchmarks.
- In a study where students took ACT from three different states, 17% of students who took four years of mathematics in high school needed remediation when they entered college, compared to 26% of students who took only three years of mathematics in high school.
- One additional year of high school math instruction (four years as opposed to three) made a significant difference in students' scores on the SAT-I quantitative section: 63 points higher.

SAT or ACT

A study of 258 research universities nationwide which looked for the determinants of college graduation rates for four-, five- and six-year time frames found that pre-college factors, including high SAT scores and top percentage high school class ranking, were positively and significantly related to graduation rates for the four-year graduation model (Goenner & Sneith, 2004).

Another predictor of students' college success is their performance on college entrance exams. According to an ACT News Release, students who achieve higher average scores on college entrance exams (both math and English entrance exams) do better in freshman-level college courses and are more likely to receive a degree (ACT Newsroom, 2000).

In an article for the National Association for College Admission Counseling, Rebecca Zwick (2007) noted that university and college admissions offices use standardized tests as criteria. By 1998, the number of students taking either the SAT or ACT tests increased from approximately 50% to 66% of high school graduates (Zwick, 2007). Most institutions now use these tests interchangeably. In undergraduate admission decisions, the results of the National Association for College Admissions Counseling (NACAC) Admissions Survey indicate that the most important factors are high school grades, followed by test scores (Hawkins & Lautz, 2005).

The most significant predictor of college algebra performance has been Scholastic Aptitude Test (SAT) scores (Bridgeman, 1982). Zhang et al. (2004) examined 87,167 engineering students at nine institutions from 1987 to 2002 and quantitatively evaluated pre-existing factors to determine their impact on engineering students' success. A

multiple logistical regression model was used to explore the relationship between graduation and the demographic and academic characteristics (including quantitative and verbal SAT scores, high school GPAs, gender, ethnicity, and citizenship) that had a significant impact on graduation. In all nine institutions, among all of the models, high school GPA and quantitative SAT scores were found to be the most significant of all the factors for predicting engineering students' success.

Perkins (2002) studied student persistence among 211 undergraduate students majoring in engineering at the University of South Carolina. The results showed a positive relationship between persistence and high school academic factors such as high school GPA, SAT Math scores, and taking AP Calculus.

Based on a report by the College Board (2008) in which researchers sought to establish the validity of the SATs for predicting first-year college GPAs, the best combination of predictors is a student's high school GPA and SAT scores. In this study, the sample came from 110 four-year colleges and universities throughout the United States. Students entering these institutions in the fall of 2006 and completing their first year of college in May/June 2007 all shared the multiple correlations of submitting a high school GPA and completing all three SAT sections as part of their acceptance. For these students, their first year GPA, based on GPA and SAT scores, was 0.46 (Adj. $r= 0.62$), which recommends that colleges use both HSGPA and SAT scores as predictors.

Transfer Credit

In a 2011 study, researchers confirmed the results of this study in respect to the effectiveness of dual registration in college and high school courses while still in high school. Both studies conclude that dual credit participation results in greater first year

persistence and college graduations rates. The 2011 study indicates that the strongest positive relationship occurs when students completed more than 12 dual credit hours (Appleby, Ashton, Ferrell, Gesing, Jackson, Lindner, Mata, Shelnutt, & Wu, 2011).

While Kuh et al. noted that transfer status was negatively related to persistence, they did not separately identify dual registration courses taken through two-year colleges while still attending high school from high school graduates who completed credits at a two-year college (Kuh, Cruce, Shoup, Kinzie & Gonyea, 2008) to analyze the variation. Hughes et al. also considered dual registration in their study of ways to help all youth make a successful transition to college and determined that while dual registration programs for high school students typically target high-achieving students, middle and low-achieving students would benefit from participation (Hughes, Karp, Fermin, & Bailey, 2006). Hughes' study indicated that students benefit from earning free college credit, gaining a college experience, and increasing their academic confidence.

Swanson (2008) also concurred that dual enrollment participants were more likely than non-participants to remain in college and specified that dual enrollment participants were more likely to complete consecutive semesters without stopping for more than one semester within the first two years of college.

Eimers and Mullen (2003) concurred with positive aspects of dual enrollment, noting that participants are more likely to return for their second year of college. They also found that students earning dual credit at colleges awarding only two-year degrees tended to have lower GPAs than dual credit participants earning credits from four-year institutions.

Researchers have found that pre-college summer programs help students make a

better transition to college. In some cases, summer programs are a component of a larger pre-college program that includes dual enrollment or other linkages between high school and college. This approach is often used to recruit minority, low-income, first-generation, and female students for undergraduate programs in science, technology, engineering, and mathematics (STEM) education (Cech, 2008; Gilmer, 2007).

Retrospectively, many first-year college students report they wish they had had better academic preparation (Cohen, 2008). Ideally, bridge programs for students who are at risk of dropping out extend through the first semester of college and, in some cases, into the sophomore year (Risku, 2002).

Academic and social transition and support are provided by colleges and universities to incoming freshman through programs such as Upward Bound, Upward Bound Math/Science Program, Talent Search, Educational Opportunity Centers, Student Support Services, the Ronald E. McNair Post Baccalaureate Achievement Program, and the Staff and Leadership Training Authority (Maggio, White, Molstad & Kher, 2005).

Low income and minority populations are making up greater percentages of incoming freshman classes each year, necessitating that colleges address this growing need to see these students through to the completion of their degrees (Seidman, 2005). A large gap still exists, however, between middle and upper income students who complete a bachelor's degree at a rate of 56%, while low income results are averaging a 26% graduation rate (Engstrom & Tinto, 2008).

STEM Programs

Throughout the world, science, technology, engineering and mathematics (STEM) programs for education are increasing in popularity and emphasis at all levels of

education. Governments and industry alike see this emphasis and success in these realms as necessities in order to compete and succeed in the global economy, as well as in military endeavors. Colleges, high schools, and elementary schools have responded to this need by changing or adapting their curricula, graduation requirements, and course offerings.

Gilmer (2007) explored the Academic Investment in Math and Science (AIMS) program adopted by Bowling Green State University. The program targeted minorities and women, who are poorly represented in STEM careers. The program has high academic standards: participants are required to have a 3.0 GPA, a combined reading and math SAT score of 1000, and have to plan to take pre-calculus, calculus, or a more advanced mathematics course in their first college semester. The expected course requirement was simply a way of ensuring that the students would not require a developmental math course. The registration goal of this program was to eliminate underprepared students from participation.

There are many variables that may affect student success, including academic achievement (based on high school grade point average), aptitude-based assessments (based on achievement tests performance), and generalized academic achievement (based on standardized tests such as SAT and ACT) (Kim et al., 2010, para .4). In addition, socioeconomic status, ethnicity, being the first in the family to attend college, and other circumstantial variables that relate to student persistence and academic performance can affect student success (Kim et al., 2010, para. 5).

New York State Regents Exams

"Sixty-five percent of college professors report that what is taught in high school does not prepare students for college. One major reason is that the tests students must take in high school for state accountability purposes usually measure 9th or 10th grade level knowledge and skills" (Wagner, 2008, p. xix). In regard to standardized multiple-choice assessments, Wagner (2008) maintains that such assessments rarely ask students to explain their reasoning or to apply knowledge to new situations (skills that are critical for success in college); therefore, neither teachers nor students obtain constructive feedback about college readiness. "Only about a third of U. S. high school students graduate ready for college today and the rates are much lower for poor and minority students" (p. 19).

American students' math and English skills when exiting high school are the equivalent of what students in other economically comparable countries learn in eighth grade (Achieve, 2004). In contrast, an examination of the alignment between Arizona's high school exit exams showed a one-to-one relationship between a student passing the math exit exam and earning a 3.0 in a college entry-level math course (D'Agostino & Cimetta, 2008).

There is concern regarding the high school diploma in the United States because it does not equate to success beyond high school. Research recommends stronger coursework requirements and rigor in instructional practices in high schools in order to prepare students for postsecondary success (ACT, 2005; American Diploma Project, 2005). One of the American Diploma Project's recommendations was to create an exit exam. In New York, as in many other states, there is a required exam that students have

to pass in order to graduate and receive a Regents diploma. One of the first attempts at standardizing admissions was the implementation of the New York State Regents Exams, begun in 1878 (Stoel, 1988). Beginning with the 2001 No Child Left Behind Act, a proficiency exam has been adopted by many states as a requirement for most high school graduates (Dee, Jacob, Hoxby & Ladd 2010).

The New York State Education Department report *The Potential Revision of High School Graduation Requirements* (2011) notes that a number of admissions directors of two- and four-year public and private colleges in Western and Central New York, the Hudson River Valley, and New York City stated the following:

- A score of 75 to 85 on the Regents is considered by selective schools (as part of their holistic review of applicants) the lower threshold for admissions
- SUNY campuses have determined that a score below 75 indicates inadequate preparation, while 85 indicates solid competence
- CUNY sets a score of 75 and below on Regents exams as the threshold for remediation
- CUNY views a score of 500 on the SATs as equivalent to a score of 75 on a Regents exam, and therefore uses a 500 SAT score as a threshold for remediation.
- Students scoring 0-79 on their Math Regents are far more likely to be placed in remedial college courses.

The CUNY Office of Institutional Research and Assessment released a report on Math A Regents in all of the CUNY two- and four-year institutions (see Table 1). The data show that the percentage of students performing well on the Math A Regents is

greater among students who continue with their math education beyond the Math A course than with those students who do not continue math courses beyond the Math A Regents.

Table 1

Math A Regents in All of the CUNY Two- and Four-Year Institutions (Fall 2008)

	Arithmetic	Elementary Algebra	Intermediate Algebra **	Intermediate Algebra **	College Algebra	Pre-Calculus	Calculus
Less than 55	68.3%	29.7%	0.0%	1.4%	0.7%	0.0%	0.0%
55 to 64.9	61.4%	33.7%	0.6%	3.2%	0.8%	0.3%	0.0%
65 to 69.9	38.9%	44.7%	1.8%	8.0%	4.8%	1.8%	0.7%
70 to79.9	14.7%	24.6%	5.9%	23.5%	21.3%	8.1%	1.8%
80 to 89.9	0.8%	2.8%	4.3%	17.3%	30.6%	32.3%	12.0%
Above 90	0.0%	0.2%	0.5%	3.4%	12.7%	39.2%	44.2%

** Intermediate Algebra is considered a remedial course in some schools in the CUNY system and a credit-bearing course in others.

Totals sum to 100% along rows, but not down columns.

Source: CUNY Office of Institutional Research and Assessment, Math A Regents; all CUNY two- and four-year institutions

In 2008, the City University of New York (CUNY) analyzed New York State Regents exam results and their impact on college readiness. The data came from CUNY students who graduated from the New York City public high schools and entered the CUNY schools in the fall of 2008. This analysis targeted students who graduated within 15 months of entering CUNY as first-time freshman or students who enrolled and started a course, but may not have finished it (the probabilities displayed are limited to those within the range of actual scores).

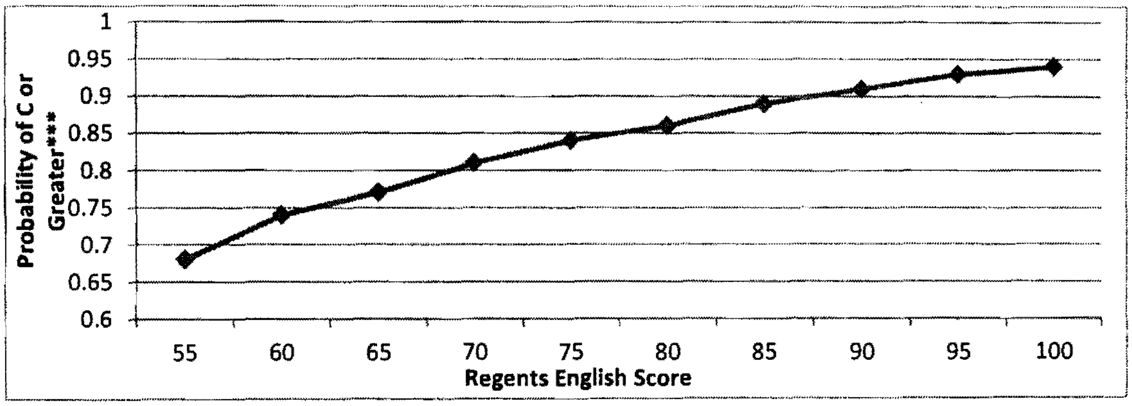

*Figure 7. Probability of C or Greater in Freshman Composition by Recent NYC Public High School Graduates Entering CUNY in Fall 2008***

**Analysis based on students enrolled in a course who started but may not have completed the course.*

***Graduated within 15 months of entering CUNY as a first-time freshman.*

**** Probabilities displayed are limited to those within the range of actual scores.*

Source: CUNY Office of Institutional Research and Assessment, Math A Regents; all CUNY two- and four-year institutions

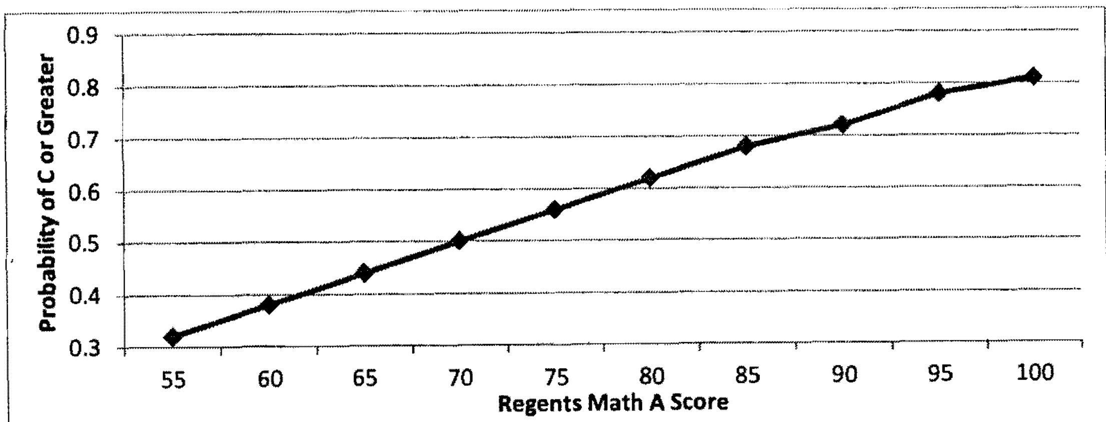

Figure 8. Probability of C or greater in college-level math courses by recent NYC public high school graduates entering CUNY in Fall 2008, based on a comparison with Regents Math A scores

**Analysis based on students enrolled in a course who started but may not have completed the course.*

***Graduated within 15 months of entering CUNY as a first-time freshman.*

**** Probabilities displayed are limited to those within the range of actual scores.*

***Intermediate Algebra is considered a remedial course in some schools in the CUNY system and a credit-bearing course in others. Totals sum to 100% along rows, but not down columns.*

Source: CUNY Office of Institutional Research and Assessment, Math A Regents; all CUNY two- and four-year institutions

The report signified that if a student scored at least a 75 on his or her English Language Arts Regents, he or she most likely would earn at least a C in Freshman Composition. Students who scored above 80 on their Regents Math A exam had a good chance of earning at least a C in college-level math.

Persistence of Science Majors to Graduation

As reported in the 2005 National Survey of Student Engagement, students who are the first in their family to attend college lack implicit knowledge about the college experience, while other more traditional students may not be developmentally ready for serious academic work (Center for Postsecondary Research, 2005). The problem begins when these students drop out of their major due to frustration or lack of success in college-level science coursework (NCES, 2004).

The percentage of students majoring in science declines from 28.7% to 17.4% between the freshman and senior year of college, with the greatest losses occurring in the biological sciences and engineering (Drew, 1996). An article by Kenneth Green published in *American Scientist* presented data showing the trends in college freshmen's initial choice of major. As quoted by Drew (1996), Green wrote, "[T]he largest and oldest empirical study of higher education in the United States indicates that the nation's science resources, as represented by students who are planning undergraduate work in the sciences, have suffered serious erosion over the past two decades" (p. 88).

Parent with a College Education

Schools are discussing the fact that college does not start in high school nor in middle school, but in elementary school, and even before that; the educational

backgrounds of students' parents and families influence the student's educational attainment (Choy, 2001; Collier & Morgan, 2008; Hertel, 2002; Pascarella, Pierson, Wolniak & Terenzini, 2004). Choy (2001) found that if a student's parents did not attend college, the student was less likely to enroll in college. However, if a student's parents did not attend college and that student did enroll in college, he or she would have a lower potential retention and graduation rate than a student who was non-first-generation. Reasons for this could be less support and less knowledge about the demands of college life.

First-generation college students are those students who are the first in their families to attend college. First-generation college students often report higher stress levels than other students (Hertel, 2002; Pauley, 2011; Wang & Casteneda-Sound, 2008). These students have less knowledge of college life, less social and family support, and fewer financial resources (Hertel, 2002). Often, they have lower academic self-efficacy, which places them at risk of higher stress levels and lower persistence (Wang & Casteneda-Sound, 2008). Because of all of these factors, the college graduation rate for first-generation students is low. In fact, research indicates that first-generation students have a 71% dropout rate (Ishitani, 2003). Consequently, policymakers and educators who want to increase the number of college graduates across the economic spectrum must find effective ways to help first-generation students successfully handle the challenges of college life.

Socioeconomic Status (SES)

The rising undergraduate student population includes a higher percentage of minority students, first-generation students, students from low socioeconomic families,

and more students with special academic needs. Many more undergraduate students must take jobs to help pay for increasing college tuition and living expenses (McGrath & Richards, 2001). These factors notwithstanding, the sudden freedom that comes with college often sets the stage for emotional turmoil and academic failure. It is not surprising that approximately 60% of students at public universities fail to complete a bachelor's degree within five years, and 50% of these students leave during their freshman year (McGrath & Richards, 2001).

Students from the most affluent families (the uppermost income quartile) have seven times the probability of earning a baccalaureate degree as students from families in the lowest quartile (Lerner & Brand, 2006). Since the mid-1990s, colleges are recognizing and taking steps to rectify the disproportionate number of socio-economically disadvantaged students who are not able to persist in completing a college degree through a series of special programs and interventions, which include addressing the transition from high school to college (Engstrom & Tinto, 2008; Green, 2006).

SES even appears to neutralize the impact of race and ethnicity on educational achievement (Lee et al., 2008). At the same time, low-income, minority, and first-generation college student characteristics frequently overlap, forming a triple jeopardy for students aspiring to earn a college degree (Carter, 2006; Green, 2006).

Middle-income students tend to have a lower college completion persistence rate due to financial burdens. While low-income students are given grants, middle income students rarely qualify; yet their parents often can contribute very little, resulting in overwhelming debt in the form of college loans (DesJardins, Ahlburg, & McCall, 1999; Peng & Feters, 1978).

Race

While the United States may consist of a mosaic of races and people of different backgrounds, colleges and universities tend not to reflect this diversity in the same proportions. Researchers have found that the race-ethnicity of students is a strong predictor of their likelihood of enrolling in college. Students who are African American or Hispanic have consistently been found to be considerably less likely to continue their education to the postsecondary level than their White peers (ACT, 2004; Allensworth, 2006; National Center for Education Statistics, 2010; Perna & Titus, 2005; Roderick et al., 2008). Studies by Choy (2002) and Perna (2000) indicate that the number of African Americans and Hispanics attending college is higher than ever before; however, both groups are still underrepresented relative to their proportion in the traditional college-age population. A report released by the National Center for Education Statistics in 2003 revealed that while more than 65% of White high school graduates continued their education to college, only 56% of African American and 49% of Hispanic high school graduates did. Also, the 2010 National Center for Education Statistics observed that while 63% of college students in 2008 were White, only 14% were African American, 12% were Hispanic, and 7% were Asian/Pacific Islander.

Sinha 's research also supports our finding that White students have had consistently greater academic success in collegiate biology courses (Sinha, 2010).

Students who are African American or Hispanic have consistently been found to be considerably less likely to continue their education to the postsecondary level than their white peers (ACT, 2004; Allensworth, 2006; National Center for Education Statistics, 2010; Perna & Titus, 2005; Roderick et al., 2008). Researchers have presented

conflicting data regarding the relationship between ethnicity and persistence in completing a college degree. Research has shown both no significant differences between Whites and Non-Whites in terms of college persistence (Allen & Robbins, 2008; Chen & DesJardins, 2008), and significant differences between Whites' and Non-Whites' success in college (Wohlgemuth, Whalen, Sullivan, Nading, Shelley & Wang, 2007), particularly in STEM majors (Seymour & Hewitt, 1997).

Parents' College Education

A great deal of research has been conducted to determine the impact of a student's parents' college education level on his or her college persistence and success. Students whose parents did not attend college or whose parents had a low level of educational attainment have been found by empirical research studies to be less likely to enroll in college than students whose parents received a college education (Choy, 2001, 2002; Horn & Nunez, 2000; Pathways to College Network, 2004), and the level of parents' educational attainment is a strong predictor of their children's educational attainment. Using 1999 national data from the Department of Education, Choy (2001) reported that if parents had a bachelor's degree or higher, 82% of their children enrolled in college upon finishing high school; if parents only completed high school, the enrollment rate dropped to 54%; and if parents did not graduate from high school, the rate plummeted to 36%. In a study of the relationship between parents' level of education and GPAs of college freshman, Regina Vincent Clark's study in Tennessee (Clark, 2007) found no statistically significant relationship. Students performed well or poorly irrespective of their parents' educational achievement or attainment. Choy (2001) indicates that first-generation students variable is a significant predictor for dropping out of college. While 23% of

first-generation college students tend to drop out, only 10% of students whose parents had attended college dropout (Choy, 2001).

Since parents with no postsecondary attainment have much less experience with the higher education system, the differences in college enrollment persist between students whose parents had a postsecondary education and those whose parents did not (Allensworth, 2006). The seemingly endless forms and processes that must be completed prior to entering college and throughout the student's collegiate years is not within these parents' experience, and many do not have friends or relatives with this experience either. Because of this, families cannot provide good guidance along the path to college for their children. Their children face a struggle in regard to having the right information to fulfill the complex requirements (especially the financial costs) of college application and admission. Once a student is at a postsecondary institution, their background factors continue to influence whether or not they persist and, ultimately, successfully complete a college degree (Adelman, 2006).

Ramos-Sanchez and Nichols note (2007) that first-generation students are generally outperformed by non-first-generation peers despite evidence of first-generation students' academic confidence or self-efficacy. Bui (2002) discovered that first generation students have a great chance of earning a bachelor's degree if they attend a four-year institution (40% graduate) instead of transferring from a two-year institution (10% graduate).

Gender

Many studies have looked at the impact of gender differences to account for students' persistence in attaining a college degree. Empirical studies have revealed that

there is a clear gender division in college enrollment outcomes, with females being considerably more likely to attend college than their male counterparts (Allensworth, 2006; Choy, 2002; Rosin, 2010). It has been estimated that for every two men who received a college degree in 2010, three women did the same (Rosin, 2010). Similarly, using data from the 1997 National Longitudinal Survey of Youth, Aughinbaugh (2008) found that after controlling for other background traits, female students were seven percentage points more likely to attend college than their male peers. Many studies have investigated why this disparity exists.

In addition to the predictive role noted by researchers regarding the relationship between students' performance in academic measurements and their success and persistence in college, gender differences also come into play when analyzing trends and behaviors. Stratton, O'Toole and Wetzel (2007) found that there was little difference in the persistence rate of males and females, but as the age of matriculation increased, males were less likely to depart than females. However, other studies indicate that sex does not influence the educational experience differently for males and females. Females typically have greater first-semester departure rates than males (Boyer, 2005). Male persistence has been directly related to academic integration and subsequent goal commitment and only indirectly to pre-entry attributes (Murtough, Burns, & Schuster, 1999).

Even though studies have indicated that males and females are both taking more high-level mathematics, such as pre-calculus and calculus (Ingels & Dalton, 2008; United States Department of Education, 2004), the studies also reveal that males outperform females on standardized mathematics assessments (Martin, Mullis, & Foy, 2008; United States Department of Education, 2004).

Hyde and Mertz, researchers from the University of Wisconsin-Madison and the University of California, Berkley, respectively, conducted a study of over seven million students using math scores from state exams and found that the degree of difference between girls' and boys' average math scores was basically zero (Hyde & Mertz, 2009).

In contrast, other research posits that a lack of academic preparation and lower academic achievement are factors explaining why male high school students are less likely to enroll in college than their female peers (Kuh et al., 2006; Rosin, 2010). In her study of high school students in Chicago's public schools, Allensworth (2006) suggested that the large differences in the GPAs of male and female students help to explain the lower college attendance rate of male high school students relative to their female counterparts.

As a side note, in the State University of New York (SUNY) at Oswego, all of the students are required to live on campus. In a recent study, de Arajo and Murray (2010) found empirical evidence that living on campus leads to improved performance; they identified both immediate effects (an improvement in GPA while the student lived on campus) and permanent effects (where the GPAs remained higher even after the students moved off campus).

Size of the High School

There has been much discussion regarding the size of a high school and its impact on college achievement. Researchers (Blatchford, Bassett, Goldstein, & Martin, 2003; Rohr, 2009) have demonstrated that small class sizes in high school have a positive impact on the academic success of students in college. Larger high schools (greater than 800 students) have the opportunitiy to provide more after-school activities, as well as

curricular offerings that include advanced placement and college credit courses. This might have a beneficial impact on students' preparedness for college mathematics and science courses (Rohr, 2009). Rohr (2009) looked at students' high school size to discover if the size of the school (i.e., variety of curricular offerings) could be used to determine whether a person is likely to remain and succeed in STEM careers. He found that attending a specific size range of high school (e.g., a large school with many electives and advanced courses vs. a small school with few electives or advanced courses) was not a reliable predictor of retention or failure in STEM careers.

Summary

Researchers propose many ways to improve American students' preparation for, and persistence in, completing a college degree. Creating a student population that is equipped with twenty-first century knowledge and skills could fulfill the technological needs and challenges faced by the country and the world. A rigorous, academic high school environment is one of the key starting points for a systemic reform that enables students to be college-ready and graduate within four years. Science and mathematics are the wave of the future. The Carnegie Corporation recently noted that "The United States has taken important steps toward articulating higher expectations for all students, but we have not reached agreement about how our schools can best help students reach these new, higher levels of learning, especially in STEM" With the recession reshaping our economy in both short-term and permanent ways, good-paying jobs requiring only a high school education continue to dwindle. Analysis by Georgetown University researcher Anthony Carnevale suggests that by 2018, 63% of all jobs in the United States will

demand at least some college education--up from 28% in 1973 and 59% in 2007. (Carnegie Corporation of New York, 2011, p. 8).

When states and college report data involving high school students' performance on college admissions, placement, and readiness tests, it ensures that students make a successful transition from high school to postsecondary education. Students' college readiness is indicated by their performance on the SATs, SAT II, ACT, and high school exit exams (New York State Regents [EOC] exams), as well as their performance in advanced placement (AP) exams. This data should be collected and reported annually by all states. States should collect and report these data annually. On the other side, based on student demographics, colleges can develop programs and support systems for those who the research indicates are dropping out faster.

Chapter III

DESIGN AND METHODS

The purpose of this research is to examine the influence of high school academic performance on freshman-level math and science course performance at SUNY Oswego, while controlling for New York students' demographic factors. Additionally, a secondary purpose is to identify the potential factors, if any, at the secondary school level that best predict and explain a student's chances of being successful and persisting in college freshman STEM major courses at SUNY Oswego.

The overarching research question explored in this study is as follows: What is the nature of the relationship between New York State high school students' academic performance, as measured by final grades in freshman college mathematics and science courses at SUNY Osweg when controlling for student and High School demographic factors?

Subsidiary Research Questions

Based on the overarching research question stated above, the following subsidiary research questions will be investigated and the following null hypotheses tested:

- SRQ 1: What influence, if any, do the factors of first-time college attendees right after high school, and the student mutable variables of SES, gender, race, and high school typology (large population, small population) have on student performance in college freshman math and science courses at SUNY Oswego?
- SRQ 2: What high school academic factors are significantly related to first-year students' academic success in STEM disciplines?

- SRQ 3: What high school factors indicate college first-year student retention (from the first fall of enrollment to the beginning of the first spring term) in STEM disciplines?
- SRQ 4: What is the nature of the relationship between New York State high school students' overall high school GPA and their final grades in first-year mathematics and science courses at SUNY Oswego when student mutable demographic variables are controlled for?

  Null Hypothesis: There is no statistically significant relationship between New York State high school students' overall GPA and their final grades in college freshman mathematics and science courses at SUNY Oswego when student mutable demographic variables are controlled for.
- SRQ 5: What is the nature of the relationship between students' overall high school New York State Regents Exam scores and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for?

  Null Hypothesis: There is no statistically significant relationship between students' New York State Regents Exam (Exit Exam) scores and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for.
- SRQ 6: What is the nature of the relationship between New York State high school students' transfer credit (college credits which they earned during high school) and their final grades in college freshman mathematics and science

courses at SUNY Oswego when mutable demographic variables are controlled for?

Null Hypothesis: There is no statistically significant relationship between New York State high school students' transfer credit (college credits which they earned during their high school) and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for.

- SRQ 7: What is the nature of the relationship between New York State high school students' SAT scores and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for?

Null Hypothesis: There is no statistically significant relationship between New York State high school students' SAT scores and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for.

- SRQ 8: When controlling for demographic mutable variables, which model best accounts for the greatest proportion of explained variance in college biology performance?
- SRQ 9: When controlling for demographic mutable variables, which model best accounts for the greatest proportion of explained variance in college chemistry performance?

- SRQ 10: When controlling for demographic mutable variables, which model best accounts for the greatest proportion of explained variance in college mathematics performance?

The common indicators used in this study were HSGPA (high school grade point average), New York State Regents Exam (exit exam) scores, Parent with College Education, Race, SES (socioeconomic status), Gender, Transfer Credit (college credits earned in high school), college placement test results on the SAT, and high school typology. This study was conducted to investigate correlations between high school academics and demographics and the performance of students' first-year college mathematics and science courses.

Setting

The State University of New York at Oswego is a small-sized college with an enrollment of approximately 8,300 students, located in Oswego in Northwestern New York State. SUNY Oswego was founded in 1861 as the Oswego Primary Teachers' Training School by Edward Austin Sheldon, who embraced and popularized some of the most innovative teaching methods of his day. The following data are based on the university's admissions and profile for the Fall 2011 freshman class:

- Freshman Applicants: Out of 10,000 applicants, 48% were admitted
- Freshman Enrollment by Gender: Female 52% Male 48%
- Freshman SAT Scores: The middle 50% range is 1035-1185; the mean is 1110
- Distribution by major: Sciences/ Math/ Computer Science 19%; Undeclared 15%

- 66% of the freshmen class received need-based aid.

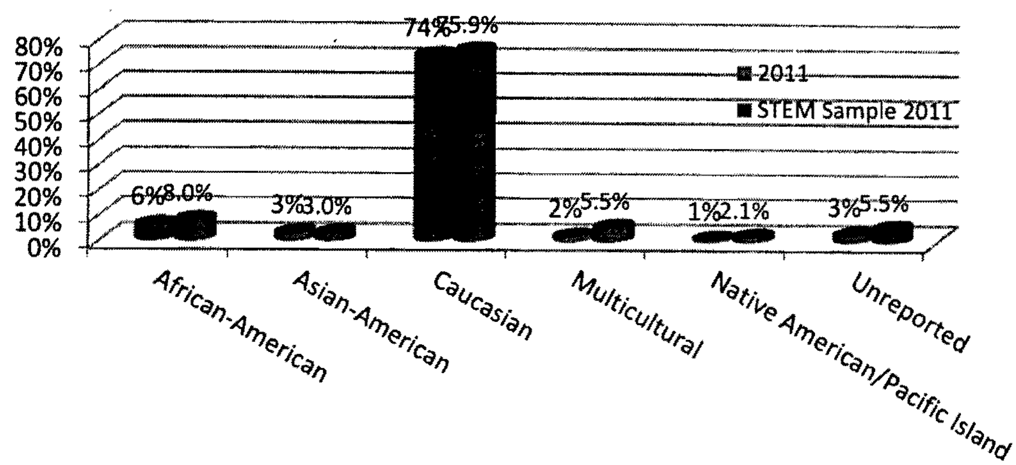

Figure 9. *Freshman Enrollment from Underrepresented Groups.*

Table 2

First-Time Full-Time Undergraduate Admissions Profile--Freshmen, Fall 2011

Entry Status	Fall - 2011
Applied	9,743
Admitted	4,707
% of Applied Enrolled	48 %
Enrolled	1,336
% of Admitted who Enrolled	28 %
Averages Scores /Grades Fall 2011	
SAT Verbal	
SUNY Oswego Freshmen	545
National	497
SAT Math	
SUNY Oswego Freshmen	560
National	514
High School Grade Point Average	
SUNY Oswego Freshmen	90

Source: SUNY Oswego Office of Admissions, College Board

Table 3 includes the independent and dependent variables that will be used in this quantitative analysis and their corresponding values. For the dichotomous variables, I set up a range of dummy coded (0 or 1) variables for the regression. There are four dependent variables used in this study:

- Status in spring was dichotomized as students who enrolled for the spring semester categorized as "1" and students who did not enroll for the spring semester categorized as "0".
- Final grade of freshman college biology on a scale of 0 to 4. The final grade was used as a continuous variable. Students' letter grades were converted to numerical values in keeping with SUNY Oswego's grading system (see Table 5).
- Final grade of freshman college chemistry on a scale of 0 to 4. The final grade was used as a continuous variable. Students' letter grades were converted to numerical values in keeping with SUNY Oswego's grading system (see Table 5).
- Final grade of freshman college mathematics on a scale of 0 to 4. The final grade was used as a continuous variable. Students' letter grades were converted to numerical values in keeping with SUNY Oswego's grading system (see Table 5).

Two sets of predictor variables were extracted from the SUNY Oswego database: demographic and academic variables.

Demographic Variables

- Gender was dichotomized as male (0) and female (1)

- Race or Gross Ethnicity was dichotomized with students who were classified as African American, Asian, and Pacific Islander, Multi Race, Unknown, or Native American placed in one category as Non-White (0) and students who were classified as White placed in a second category indicated as "1."
- Estimated Family Contribution of less than $1,000 (EFC<1000) was dichotomized with students whose parents had less than $1,000 contribution as "1" and students whose families contributed more than $1,000 as "0."
- Pell Grant was dichotomized with Pell Grant recipients categorized as "1" and not Pell Grant recipients as "0."
- Parent with College Education was dichotomized with students who had at least one parent with a college degree categorized as "1" and students with no parent with a college degree categorized as"0."
- School Size was dichotomized with schools with a population of 800 students or more categorized as "1" and schools with less than 800 students categorized as "0."

Academic Variables

- High school grade point average (HSGPA) on a scale of 0 to 100. The GPAs were used as a continuous variable.
- Transfer Credit was used as continuous variable from 0 to 51.
- New York State Regents Exams were catégorized as Integrated Algebra, Biology, and Chemistry Regents Exam. All of these Exam results were on a scale of 0 to 100 with a passing score of 65. The Regents Exams were used as continuous variables.

- SAT Composite Score was on a scale of 400 to 1600 and was used as a continuous variable. Pell Grant not recipients as "0."

Table 3

Dependent/Outcome and Independent/Predictor Variables Relating to Performance in First-Year College Mathematics and Science Courses

DEPENDENT/OUTCOME VARIABLES	
Status in Spring Dichotomous	Continued in the same major (0=no; 1=yes) Continued as a SUNY Oswego College Students
Freshman Science Courses Categorical	1. General Chemistry 2. Biology
Freshman Mathematics Categorical	1. Mathematics
INDEPENDENT/PREDICTOR VARIABLES	
Demographic Factors	
Gender (Dichotomous)	Male (0) Female (1)
Gross- Ethnicity (Dichotomous)	White (1) Non - White (Black, Native American, Asian, Pacific Islander, Multi Race, unknown) (0)
Parent with College Education (Dichotomous)	Yes (1) No (0)
Expected Family Contribution (EFC) <1000 (Dichotomous)	Yes (1) No (0)
Pell Grant (Dichotomous)	Yes (1) No (0)
School Size (Dichotomous)	Student attending a School that has 800 or more than 800 student population (1) Less than 800 student population (0)
Academic Factors	
Overall High School GPA (Continuous)	0 - 100
SAT Composite (Continuous)	SAT Math (200-800) SAT Verbal (200-800)

New York State Regents Exam scores (Categorical)	Passing score required: a minimum of 65 in 1. Integrated Algebra (0-100) - (Continuous) 2. Biology (0-100) - (Continuous) 3. Chemistry (0-100) - (Continuous)

SUNY Oswego received a total of 9,109 student applicants to the college in Fall 2011. These applicants earned an average SAT score of 1053.4 with a standard deviation of 144.3, and had an average HSGPA of 85.9, with a standard deviation of 6.5. SAT and GPA scores were significantly higher for those students who enrolled at SUNY Oswego, with SAT scores averaging 1098.4 with a standard deviation of 95.8, and GPAs averaging 89.6 with a standard deviation of 4.1 (see Table 4).

Table 4

Fall 2011 SAT and HSGPA Summary

Total Regular Admit Applicants 9,109				
	Count of SAT	**Average of SAT**	**Excluded records**	**Std. Deviation**
SAT	7,387	1053.4	1722	144.3
HSGPA	8,347	85.9	762	6.5
Total Regular Admit Accepts 4,354				
	Count of SAT	**Average of SAT**	**Excluded records**	**Std. Deviation**
SAT	4,315	1113.4	39	102.4
HSGPA	4,324	89.5	30	4.1
Total Regular Admit Enrolled 1,146				
	Count of SAT	**Average of SAT**	**Excluded records**	**Std. Deviation**
SAT	1,135	1098.4	11	95.8
HSGPA	1,141	89.6	5	4.1

Source: Term Applicant Argos Report, Fall 2011. Retention file run 28 Jan 13

The dependent variables in this study were mathematics and science courses. Students' letter grades were converted to numerical values in keeping with SUNY Oswego's grading system (see Table 5).

Table 5

SUNY Oswego Letter Grades

Letter Grade	Quality Points for Each Credit Hour
A	4.00
A-	3.67
B+	3.33
B	3.00
B-	2.67
C+	2.33
C	2.00
C-	1.67
D+	1.33
D	1.00
D-	0.67
E	0

Data Collection Sources

All the data sources used in this research were reported to and reviewed by the Office of Institutional Research and Assessment at SUNY Oswego. Permission was granted to me as the researcher by SUNY Oswego to use the information. Data were then gathered by Dr. Mehran Nojan, SUNY Oswego Director of Institutional Research and Assessment, and sent to me via an Excel spreadsheet categorized by student numbers. These numbers were assigned to individual students in order to ensure that the data set remained anonymous and confidential.

Data for students enrolled in the Fall 2011 semester were extracted from the student enrollment database. These included information on enrollment, gender, race/ethnicity, class levels, SAT score ranges (SAT Math and SAT Verbal), high school grade point average ranges, academic standing, cumulative grade point averages, cumulative credit hours earned by Fall 2011 and by Spring 2012, the number of transfer

credits, New York State Regents scores, expected family tuition contribution, SES, parent with college education, and retention status at the end of the fall and/or spring semester. The data for high school size, based on the number of students served by each high school, were taken from the New York State report cards for the years 2010 and 2011.

The participants in this study were full-time, first-time (attending college right after high school), first-year students enrolled at SUNY Oswego. All the data involved first-year students in undergraduate STEM programs for Fall 2011. They were all American citizens and permanent residents; international students were excluded. Only New York State students who had graduated from New York State high schools were included. All students are required to stay on campus at SUNY Oswego for their freshman and sophomore years. The SUNY Office of Institutional Research extracted the student records that met all of the specified criteria.

A total population of 237 first-year students was studied. To protect students' anonymity, no personally identifiable information was included in the data sheet, and all data were first screened by staff from the SUNY Office of Institutional Research to ensure that no extra student information was included. Each student was assigned an ID number by the Office of Institutional Research. This was the only identifier for each student. The SUNY Office of Institutional Research keeps the real names to verify any data, but this data was not released to the researcher.

Statistical Analysis of Data

The SSPS 21.0 version was used to complete the data analysis using quantitative data that included students' high school grade point averages (HSGPAs), Transfer Credit, SAT composite scores, and New York State Regents Exam scores, while controlling for

the student and demographic factors. The academic and demographic data were analyzed using descriptive statistics.

The researcher specifically investigated and explored relationships between variables and the strengths of their associations by utilizing a non-experimental associational/relational explanatory design. The investigation yielded data on the possible relationships between academic performance in high school and the academic achievement of first-year college STEM majoring students in college. For this study, Pearson Correlation, binary logistic regression, simple regression, simultaneous multiple regression, and hierarchical regression analyses were used to analyze the results for each research question. While in simple regression there is only one predictive value for each dependent variable, there are two or more predictive variables for each dependent variable in multiple regression (Statsoft, 2012).

I examined the correlation matrix and ran the simultaneous multiple regressions to identify academic and demographic variables that explained the greatest amount of variance in final grades of freshman college mathematics and science. When the models were constructed, I considered the threat of multicollinearity on the independent variables.

For Subsidiary Research Question 1, in order to more thoroughly address the main question exploring the relationship between college freshman science and mathematics final grades and high school academics, multiple linear regressions were conducted. Multiple linear regressions are an appropriate statistical methodology to better examine and identify variables that might be statistically significant predictors of students' success. In these regression analyses, demographic (School Size, Gender, Race,

SES, Pell Grant, and Parent with College Education) variables were used as independent variables and final course grade of freshman College Mathematics and Science as dependent variables.

Since a multiple regression allows for the simultaneous testing and modeling of multiple independent variables, it allowed me to examine the nature of the relationship between New York State high school students' demographic factors, including school typology, and their final grades in college freshman mathematics and science courses at SUNY Oswego. Table 6 shows the predictor variables per regression model.

Table 6

Simultaneous Regression for Demographic Variables

Simultaneous Regression		
College Biology	All Variables	Gender (male = 0; female = 1) Non-White (white = 0, Non-White = 1) Parent With College Education (no = 0, yes = 1) School size (less than 800 students = 0, more than 800 students =1) Pell Grant (not Taken = 0, taken = 1)
College Chemistry	All Variables	School Size (less than 800 = 0, 800 or more = 1) Pell Grant (not received = 0. Received = 1) Parent with College Education (No = 0, yes = 1) Gender (male = 0, female = 1) Non-White (White = 0, Non-White = 1)
College Mathematics	All Variables	School Size (less than 800 = 0, 800 or more = 1) Pell Grant (not received = 0. Received = 1) Parent with College Education (No = 0, yes = 1) Gender (male = 0, female = 1) Non-White (White = 0, Non-White = 1)
College Physics	All Variables	School Size (less than 800 = 0, 800 or more = 1) Pell Grant (not received = 0. Received = 1) Parent with College Education (No = 0, yes = 1) Gender (male = 0, female = 1) Non-White (White = 0, Non-White = 1)

For Subsidiary Research Question 2, Pearson's correlations were used to see the relationships among the variables of first-semester mathematics and science courses grades, New York State Regents exam scores, SAT scores, Transfer Credit, HSGPA, School Size, Gender, Race, SES (Pell Grant) and Parent with College Education.

To address Subsidiary Research Question 3, a binary logistic regression analysis was used since the dependent /outcome variable was dichotomous. If a dependent variable is dichotomous, it can be a logistic or probabilistic regression; i.e., a logit or a probit model. Mertler and Vannatta (2005) noted that the goal of logistic regression is to "predict membership into one or more groups" (p. 313). It is a statistical technique that estimates the individual effects of different independent variables on a dependent variable (such as college enrollment or fall to spring semester college retention) when the dependent variable is dichotomous (yes/no). For this research question, dummy coding was used for the outcome variable. Students who were retained in college from fall to spring (Spring Status) were coded as one and students who did not continue for spring semester were coded as zero. Logistic regression was used to find the retention of the STEM majoring students from 2011 Fall to 2012 Spring semester. The goal of using the logistic regression model was to find the relationship between the dependent variable and the independent (explanatory) variable called covariates. As Garson (2004) indicated, logistic regression predicts the probability of the students who were retained from the fall to the spring semester. For retention studies, logistic regression is an established method (Cabrera, Nora, & Castaneda, 1993).

For Subsidiary Research Questions 4, 5, and 6, the researcher conducted multiple regression analyses on data involving students' high school academics and demographics,

including school typology (independent/predictor variables), and final course grades of freshman College Mathematics and Science courses (the dependent/outcome variables) in an attempt to determine which, if any, predictor variables were significantly related to outcome variables. To understand which variable will provide the best prediction, the researcher applied a multiple regression equation model (Leech, Morgan, & Barrett, 2008). Based on the work of Ravid (2000) and Witte and Witte (2007), the multiple regression model has often been used in prediction and forecasting and in understanding the strength of relationships. The main purpose of multiple regression is to analyze the relationship between metric independent variables (those involving units of measure: SAT score, Regents score, HSGPA, and so forth) and dichotomous independent variables (those with only two values, 0 and 1, dummy variables--whether a student's parent has a college education or not, whether a student is male or female, and so forth).

All regression analyses explore either a “simultaneous” or “entry” method for each model’s variables along with hierarchical models dependent upon the “simultaneous” outcomes (Witte & Witte, 2007). Simultaneous regression is used to identify the subset of independent variables that have the strongest relationship to a dependent variable. In this model, the computer (SSPS 21.0 version) runs all possible regression combinations after being given the dependent variable and all of the independent variables.

Since a multiple regression allows for the simultaneous testing and modeling of multiple independent variables, it allowed the examination of the nature of the relationship between New York State high school students’ academic performance and

their final grades in college freshman mathematics and science courses at SUNY Oswego, when student and demographic factors were controlled for.

If one or more of the independent variables is highly correlated with one or more of the other independent variables, that is an indication of multicollinearity. Multicollinearity is a problem when the coefficients are interpreted (Schroeder, 1990). Multicollinearity can result in inaccurate results, and it occurs when there are high intercorrelations among some set of the predictor variables (Leech, Barrett, & Morgan, 2011). Multcollinearity can be understood by looking at the tolerance and variation inflation factor (VIF) values in the collinearity statistics box. Tolerance and VIF value give the same information. If the tolerance value is low ($<1\text{-}R^2$), then there is probably a problem with multicollineartiy (Leech, Barrett, & Morgan, 2011). I used the VIF value of less than or equal to 2. Therefore, I dropped variables from the regression equation that contributed to multicollinearity within a specific model. Table 7 shows the predictor variables per regression model.

Table 7

Simultaneous Regression

College Biology	All Variables	Regents Biology Exam HSGPA SES Gender Non-White Parent With College Education Transfer Credit School Size

College Chemistry	All Variables	Regents Chemistry Exam HSGPA SES Gender Non-White Parent With College Education Transfer Credit School Size
College Mathematics	All Variables	Regents Integrated Algebra Exam HSGPA SES Gender Non-White Parent With College Education Transfer Credit School Size

To address Subsidiary Research Question 7, a simple regression analysis was used for final course grade of College Mathematics and Science as the dependent variables and SAT composite score as the independent variable. A student's success in college freshman Mathematics and Science courses was best predicted by considering the student's Gender, Race, School Size, Parent with College Education, Socioeconomic Status, High School GPA, Transfer Credit, New York State Regents Exam score, and SAT composite score. However, in this study SAT composite score showed high multicollinearity; therefore, it was eliminated from the regressions and a separate simple regression was run for SAT composite score to see its impact on freshman College Mathematics and Science performances.

For Subsidiary Research Questions 8, 9, and 10, a hierarchical regression analysis was used to find the best model that explains the most variance of the dependent variables. If there is a relationship between the dependent and the independent variables,

using the information of the independent variables improves accuracy in predicting values for the dependent variable (over and above using a simple, single variable regression model). In our case, I conducted a series of hierarchical regression models using the information from the multiple regression models. Based on the literature review, high school GPA and SAT composite scores, etc. seemed to be significant; in our hypothesis, we added other controlling variables to see whether they would have a significant effect on the dependent variable. Table 8 shows the predictor variables per regression model.

Table 8

Hierarchical Regression Analyses Models for College Biology, College Chemistry, and College Mathematics

1st Model College Biology	2nd Model College Chemistry	3rd Model College Mathematics
School Size Gender Non-White Regents Biology Exam Transfer Credit	School Size Gender Non-White	School Size Gender Non-White Regents Algebra Exam Pell Grant
School Size Gender Non-White Pell Grant Regents Biology Exam Transfer Credit	School Size Gender Non-White Pell Grant	School Size Gender Non-White Regents Algebra Exam Pell Grant Transfer Credit
School Size Gender Non-White Pell Grant Regents Biology Exam Transfer Credit Parent with College Credit	School Size Gender Non-White Pell Grant Transfer Credit	School Size Gender Non-White Regents Algebra Exam Pell Grant Transfer Credit HSGPA
School Size Gender Non-White	School Size Gender Non-White Pell Grant	

Pell Grant Regents Biology Exam Transfer Credit Parent with College Credit HSGPA	Transfer Credit HSGPA	
	School Size Gender Non-White Pell Grant Transfer Credit HSGPA Regents Chemistry Exam	

Chapter Summary

The 237 first-time freshman college students in the fall semester of 2011 who were enrolled in STEM majors made up the sample for this study. The findings of this study will help to build an understanding of the relationship between key academic/ demographic variables of New York State high school students and success in freshman college mathematics and science courses.

Chapter IV

RESULTS

The purpose of this research is to examine the influence of high school academic performance on freshman-level math and science course performance at SUNY Oswego, while controlling for the demographic factors affecting New York students. Additionally, a secondary purpose will be to identify the potential factors, if any, at the secondary school level that best predict and explain a student's chances of being successful and persisting in college freshman STEM major courses at SUNY Oswego. Pearson's correlations were used to test the null hypotheses that examine relationship between the variables of HSGPA, SAT total scores, Transfer Credit, and Parent with a College Education. Regressions were conducted to address the four questions that would determine the relationship between the college freshman mathematics and science courses final grades and student demographics, HS GPA, New York State Regents Exams, SAT scores, AP final scores, and Transfer Credit. Also, a multiple linear regression was conducted to examine the factors that were statistically significant predictors of students' success.

Description of Sample

The sample for this study was freshmen enrolled at SUNY Oswego. The sample was limited to full-time, first-time, first-year freshman students enrolled in college mathematics, biology, chemistry, physics, and computer science for the Fall 2011 semester. There were 237 students registered who took college mathematics, biology, chemistry, physics and computer science for a total population of 237 first-year students studied.

To protect students' anonymity, each student was assigned an ID number by the Office of Institutional Research. This was the only identifier for each student. The SUNY Office of Institutional Research keeps the real names to verify data, but these data were not released for this research.

The profile for independent variables includes Gender, Ethnicity, Estimated Family Contribution, Pell Grant, New York State Regents Exam, SAT, and HSGPA. The 237 freshman students consisted of 108 (45.6 %) females and 129 (54.4 %) males (see Table 9).

Table 9

Gender Demographics

Gender				
		Frequency	Valid Percent	Cumulative Percent
Valid	Female	108	45.6	45.6
	Male	129	54.4	100.0
	Total	237	100.0	

With 237 STEM major students, the demographics with regard to race were approximately 56.3% White, 2.2% Asian, 5.9% Black, 0.9% Native American, 4.1% Multi Racial, 0.6% Pacific Islander, and 4.1% unknown. Table 10 provides the race or ethnicity demographic characteristics of the students.

Table 10

Distribution by Race

Race	Frequency	Valid Percent	Cumulative Percent
Asian	7	3.0	3.0
Black	19	8.0	11.0
Native American	3	1.3	12.3
Multi-Racial	13	5.5	17.8
Pacific Islander	2	.8	18.6

Unknown	13	5.5	24.1
White	180	75.9	100.0
Total	237	100.0	

Expected family contribution is the number that is used to determine a student's eligibility for federal student financial aid. In this study, SUNY Oswego provided the data for those families who were able to contribute less than $1,000. The financial need is calculated by the difference between the cost of attendance (COA) at a school and the expected family contribution (EFC). While COA can vary from school to school, the EFC does not change based on the school student will attend. In Table 11, 22.4% or students were eligible for federal student aid, whereas 77.6% were not eligible.

Table 11

Expected Family Contribution

Expected Family Contribution (EFC)				
(EFC) <1000		Frequency	Valid Percent	Cumulative Percent
Valid	No	184	77.6	77.6
	Yes	53	22.4	100.0
	Total	237	100.0	

Federal Pell Grants are usually awarded only to undergraduate students. The amount of aid a student can receive depends on the student's financial need, the cost of attendance at the school, and other factors. Amounts can change yearly. The maximum federal Pell Grant award is $5,550 for the 2012–2013 award year (July 1, 2012 to June 30, 2013). The amount a student is awarded, though, will depend on the following:

- Financial need
- Cost of attendance
- Status as a full-time or part-time student

- Plans to attend school for a full academic year or less

Thirty-five percent of the 2011 freshman students received a Pell Grant, whereas 65% did not (see Table 12).

Table 12

Pell Grant Recipients

Pell				
		Frequency	Valid Percent	Cumulative Percent
Valid	No	154	65.0	65.0
	Yes	83	35.0	100.0
	Total	237	100.0	

Larger high schools (more than 800 students) might have the opportunity to provide more after-school activities, as well as curricular offerings that include advanced placement and college credit courses. This might have a beneficial impact on students' preparedness for college mathematics and science courses (Rohr, 2009). This study categorized the schools as having a population of less than or more than 800 students. (see Table 13).

Table 13

School Size Based on Less or More than 800 Students in Grades 9-12

School size				
		Frequency	**Valid Percent**	**Cumulative Percent**
Valid	**Less than 800 students**	72	33.0	33.0
	800 or more students	146	67.0	100.0
	Total	218	100.0	

In the data set Parent with College Education, if a student indicated "yes," it meant one or both parents have college education degree; if a student indicated "no," it

meant neither parent has a college degree. For 37.6 % of the 2011 freshman students, neither parent had any college education; and for 62.4 %, either one or both parents had a college education (see Table 14).

In the data set of New York State Regents performance, students' mean was 84.45 in Integrated Algebra Regents (SD=7.39), 86.77 in Biology Regents (SD=6.735), and 76.96 in Chemistry Regents (SD=8.737) (see Table 15).

Table 14

Parent with College Education

		Frequency	Valid Percent	Cumulative Percent
Valid	**Parent with No College Education**	89	37.6	37.6
	Parent with College Education	148	62.4	100.0
	Total	237	100.0	

Table 15

Student Performance on New York State Regents Exam: Mathematics (Algebra, Geometry, and Algebra II/Trigonometry), Science (Biology, Chemistry, Earth Science, and Physics), Humanities (English, Global, U.S History, and Foreign Languages)

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Integrated Math Regents	220	66	100	84.45	7.39
Biology Regents	225	65	99	86.77	6.735
Chemistry Regents	207	50	100	76.96	8.737
Valid N (list wise)	207				

In the data (see Appendix A), White students comprised 75% of the females and 77% of the males who had declared science majors. In both male and female categories of science majors, Black and mixed race comprised 13% of females and 14% of males.

All other races combined comprised 12% of females and 9% of males.

The data show

that females predominately (68% of the 108 female students) prefer three areas of science as majors: Biology BA, Biology BA Pre-Health, and Zoology BS. Seven of the 23 categories (30%) had no female majors at all, and eight categories (35%) had only one female major. While the greatest majority of males (16% of 129 male students) also chose Biology BA as a major, selections of other majors were more evenly distributed. With the exception of Zoo Technology, there was at least one male in each major, with all other majors averaging approximately five males.

Of the 27 Non-White female students, 12 chose Biology BA as a major, and 15 chose majors other than biology. Black and unknown race females chose Biology BA most often, while mixed race female students selected Zoology most frequently. White males demonstrated similar choices that characterize the male group overall, with Software Engineering standing out as a significant difference between the genders with 12 male majors and zero females. Similarly, out of the three physics-related majors, there was only one female, but 13 males, and in computer science, no female majors, but eight males.

SUNY Oswego 2011 Fall (first semester) and Spring (second semester recorded as cumulative) college GPAs are indicated in Table 16 below. The highest GPA in the fall semester was 3.97 with a mean of 2.57 (SD=0.80); and in the spring semester, the highest GPA was 3.98 with a mean of 2.57 (SD=0.77).

Table 16

Students' College Grade Point Average

Descriptive Statistics

College GPA	N	Minimum	Maximum	Mean	Std. Deviation
GPA Fall 2011	237	0.00	3.97	2.57	0.80
Cum. GPA as of Spring 2012	237	0.00	3.98	2.57	0.77
Valid N (list wise)	237				

Most of the colleges and universities are using the SAT or ACT score as one of the main criteria to admit students. For the freshman students, the SAT composite scores ranged from 640 to 1460. Average SAT score of 237 students accepted in SUNY Oswego for fall 2011 freshman class is 1081.14 (SD= 129.07) with the average verbal score being 557.89 (SD= 71.47) and average math score being 523.25 (SD= 76.62) (see Table 17).

Table 17

Students' Performance on SAT

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
SAT Total	237	640.00	1460.00	1081.14	129.07
SAT Math	237	300.00	770.00	557.89	71.47
SAT Verbal	237	300.00	730.00	523.25	76.62
Valid N (list wise)	237				

The national average for SAT mathematics is 514 and SAT Critical Reading is 497 (U.S. Department of Education, National Center for Education Statistics, 2012). The frequency of the SAT composite scores that the students received who enrolled at SUNY Oswego is shown in Table 18.

Table 18

Students' SAT Composite Scores

SAT Composite				
SAT Composite		Frequency	Valid Percent	Cumulative Percent
Valid	600 - 699	1	0.40	0.40
	700 - 799	6	2.60	3.00

	800 - 899	9	3.80	6.80
	900 - 999	35	14.70	21.50
	1000 - 1099	81	34.20	55.70
	1100 - 1199	61	25.70	81.40
	1200 - 1299	32	13.50	94.90
	1300 - 1399	11	4.70	99.60
	1400 - 1499	1	0.40	100.00
	Total	237	100.00	

One of the SUNY Oswego admission criteria is high school grade point average. The average high school grade point average (HSGPA) score of 237 students accepted to SUNY Oswego for the Fall 2011 freshman class was 89.62 on a 100 point grading scale (SD= 4.16). The frequency distribution of students' high school grades (see Table 20) is as follows: 115 (48.52%) students had a HSGPA between 90-100; 120 (50.64%) had a HSGPA between 80–89, and two (0.84) had a HSGPA between 75-79.

The frequency of the SAT composite scores received by the students enrolled at SUNY Oswego is shown in Table 20.

Table 19

Students' High School Grade Point Average

Descriptive Statistics					
High School Grade Point Average	N	Minimum	Maximum	Mean	Std. Deviation
HSGPA	237	78.00	99.00	89.62	4.16
Valid N (list wise)	237				

Table 20

Students' High School GPA

High School Grade Point Average				
HSGPA (0-100)		Frequency	Valid Percent	Cumulative Percent
Valid	90 - 100	115	48.52	48.5
	80-89	120	50.64	99.16

	75-79	2	0.84	100.00
	Total	237	100	

While White students had the highest SAT total composite scores, Pacific Islander students scored the lowest. African-American, biracial, and unknown performed slightly better than Pacific Islanders (see Table 21).

Table 21

Students' SAT Performance Disaggregated by Race/Ethnicity

RACE								
		A(n=7)	B(n=19)	I(n=3)	M(n=13)	P(n=2)	U(n=13)	W(n=180)
SAT TOTAL	Mean	922.86	974.21	1030	1093.08	905	974.62	1108.22
	Std	185.63	154.39	69.28	129	162.63	116.16	109.7
SAT MATH	Mean	518.57	496.84	560	533.85	460	500	572.83
	Std	124.29	83	52.92	55.91	113.14	48.48	63.1
SAT VERBAL	Mean	404.29	477.37	470	559.23	445	474.62	535.39
	Std	96.41	83.99	52.92	78.47	49.5	88.38	66.57
CUM GPA AS OF SPRING 2012	Mean	2.69	2.41	1.66	2.37	2.68	2.4	2.62
	Std	0.99	0.91	0.78	0.44	0.5	0.45	0.78

Dual credit programs are programs in which students participate in coursework for which they receive high school and postsecondary credit. Dual credit programs are a type of dual enrollment policy designed to promote college readiness and facilitate the transition to enrollment in postsecondary institutions (Bhatt & Best, 2009).

Table 22

Students Who Completed College Course during High School and Transferred to SUNY Oswego

Transfer Credit				
Total number of transferred College Credits		Frequency	Valid Percent	Cumulative Percent
Valid	1 – 10	58	47.15	47.15
	11 – 20	46	37.40	84.55

	21 –30	13	10.57	95.12
	31 – 40	4	3.25	98.37
	41 – 50	1	0.81	99.19
	51	1	0.81	100
	Total	**123**	**100**	**100**

In above table (Table 22), we summarize the transfer credit frequencies. For example, there are 58 students who transferred from 1 to 10 college credits, whereas there are 19 students who were able to transfer 21 or more college credits while they were in high school to SUNY Oswego.

Findings for Subsidiary Research Questions

There is one overarching research question in this study: What is the nature of the relationship between New York State high school students' academic performance as measured by final grades in freshman college mathematics and science courses at SUNY Oswego when controlling for student and high school demographic factors? Based on this overarching question, the subsidiary research questions were investigated and resulted in the following findings:

Findings for Subsidiary Research Question 1

What influence, if any, do the factors of first-college attendees after high school and the student mutable variables of SES, Parent with College Education, Gender, Race, and High School Typology Environment (large population, small population) have on student performance in college freshman math and science courses at SUNY Oswego?

Multiple regression analysis was performed to determine the amount of variability in the dependent or outcome variable freshman college mathematics and science courses

that could be explained by the student demographic variables of Gender (see Table 9), Race (see Table 10), EFC (see Table 11), Pell Grant (see Table 12), School Size (see Table 13) and Parent with College Education (see Table 14). The tables listed above provide the descriptive statistics for all the predictor variables used in the model.

Before I computed the regressions, I examined the relationships between the independent variable and dependent variable. Table 26 indicates the relationship at $p < 0.01$ or $p < 0.05$ level. The correlation coefficient is a measure of linear association between two variables. Values of the correlation coefficient are always between -1 and +1.

The Pearson Correlation table (see Table 26) reveals the direction and the strength of the relationships. There is a positive moderate relationship between the predictor variable of HSGPA and the outcome variables (Pearson r for College Biology= .413, r for College Chemistry= .457, and r for College Mathematics= .398), which was found to be statistically significant ($p \leq .001$). However, Pearson r for College Physics was not significant.

There is a positive moderate relationship between the predictor variable of SAT and the outcome variables (Pearson r for college biology= .235, r for college chemistry= .402, r for college mathematics= .206, and r for college physics= .455), which was found to be statistically significant ($p \leq .001$). However, SAT has a higher correlation with Regents Exam Algebra r= .654, Regents Biology r=620, and Regents Chemistry r= .556.

The relationship between the independent variable of School Size and the dependent variables of College Chemistry, College Mathematics, and College Physics was found not to be statistically significant ($p \leq .05$) and had a weak negative relationship

with College Biology (Pearson r= -.203), which was found to be statistically significant ($p \leq .05$).

The relationship between the independent variable of Non-White and the dependent variables of College Mathematics and College Physics was found not to be statistically significant ($p \leq .05$) and had a weak negative relationship with College Biology (Pearson r= -.239) and with College Chemistry (Pearson r= .250), which was found to be statistically significant ($p \leq .001$).

The relationship between the independent variable of EFC, Gender, Non-Suburban and Pell Grant and the dependent variables of College Biology, College Chemistry, College Mathematics, and College Physics was found to be not statistically significant ($p \leq .05$).

The relationship between the independent variable of Parent with College Education and the dependent variables of College Chemistry, College Mathematics, and College Physics was found not to be statistically significant ($p \leq .05$) and had a weak positive relationship with College Biology (Pearson r= .283), which was found to be statistically significant ($p \leq .05$).

The relationship between the independent variable of Transfer Credit and the dependent variables of College Biology and College Physics was found not to be statistically significant ($p \leq .05$) and had a weak positive relationship with College Mathematics (Pearson r= .290) and a stronger relationship with College Chemistry (Pearson r= .391), which was found to be statistically significant ($p \leq .001$).

Two predictor variables, Expected Family Income and Pell Grant, had a stronger correlation (r=.731), which was found to be statistically significant ($p \leq .0001$). The

partial correlation coefficients for each of these variables would be required to examine the coefficients for each of these variables because one variable could on occasion act as a suppressor to the other variable; variables might be combined (aggregated) then into a composite variable or eliminate one or more of the highly correlated variables (Leech, Barrett, & Morgan, 2011).

If there are more than four predictor variables in a simultaneous regression model and/or when there is a strong correlation between two or more predictor variables in any regression model that is run--even though the tolerances might be within acceptable ranges--it is important to examine the partial correlations (Robinson, 2012). There is a closer approximation of the amount of variance explained by that particular predictor variable on the outcome variable (Leech, Barrett, & Morgan, 2011).

In this study, Expected Family Contribution (EFC) seemed to surpass Pell Grant and SAT seemed to surpass HSGPA; therefore, they were eliminated from the variable table. Table 23 shows the regression models that were used to analyze all of the predictor variables and their influence on students' final course grade in College Mathematics and Science.

Table 23

Simultaneous Regression

		Simultaneous Regression
College Biology	All Variables	Gender (male = 0; female = 1) Non-White (White = 0, Non-White = 1) Parent With College Education (no = 0, yes = 1) School size (less than 800 students = 0, more than 800 students = 1) Pell Grant (Not Taken = 0, taken = 1)
College Chemistry	All Variables	School Size (less than 800 = 0, 800 or more = 1) Pell Grant (not received = 0. Received = 1)

		Parent with College Education (No = 0, yes = 1) Gender (male = 0, female = 1) Non-White (White = 0, Non-White = 1)
College Mathematics	All Variables	School Size (less than 800 = 0, 800 or more = 1) Pell Grant (not received = 0. Received = 1) Parent with College Education (No = 0, yes = 1) Gender (male = 0, female = 1) Non-White (White = 0, Non-White = 1)
College Physics	All Variables	School Size (less than 800 = 0, 800 or more = 1) Pell Grant (not received = 0. Received = 1) Parent with College Education (No = 0, yes = 1) Gender (male=0, female = 1) Non-White (White = 0, Non-White = 1)

College Biology

The number of subjects (N) in this model was 117. The ANOVA reported in Table 64 (Appendix B) indicates the model was statistically significant (F=10.825; df = 3,236; p≤ .000). An examination of the Adjusted R square (R^2) in the model summary (see Table 63, Appendix B) reveals that 11.1 % (.111) of the variance in College Biology can be explained by all predictor variables (Parent with College Education, School Size, Pell Grant, Non-White and Gender) entered in the model. All reported variance inflation factors (VIFs) were less than 2, suggesting that multicollinearity issues are not present in this model.

Table 24

Coefficients[a] Table for Demographic Variables on College Biology Performance

Model	Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
(Constant)	2.056	.318		6.459	.000					
Gender	.420	.195	.188	2.157	.033		.201	.187	.985	1.015

Non-White	-.334	.220	-.139	-1.514	.133	-.218	-.142	-.131	.898	1.114
Pell	.312	.222	.138	1.406	.162	.023	.132	.122	.781	1.281
School Size	-.299	.211	-.129	-1.418	.159	-.203	-.133	-.123	.903	1.108
Parent with College Education	.591	.221	.264	2.672	.009	.270	.246	.232	.771	1.298

[a] Dependent Variable: College Biology

Gender is a significant predictor in the model (β=.188; t=5.157; p≤ .033), contributing 3.5 % $(.188)^2$ to 4 % (.201) of the variance in College Biology performance, as indicated by the standardized beta and partial correlation values, respectively. Female students have better College Biology performance than male students.

Parent with College Education is a significant predictor in the model (β=.264; t=2.672; p≤ .009), contributing 3.5% $(.264)^2$ to 4% (.246) of the variance in College Biology performance, as indicated by the standardized beta and partial correlation values, respectively. Students whose parents have a college education seem to be performing better than students whose parents have no college education.

College Chemistry

The number of subjects (N) in this model was 162. The ANOVA reported in Table *66* (Appendix B) indicates the model was statistically significant (F=3.115; df= 5, 156; p≤ .010). An examination of the Adjusted R square (R^2) in the model summary (see Table 65, Appendix B) reveals that 6.2% (.062) of the variance in College Chemistry can be explained by all predictor variables (Parent with College Education, Pell Grant, School Size, Non-White, and Gender) entered in the model. All reported variance inflation

factors (VIFs) were less than 2, suggesting that multicollinearity issues are not present in this model.

Table 25

Coefficients[a] Table for Demographic Variables on College Chemistry Performance

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Err	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.141	.231		9.252	.000					
	Gender	.169	.162	.081	1.047	.296	.073	.084	.080	.986	1.015
	Non-White	-.527	.203	-.215	-2.592	.010	-.225	-.203	-.198	.845	1.183
	Pell Grant	.378	.182	.171	2.072	.040	.099	.164	.158	.857	1.167
	School Size	-.127	.173	-.058	-.732	.465	-.126	-.058	-.056	.912	1.096
	Parent with College Education	.208	.184	.096	1.131	.260	.127	.090	.086	.804	1.243

[a] Dependent Variable: College Chemistry

Pell Grant is a significant predictor in the model (β=.171; t=2.072; p≤ .05), contributing 11 % $(.171)^2$ to 11.2% $(.164)^2$ of the variance in College Chemistry performance, as indicated by the standardized beta and partial correlation values, respectively. Students who received a Pell Grant have better College Chemistry performance than students who did not.

Race (Non-White) is a significant predictor in the model (β= -.215; t=-2.592; p≤ .010), contributing 4.6 % $(-.215)^2$ to 4.1% $(-.203)^2$ of the variance in College Chemistry performance, as indicated by the standardized beta and partial correlation values, respectively. White (coded 0) students have better College Chemistry performance than Non-White (coded 1) students.

College Mathematics

The number of subjects (N) in this model was 129. A similar model was run where freshman College Mathematics was the dependent variable and the model was not statistically significant ($p \leq .360$) (see Table 67, Appendix B).

College Physics

A similar model was run where freshman College Mathematics was the dependent variable and the model was not statistically significant See Table 69, Appendix B).

Findings for Subsidiary Research Question 2

What high school academic factors indicate first-year students' academic success in STEM disciplines?

For this study, I used the SPSS software to calculate the Pearson Correlation Coefficient for each relationship. Pearson product-moment correlations were conducted to determine the significance, strength, and direction of the relationship between each independent variable and the College Mathematics and Science performance variable in this study. Table 26 displays the correlation analyses for all variables.

Freshman College Mathematics, Biology, and Chemistry performances were considered the dependent variables and paired with the following independent variables:

1. Gender
2. Non–White
3. Expected Family Contribution
4. Pell Grant
5. Non-Suburban
6. School Size
7. Transfer Credit
8. SAT Total
9. Regents Integrated Algebra Exam
10. Parent with College Education
11. HSGPA
12. Regents Biology Exam
13. Regents Chemistry Exam
14. Regents Physics Exam

Table 26

Pearson Correlations: All Variables

		Gender	Non White	EFC lt 1000	Pell	Non Suburban	School Size	Parent w/College Education	Transfer Credit	HSGPA
Gender	Pearson Correlation	1	.020	-.023	-.068	.059	.003	.080	.147*	.285**
	Sig. (2-tailed)		.756	.720	.298	.370	.966	.221	.024	.000
	N	237	237	237	237	231	233	237	237	237
Non-White	Pearson Correlation	.020	1	.409**	.249**	.396**	.109	-.318**	-.219**	-.256**
	Sig. (2-tailed)	.756		.000	.000	.000	.098	.000	.001	.000
	N	237	238	237	237	231	233	237	237	237
Expected Family Contribution EFClt1000	Pearson Correlation	-.023	.409**	1	.731**	.287**	-.055	-.462**	-.141*	-.228**
	Sig. (2-tailed)	.720	.000		.000	.000	.400	.000	.030	.000
	N	237	237	237	237	231	233	237	237	237
Pell	Pearson Correlation	-.068	.249**	.731**	1	.235**	-.134*	-.326**	-.074	-.142*
	Sig. (2-tailed)	.298	.000	.000		.000	.040	.000	.253	.029
	N	237	237	237	237	231	233	237	237	237
Non-Suburban	Pearson Correlation	.059	.396**	.287**	.235**	1	-.197**	-.090	-.053	-.105
	Sig. (2-tailed)	.370	.000	.000	.000		.003	.174	.421	.111
	N	231	231	231	231	231	231	231	231	231
School Size	Pearson Correlation	.003	.109	-.055	-.134*	-.197**	1	-.048	-.270**	-.100
	Sig. (2-tailed)	.966	.098	.400	.040	.003		.464	.000	.127
	N	233	233	233	233	231	233	233	233	233
Parent with College Education	Pearson Correlation	.080	-.318**	-.462**	-.326**	-.090	-.048	1	.165*	.150*
	Sig. (2-tailed)	.221	.000	.000	.000	.174	.464		.011	.021
	N	237	237	237	237	231	233	237	237	237
Transfer Credit	Pearson Correlation	.147*	-.219**	-.141*	-.074	-.053	-.270**	.165*	1	.383**
	Sig. (2-tailed)	.024	.001	.030	.253	.421	.000	.011		.000
	N	237	237	237	237	231	233	237	237	237
HSGPA	Pearson Correlation	.285**	-.256**	-.228**	-.142*	-.105	-.100	.150*	.383**	1
	Sig. (2-tailed)	.000	.000	.000	.029	.111	.127	.021	.000	
	N	237	237	237	237	231	233	237	237	237
SAT Total	Pearson Correlation	-.080	-.374**	-.344**	-.234**	-.292**	.028	.241**	.412**	.377**

	Sig. (2-tailed)	.221	.000	.000	.000	.000	.674	.000	.000	.000
	N	237	237	237	237	231	233	237	237	237
Regents Exam Algebra	Pearson Correlation	.026	-.348**	-.308**	-.195**	-.304**	.022	.146*	.421**	.536**
	Sig. (2-tailed)	.700	.000	.000	.004	.000	.743	.031	.000	.000
	N	220	220	220	220	217	217	220	220	220
Regents Exam Physics	Pearson Correlation	-.102	-.090	.005	.075	-.062	-.033	.015	.350**	.207*
	Sig. (2-tailed)	.236	.295	.952	.388	.476	.707	.858	.000	.015
	N	136	136	136	136	135	135	136	136	136
Regents Exam Biology	Pearson Correlation	-.045	-.395**	-.332**	-.232**	-.377**	.032	.135*	.276**	.372**
	Sig. (2-tailed)	.498	.000	.000	.000	.000	.638	.042	.000	.000
	N	225	225	225	225	222	222	225	225	225
Regents Exam Chemistry	Pearson Correlation	-.179**	-.211**	-.187**	-.024	-.187**	-.131	.088	.399**	.385**
	Sig. (2-tailed)	.010	.002	.007	.731	.007	.061	.209	.000	.000
	N	207	207	207	207	206	206	207	207	207
College Biology	Pearson Correlation	.157	-.239**	-.125	.039	-.026	-.203*	.283**	.208*	.413**
	Sig. (2-tailed)	.088	.009	.177	.672	.784	.028	.002	.023	.000
	N	119	119	119	119	115	117	119	119	119
College Chemistry	Pearson Correlation	.051	-.250**	-.009	.113	-.152	-.126	.133	.391**	.457**
	Sig. (2-tailed)	.515	.001	.905	.148	.055	.110	.088	.000	.000
	N	166	166	166	166	160	162	166	166	166
College Mathematics	Pearson Correlation	.095	-.144	-.024	.084	.031	-.071	.053	.290**	.398**
	Sig. (2-tailed)	.276	.099	.788	.337	.729	.426	.543	.001	.000
	N	132	132	132	132	129	129	132	132	132
College Physics	Pearson Correlation	.206	.047	-.221	-.313	.182	-.218	.157	.241	.164
	Sig. (2-tailed)	.370	.841	.336	.167	.431	.342	.498	.293	.478
	N	21	21	21	21	21	21	21	21	21

Table 27

Pearson Correlations: All Variables

		SAT Total	Regents Exam Algebra	Regents Exam Physics	Regents Exam Biology	Regents Exam Chemistry	College Biology	College Chemistry	College Math	College Physics
Gender	Pearson Correlation	-.080	.026	-.102	-.045	-.179**	.157	.051	.095	.206
	Sig. (2-tailed)	.221	.700	.236	.498	.010	.088	.515	.276	.370

	N	237	220	136	225	207	119	166	132	21
Non-White	Pearson Correlation	-.374**	-.348**	-.090	-.395**	-.211**	-.239**	-.250**	-.144	.047
	Sig. (2-tailed)	.000	.000	.295	.000	.002	.009	.001	.099	.841
	N	237	220	136	225	207	119	166	132	21
Expected Family Contribution EFC lt 1000	Pearson Correlation	-.344**	-.308**	.005	-.332**	-.187**	-.125	-.009	-.024	-.221
	Sig. (2-tailed)	.000	.000	.952	.000	.007	.177	.905	.788	.336
	N	237	220	136	225	207	119	166	132	21
Pell	Pearson Correlation	-.234**	-.195**	.075	-.232**	-.024	.039	.113	.084	-.313
	Sig. (2-tailed)	.000	.004	.388	.000	.731	.672	.148	.337	.167
	N	237	220	136	225	207	119	166	132	21
Non-Suburban	Pearson Correlation	-.292**	-.304**	-.062	-.377**	-.187**	-.026	-.152	.031	.182
	Sig. (2-tailed)	.000	.000	.476	.000	.007	.784	.055	.729	.431
	N	231	217	135	222	206	115	160	129	21
School Size	Pearson Correlation	.028	.022	-.033	.032	-.131	-.203*	-.126	-.071	-.218
	Sig. (2-tailed)	.674	.743	.707	.638	.061	.028	.110	.426	.342
	N	233	217	135	222	206	117	162	129	21
Parent with College Education	Pearson Correlation	.241**	.146*	.015	.135*	.088	.283**	.133	.053	.157
	Sig. (2-tailed)	.000	.031	.858	.042	.209	.002	.088	.543	.498
	N	237	220	136	225	207	119	166	132	21
Transfer Credit	Pearson Correlation	.412**	.421**	.350**	.276**	.399**	.208*	.391**	.290**	.241
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.023	.000	.001	.293
	N	237	220	136	225	207	119	166	132	21
HSGPA	Pearson Correlation	.377**	.536**	.207*	.372**	.385**	.413**	.457**	.398**	.164
	Sig. (2-tailed)	.000	.000	.015	.000	.000	.000	.000	.000	.478
	N	237	220	136	225	207	119	166	132	21
SAT Total	Pearson Correlation	1	.654**	.477**	.620**	.556**	.235*	.402**	.206*	.455*
	Sig. (2-tailed)		.000	.000	.000	.000	.010	.000	.018	.038
	N	237	220	136	225	207	119	166	132	21
Regents Exam Algebra	Pearson Correlation	.654**	1	.389**	.567**	.534**	.110	.440**	.207*	.508*
	Sig. (2-tailed)	.000		.000	.000	.000	.254	.000	.022	.022
	N	220	220	132	216	198	109	154	123	20
Regents Exam Physics	Pearson Correlation	.477**	.389**	1	.388**	.494**	.228	.483**	.318**	.351
	Sig. (2-tailed)	.000	.000		.000	.000	.082	.000	.007	.200
	N	136	132	136	132	125	59	92	72	15
Regents Exam	Pearson Correlation	.620**	.567**	.388**	1	.564**	.132	.303**	.178*	.319
	Sig. (2-tailed)	.000	.000	.000		.000	.162	.000	.046	.184

Biology	N	225	216	132	225	202	113	159	126	19
Regents Exam Chemistry	Pearson Correlation	.556**	.534**	.494**	.564**	1	.179	.463**	.275**	.495*
	Sig. (2-tailed)	.000	.000	.000	.000		.071	.000	.003	.044
	N	207	198	125	202	207	103	147	118	17
College Biology	Pearson Correlation	.235*	.110	.228	.132	.179	1	.571**	.481**	.[c]
	Sig. (2-tailed)	.010	.254	.082	.162	.071		.000	.000	
	N	119	109	59	113	103	119	113	87	0
College Chemistry	Pearson Correlation	.402**	.440**	.483**	.303**	.463**	.571**	1	.674**	.[c]
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		.000	
	N	166	154	92	159	147	113	166	108	1
College Mathematics	Pearson Correlation	.206*	.207*	.318**	.178*	.275**	.481**	.674**	1	-.033
	Sig. (2-tailed)	.018	.022	.007	.046	.003	.000	.000		.950
	N	132	123	72	126	118	87	108	132	6
College Physics	Pearson Correlation	.455*	.508*	.351	.319	.495*	.[c]	.[c]	-.033	1
	Sig. (2-tailed)	.038	.022	.200	.184	.044			.950	
	N	21	20	15	19	17	0	1	6	21

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

[c] Cannot be computed because at least one of the variables is constant.

The Pearson Correlation Analysis performed accounts for all variables used in the study. Its purpose was to compare the correlation of predictor variables to the outcome variable. Further, the analysis allowed for the identification of potential multicollinearity issues between predictor variables in addition to possible suppressor variables among the predictors. Predictor variables found to be strongly related (i.e., r >.600) provide the possible potential for creating the multicollinarity problems within the regression model.

The Pearson Correlation table reveals that none of the variables revealed a strong, significant correlation to the dependent variables (College Mathematics, College Biology, College Chemistry, and College Physics) performance.

College Mathematics

The table indicates HSGPA as a moderately strong and significant correlate ($r = .398$, $\alpha \leq .001$) for College Mathematics. The weakest correlate, and not significant, was Non-Suburban ($r = .031$, $\alpha \leq .729$). The weakest, significant correlate of College Mathematics performance was Regents Chemistry Exam ($r = .275$, $\alpha \leq .001$) and Regents Biology Exam (($r = .178$, $\alpha \leq .05$).

College Biology

The Pearson Correlation table indicates HSGPA as a moderately strong and significant correlate ($r = .413$, $\alpha \leq .001$) of College Biology performance. Like College Mathematics, the weakest correlate, and not significant, was Non-Suburban ($r = -.026$, $\alpha \leq .784$) for College Biology performance. The weakest significant correlate was Non-White ($r = -.239$, $\alpha \leq .001$) and School size ($r = -.203$, $\alpha \leq .05$).

College Chemistry

The Pearson Correlation table indicates Regents Physics Exam as a moderately strong and significant correlate ($r = .483$, $\alpha \leq .001$) of College Chemistry performance. The weakest correlate, and not significant, was Estimated Family contribution less than $ 1000 ($r = -.009$, $\alpha = .905$).The weakest significant correlate was Non-White ($r = -.250$, $\alpha \leq .001$).

Findings for Subsidiary Research Question 3

What pre-college factors indicate first-year student retention (from the first fall of enrollment to the beginning of the first spring term) in STEM disciplines?

When the dependent variable is categorical, using logistic regression, which is an advanced statistical analysis, becomes more appropriate. Thus, logistic regression helps

to predict a categorical variable from a set of predictor variables (Leech, Barrett, & Morgan, 2011). In this case, binary logistic regression is used since the dependent variable, whether freshman STEM majoring students are retained from the fall to the spring semester or not, is dichotomous.

Since three variables--HSGPA, Transfer Credit, and Pell Grant--were significant with the majority of the dependent variables, logistic regression was conducted to assess whether these three predictor variables significantly predict whether a student would continue his or her major for spring or not.

Status in spring is the dependent outcome variable and is coded "0" (not enrolled for spring semester) and "1" (enrolled for spring semester). Based on the classification Table 28, 20 students did not enroll for spring semester and 217 did. The classification table indicates the percentage of correct predictions (91.6%) if all of the students were predicted to be in the larger (students enrolled for spring semester) group.

Table 28

Classification Table

Observed			Predicted		
			Status in Spring 2012		Percentage Correct
			0	1	
Step 0	**Status in Spring 2012**	0	0	20	.0
		1	0	217	100.0
	Overall Percentage				91.6

[a] Constant is included in the model.

[b] The cut value is .500

The Omnibus Tests of Model Coefficients (Table 29) indicates that, when we consider all three predictors together, the model is statistically significant ($x^2 = 8.225$, df=3, N=237, p=0.042).

Table 29

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	8.225	3	.042
	Block	8.225	3	.042
	Model	8.225	3	.042

The model summary (see Table 30) indicates that approximately 7.8 % of the variance in whether the freshman students enrolled for the spring semester can be predicted from the linear combination of the of the three (HSGPA, Transfer Credit, and Pell Grant) independent variables.

Table 30

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	128.931[a]	.034	.078

[a] Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

The variables in the equation Table 31 indicates that only HSGPA is significant. The odds ratio [Exp(B)] for HSGPA was 1.17 which shows the odds of enrolling for spring semester improve by 1.17 for every unit increase in HSGPA.

Table 31

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Transfer Credit	-.036	.023	2.444	1	.118	.964
	HSGPA	.160	.064	6.257	1	.012	1.173
	Pell	.714	.559	1.629	1	.202	2.042
	Constant	-11.773	5.617	4.392	1	.036	.000

Findings for Subsidiary Research Questions 4, 5, and 6

- **SRQ 4:** *What is the nature of the relationship between students' overall high school New York State Regents Exam scores and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for?*
- **SRQ 5:** *What is the nature of the relationship between students' HSGPA and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for?*
- **SRQ 6:** *What is the nature of the relationship between students' Transfer College Credits and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for?*

To answer the above subsidiary questions, I conducted a multiple regression analysis including variables HSGPA, Gender, Race, Parent with College Education, Pell Grant, SAT Composite, HSGPA, School Size, Transfer Credit, and New York State Regents Exam results. Simultaneous multiple regression is the best method to use if the researcher has no prior idea which variables can be the best predictors (Leech, Barrett, &

Morgan, 2011). This helps to learn more about their individual relationship to the dependent variable which is used in prediction and forecasting (Witte & Witte, 2007).

The regression models run in this study measured the impact of Gender, Pell Grant, New York State Regents Exam, Transfer Credit, HSGPA, Parent with College Education, School Size, and Non-White on College Freshman Mathematics and Science (Biology, Physics, and Chemistry) courses separately. These data analyses will help college admissions officers to make empirically-based decisions for STEM majoring New York State high school students. The analyses performed will give New York State college admissions officers information on variables that potentially have the greatest influence on STEM areas.

The simultaneous regression models were used to analyze all of the predictor variables and their impact on STEM majoring college freshman students' math and science courses (see Table 32).

Table 32

Simultaneous Regression

Simultaneous Regression		
College Biology	All Variables	Regents Exam Biology HSGPA School Size (less than 800 = 0, 800 or greater = 1) Pell Grant (not received = 0. Received = 1) Parent with College Education (No = 0, yes = 1) Gender (male=0, female = 1) Non-White (White = 0, Non-White = 1) Transfer Credit
College Chemistry	All Variables	Regents Exam Chemistry HSGPA School Size (less than 800 = 0, 800 or greater = 1) Pell Grant (not received = 0. Received = 1) Parent with College Education (No=0, yes=1) Gender (male = 0, female = 1) Non-White (White = 0, Non-White = 1) Transfer Credit

College Mathematics	All Variables	Regents Exam Algebra HSGPA School Size (less than 800 = 0, 800 or greater = 1) Pell Grant (not received = 0. Received = 1) Parent with College Education (No = 0, yes = 1) Gender (male = 0, female = 1) Non-White (White = 0, Non-White = 1) Transfer Credit

Four correlation analyses were performed for the above variables used in the study. The aim of these analyses was to understand the correlation of predictor variables to the outcome variable. It also allowed the identification of potential multicollinearity issues among the predictor variables.

The first model regression analysis performed accounts for all variables used in the study. Its purpose was to determine the significance of each predictor variable and the extent of its contribution to College Biology, Chemistry, Physics, and Math performance.

College Biology

Table 33

Model Summary of All Variables on College Biology Performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Sq. Change	F Change	df1	df2	Sig. F Change
1	.548[a]	.300	.246	.95674	.300	5.475	8	102	.000

[a] Predictors: (Constant), Regents Exam Biology, School Size, Gender, Parent with College Education, Non-White, Pell, Transfer Credit, HSGPA

Table 34

ANOVA of All Variables on College Biology Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	40.091	8	5.011	5.475	.000b
	Residual	93.366	102	.915		

	Total	133.457	110			

[a] Dependent Variable: College Biology

[b] Predictors: (Constant), Regents Exam Biology, School Size, Gender, Parent with College Education, Non-White, Pell, Transfer Credit, HSGPA

The ANOVA reported in Table 34 indicates the model was statistically significant (F=5.475; df= 8,102; p≤ .000). An examination of the Adjusted R square (R^2) in the model summary (see Table 33) reveals that 24.6 % (.246) of the variance in College Biology can be explained by all predictor variables (Regents Exam Biology, Pell Grant, School Size, HSGPA, Transfer Credit, Non-White, Parent with College Education, and Gender) entered in the model. All reported variance inflation factors (VIFs) were less than 2, suggesting that multicollinearity issues are not present in this model.

Table 35

Coefficients[a] Table for All Variables on College Biology Performance

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Err.	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-6.673	2.430		-2.746	.007					
	Gender	.295	.196	.131	1.504	.136	.213	.147	.125	.904	1.106
	Non-White	-.181	.232	-.072	-.779	.438	-.196	-.077	-.065	.794	1.260
	Pell	.510	.223	.223	2.290	.024	.050	.221	.190	.721	1.388
	School Size	-.168	.232	-.070	-.725	.470	-.218	-.072	-.060	.733	1.365
	Parent with College Education	.666	.216	.293	3.081	.003	.265	.292	.255	.758	1.318
	Transfer Credit	-.001	.011	-.011	-.110	.913	.202	-.011	-.009	.675	1.482
	HSGPA	.117	.028	.423	4.172	.000	.393	.382	.346	.669	1.495
	Regents Exam Biology	-.023	.018	-.132	-1.287	.201	.072	-.126	-.107	.655	1.527

Since the regression model includes four (4) or more predictor variables in an effort to account for the possibility of one variable in the model acting as a suppressor variable on another, in an effort to properly discern the actual contribution of each significant variable found in this model and all future models, both the standardized beta and the partial correlation value will be reported as a range of variance explaining the model's outcome variable (Leech, Barrett, & Morgan, 2008).

The number of subjects (N) in this model was 111. Examination of the standardized coefficient (Table 35) indicates that there are three statistically significant predictors: HSGPA, Pell Grant, and Parent with College Education. The independent variable of HSGPA is a significant predictor and has a positive influence in the model (β=.423; t= 4.172; p$\leq$ .000), contributing 17.8 % $(.423)^2$ to 14.5% $(.383)^2$ of the variance in College Biology performance, as indicated by the standardized beta and partial correlation values, respectively. Due to the positive beta .423, the result indicates that students who had high HSGPAs seem to perform better than students who did not in College Biology. The closer the beta is to1, the stronger the influence of the predictor. The Beta of .423 indicates that HSGPA is a moderate predictor of student performance on the College Biology course. For Research Question 5, the null hypothesis states that there is no statistically significant relationship between students' HSGPA and their final grades in the College Biology course at SUNY Oswego when mutable demographic variables are controlled for. The null hypothesis was rejected when College Biology was the dependent variable.

The independent variable of Parent with College Education is a significant predictor and has a positive influence in the model (β=.293; t=3.081; p$\leq$.003),

contributing 8.6 % $(.293)^2$ to 8.5 % (.292) of the variance in College Biology performance, as indicated by the standardized beta and partial correlation values, respectively. Students whose parents have a college education seem to perform better than students who do not.

The independent variable of Pell Grant is a significant predictor and has a positive influence in the model (β=.223; t=2.290; p≤.023), contributing 4.97 % $(.223)^2$ to 4.88% $(.221)^2$ of the variance in College Chemistry performance, as indicated by the standardized beta and partial correlation values, respectively. Students who received the Pell Grant seem to perform better than students who did not. The Beta of .223 indicates that Pell Grant is a moderately weak predictor of student performance on College Biology performance.

In Table 35, an examination of the standardized beta coefficients indicates that New York State Regents Biology Exam variable was found not to be statistically significant in this model. For Research Question 4, the null hypothesis states that there is no statistically significant relationship between students' New York State Regents Exam scores and their final grades in the College Biology course at SUNY Oswego when mutable demographic variables are controlled for. The null hypothesis was retained when College Biology was the dependent variable.

In Table 35, an examination of the standardized beta coefficients indicates that Transfer Credit variable was found not to be statistically significant in this model. For Research Question 6, the null hypothesis states that there is no statistically significant relationship between students' transfer credits and their final grades in College Biology

course at SUNY Oswego when mutable demographic variables are controlled for. The null hypothesis was retained when College Biology was the dependent variable.

Additionally, the examination of the standardized beta coefficients indicates that the independent variables School Size, Gender, and Non-White are found to be not statistically significant predictors of the College Biology course, as the *p* value was greater than .05.

College Chemistry

Table 36

Model Summary of All Variables on College Chemistry Performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Sq. Change	F Change	df1	df2	Sig. F Change
1	.620[a]	.385	.349	.82220	.385	10.718	8	137	.000

[a] Predictors: (Constant), Regents Exam Chemistry, Pell, Gender, School Size, Parent with College Education, Non-White, Transfer Credit, HSGPA

The ANOVA reported in Table 37 indicates the model was statistically significant ($F=10.718$; $df= 8, 137$; $p\leq .000$). An examination of the Adjusted R square (R^2) in the model summary (see Table 36) reveals that 34.9 % (.349) of the variance in College Chemistry can be explained by all predictor variables (School Size, Pell Grant, Regents Exam Chemistry, Gender, Non-White, Transfer Credit, Parent with College Education, and HSGPA) when entered in the model. All reported variance inflation factors (VIFs) were less than 2, suggesting that multicollinearity issues are not present in this model.

Table 37

ANOVA[a] for All Variables on College Chemistry Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	57.966	8	7.246	10.718	.000[b]

	Residual	92.615	137	.676		
	Total	150.580	145			

[a] Dependent Variable: College Chemistry

[b] Predictors: (Constant), Regents Exam Chemistry, Pell, Gender, School Size, Parent with College Education, Non-White, Transfer Credit, HSGPA

The number of subjects (N) in this model was 146. Examination of the standardized coefficient (Table 38) indicates that there are four statistically significant predictors: HSGPA, Transfer Credit, New York State Chemistry Regents Exam, and Pell Grant.

Table 38

Coefficients[a] Table for All Variables on College Chemistry Performance

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Err.	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-6.404	1.811		-3.536	.001					
	Gender	.095	.156	.046	.607	.545	.086	.052	.041	.792	1.263
	Non-White	-.107	.188	-.042	-.570	.570	-.194	-.049	-.038	.825	1.212
	Pell	.453	.156	.205	2.901	.004	.157	.241	.194	.901	1.110
	School Size	-.023	.157	-.011	-.148	.882	-.179	-.013	-.010	.830	1.205
	Parent with College Education	.088	.156	.041	.563	.575	.116	.048	.038	.852	1.174
	Transfer Credit	.023	.009	.213	2.698	.008	.445	.225	.181	.719	1.390
	HSGPA	.065	.022	.248	2.978	.003	.458	.247	.200	.650	1.539
	Regents Exam Chemistry	.032	.010	.272	3.314	.001	.463	.272	.222	.666	1.500

[a] Dependent Variable: College Chemistry

The independent variable of HSGPA is a significant predictor and has a positive influence in the model (β=.248; t=2.978; p$\leq$ .003), contributing 6.1 % $(.248)^2$ to 6.0%

$(.247)^2$ of the variance in College Chemistry performance, as indicated by the standardized beta and partial correlation values, respectively. Due to the positive beta .248, the result indicates that students who had high HSGPA seem to perform better than students who did not. The closer the beta is to 1, the stronger the influence of the predictor. The beta of .248 indicates that HSGPA is a moderately weak predictor of student performance on the College Chemistry course. For Subsidiary Research Question 5, the null hypothesis states that there is no statistically significant relationship between students' HSGPA and their final grades in the College Chemistry course at SUNY Oswego when mutable demographic variables are controlled for. The null hypothesis was rejected when College Chemistry was the dependent variable.

The independent variable of Pell Grant is a significant predictor and has a positive influence in the model (β=.205; t=2.901; p≤.004), contributing 4.2 % $(.205)^2$ to 5.8% $(.241)^2$ of the variance in College Chemistry performance, as indicated by the standardized beta and partial correlation values, respectively. Students who received a Pell Grant seem to perform better than students who did not. The Beta of .205 indicates that Pell Grant is a moderately weak predictor of student performance on the College Chemistry course.

The independent variable of New York State Regents Chemistry Exam is a significant predictor and has a positive influence in the model (β=.272; t=3.314; p≤.001), contributing 7.4 % $(.272)^2$ to 7.4% $(.272)^2$ of the variance in College Chemistry performance, as indicated by the standardized beta and partial correlation values, respectively. The beta of .272 indicates that New York State Regents Chemistry Exam is a moderately weak predictor of student performance on the College Chemistry course.

Students who scored higher on the New York State Regents Chemistry Exam during high school seem to perform better in the college freshman chemistry course.

For Subsidiary Research Question 4, the null hypothesis states that there is no statistically significant relationship between students' New York State Regents Exam scores and their final grades in the College Chemistry course at SUNY Oswego when mutable demographic variables are controlled for. The null hypothesis was rejected when College Chemistry was the dependent variable. One of the reasons that the Chemistry Regents was significant might be that college chemistry is required by more majors and may be better aligned with the NY State Chemistry Regents Exam. There were more observations (N) for chemistry. More student who have taken the Chemistry Regents took college chemistry

The independent variable of Transfer Credit is a significant predictor and has a positive influence in the model (β=.213; t=2.698; p$\leq$.008), contributing 4.5 % $(.213)^2$ to 5.1% $(.225)^2$ of the variance in College Chemistry performance, as indicated by the standardized beta and partial correlation values, respectively. Students who took a college course during high school years seem to perform better than students who have not. The beta of .213 indicates that Transfer Credit is a moderately weak predictor of student performance on the College Chemistry course.

For Subsidiary Research Question 6, the null hypothesis states that there is no statistically significant relationship between students' Transfer Credit and their final grades in the College Chemistry course at SUNY Oswego when mutable demographic variables are controlled for. The null hypothesis was rejected when College Chemistry was the dependent variable.

An examination of the standardized beta coefficients indicates that School Size, Gender, Parent with College Education, and Non-White variables were found to be not statistically significant predictors of the College Chemistry course, as the *p* value was greater than .05.

College Mathematics

The ANOVA reported in Table 40 indicates the model was statistically significant (F=3.791; df= 8, 112; $p \leq .001$). An examination of the Adjusted R square (R^2) in the model summary (see Table 39) reveals that 15.7 % (.157) of the variance in College Mathematics can be explained by all predictor variables (School Size, Regents Algebra Exam, Non-White, Transfer Credit, HSGPA, Parent with College Education, and Gender) when entered into the model. Table 41 shows the VIFs were close to 1 and that the predictor variable exceeded the tolerance threshold of .847, but only marginally; multicollinearity was not considered to be an issue with this model.

Table 39

Model Summary of All Variables on College Mathematics Performance

Model					Change Statistics				
	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.462[a]	.213	.157	1.04526	.213	3.791	8	112	.001

[a] Predictors: (Constant), Regents Exam Algebra, School Size, Gender, Parent with College Education, Non-White, Pell, Transfer Credit, HSGPA

Table 40

ANOVA[a] for All Variables on College Mathematics Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33.135	8	4.142	3.791	.001[b]
	Residual	122.368	112	1.093		

	Total	155.503	120			

[a] Dependent Variable: College Mathematics

[b] Predictors: (Constant), Regents Exam Algebra, School Size, Gender, Parent with College Education, Non-White, Pell, Transfer Credit, HSGPA

The number of subjects (N) in this model was 121. Examination of the standardized coefficient (Table 41) indicates that there are two statistically significant predictors: Transfer Credit and HSGPA. The independent variable of Transfer Credit is a significant predictor and has a positive influence in the model (β= .246; t= 2.431; p≤ .017), contributing 6.1 % $(.246)^2$ to 4.2% $(.212)^2$ of the variance in College Mathematics performance, as indicated by the standardized beta and partial correlation values, respectively. Due to the positive beta .246, these results indicate that students who earned college credits and transferred them to school seem to perform better in the college freshman mathematics course. The closer the beta is to 1, the stronger the influence of the predictor. The beta of .246 indicates that Transfer Credit is a weak predictor of student performance on the College Mathematics course.

Table 41

Coefficients[a] Table for All Variables on College Mathematics Performance

	Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1 (Constant)	-7.152	2.510		-2.850	.005					
Gender	-.046	.206	-.020	-.221	.826	.132	-.021	-.019	.860	1.163
Non-White	-.175	.235	-.067	-.744	.458	-.137	-.070	-.062	.856	1.168
SES	.333	.238	.137	1.402	.164	.039	.131	.118	.732	1.365
School Size	.332	.235	.133	1.411	.161	-.048	.132	.118	.792	1.262
Parent with College Education	.001	.222	.001	.006	.995	.017	.001	.000	.770	1.299

Transfer Credit	.027	.011	.246	2.431	.017	.298	.224	.204	.688	1.454
HSGPA	.104	.029	.365	3.607	.000	.390	.323	.302	.686	1.459
Regents Exam Algebra	-.007	.017	-.039	-.384	.702	.198	-.036	-.032	.671	1.491

In Table 41, an examination of the standardized beta coefficients indicates that the New York State Regents Algebra Exam variable was found not to be statistically significant in this model. For Subsidiary Research Question 4, the null hypothesis states that there is no statistically significant relationship between students' New York State Regents Exam scores and their final grades in the College Mathematics course at SUNY Oswego when mutable demographic variables are controlled for. The null hypothesis was retained when College Mathematics was the dependent variable, whereas College Mathematics (which represents all math courses, especially Calculus I) may not be aligned with the NY State Integrated Algebra Regents Exam. Also, some of students did not take freshman college biology and mathematics courses since they already had college mathematics credits before coming to SUNY Oswego.

For Subsidiary Research Question 5, the null hypothesis states that there is no statistically significant relationship between students' HSGPA and their final grades in the College Mathematics course at SUNY Oswego when mutable demographic variables are controlled for. The null hypothesis was rejected when College Mathematics was the dependent variable.

For Subsidiary Research Question 6, the null hypothesis states that there is no statistically significant relationship between students' Transfer Credit and their final grades in the College Mathematics course at SUNY Oswego when mutable demographic

variables are controlled for. The null hypothesis was rejected when College Mathematics was the dependent variable.

The independent variable of HSGPA is a significant predictor and has a positive influence in the model (β=.365; t= 3.607; p≤.001), contributing 13.3 % $(.365)^2$ to 10.4% $(.323)^2$ of the variance in College Mathematics performance, as indicated by the standardized beta and partial correlation values, respectively. The beta of .365 indicates that HSGPA is a moderate predictor of student performance on the College Mathematics course. Students who had high HSGPA seem to perform better than students who did not. In addition, HSGPA has a 1.5 times greater influence on College Mathematics course performance than Transfer Credit, which is calculated by dividing .365 by .246, the beta for the College Mathematics course.

Additionally, the examination of the standardized beta coefficients indicates that School Size, SES, Parent with College Education, Gender, and Non-White variables were found to be nots tatistically significant predictors of the College Mathematics course, as the *p* value was greater than .05.

College Physics

The number of subjects (N) in this model was 15. A similar multiple regression was run for the dependent variable Physics, and the model was not statistically significant (see Table 42).

Table 42

Model Summary of All Variables on College Mathematics Performance

Model					Change Statistics				
	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change

1	.725[a]	.526	-.106	.87186	.526	.832	8	6	.606

[a] Predictors: (Constant), Regents Exam Physics, Pell, Gender, HSGPA, Transfer Credit, Parent with College Education, Non White, School Size

Table 43

ANOVA[a] for All Variables on College Mathematics Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.062	8	.633	.832	.606[b]
	Residual	4.561	6	.760		
	Total	9.623	14			

[a] Dependent Variable: College Physics

[b] Predictors: (Constant), Regents Exam Physics, Pell, Gender, HSGPA, Transfer Credit, Parent with College Education, Non-White, School Size

Findings for Subsidiary Research Question 7

What is the nature of the relationship between New York State high school students' SAT scores and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for?

Null Hypothesis: There is no statistically significant relationship between New York State high school students' SAT scores and their final grades in college freshman mathematics and science courses at SUNY Oswego when mutable demographic variables are controlled for.

This research question investigated the relationship between the final grades of freshman college mathematics and science courses with the student SAT total score as the independent variable. Results of this analysis (using Pearson's Correlation Coefficient) indicated that there was a significant positive relationship between first-year College Biology and SAT total score($r = .235$, $N=110$, $p \leq .010$), College Chemistry and

SAT ($r = .402, N=166, p \leq .000$), and College Mathematics and SAT total score ($r=.206, N=132, p \leq .018$) as well as College Physics and SAT total score ($r = .455, N=21, p \leq .038$). Therefore, the null hypothesis was rejected. However, for College Physics, the limitation was the number of subjects, which was only 21. This finding suggests that the higher the SAT total score, the higher the first-year College Mathematics, Physics, Chemistry, and Biology performance (see Table 44).

Students who were admitted to SUNY Oswego show homogeneity of SAT scores; therefore, there is little variability among the admitted students' SAT score. The average SAT score for the students who were enrolled is 1098.4, and the standard deviation is 95.8.

Table 44

Correlation Table for SAT Total

		BIO110 Biology	Total Chem	Total Math	Total Physics
SAT Total	Pearson Correlation	.235*	.402**	.206*	.455*
	Sig. (2-tailed)	.010	.000	.018	.038
	N	119	166	132	21

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Multiple regression analyses were conducted for SAT scores, while the demographic factors were controlled. However, it was observed that SAT had a lower tolerance value and high VIF value (more than 2) than was required. Due to the multicollinearity issue, it was eliminated.

Simple linear regression was computed to investigate whether SAT total scores predicted freshman College Mathematics and Science performance. The highest variance (10.1 %) was with SAT scores ($M=1081.14, SD=129.07$), which significantly predicted

College Chemistry (M=2.43, SD=.91), F(1,147)=17.60, p≤0.000, Adjusted R^2=0.101 (see Appendix C, Table 78). College Physics is a limitation for this study due to only 21 subjects. College Mathematics, Chemistry and Biology were found to be significant. In Table 45, all beta values are positive, which indicates that SAT has a positive influence on freshman College Mathematics, Chemistry, Physics and Biology performance.

Table 45

Coefficients[a]

SAT	Standardized Coefficients				
	N	Beta	t	Sig.	Adjusted R^2
College Biology	119	0.235	2.610	0.010	0.047
College Chemistry	166	0.402	5.622	0.000	0.156
College Mathematics	132	0.206	2.399	0.018	0.035
College Physics	21	0.455	2.228	0.038	0.165

Hierarchical Regression Analyses

Additional clarity was required in order to more thoroughly examine the R square change value dependent upon the variables in the model based on simultaneous linear regression results. Hierarchical multiple regression (HMR) analyses are used to estimate two or more regression equations simultaneously. This enables the researcher to determine, based on prior knowledge, if each new group of variables adds anything to the prediction produced by the previous blocks of variables (Leech, Barrett, & Morgan, 2011). HMR attempts to find the best model that explains the greatest proportion of variance. Because the outputs indicated that the HSGPA, Transfer Credit, Pell Grant, Parent with College Education, and Regents Chemistry Exam were the significant predictor of student achievement on the College Mathematics and Science courses, the

hierarchical regression analysis allowed the variables to be entered into various models as shown in (Table 46).

Findings for Subsidiary Research Question 8

When controlling for demographic mutable variables, which model best accounts for the greatest proportion of explained variance in College Biology performance?

The first model hierarchical regression analysis performed accounts for all significant variables used in the study that predicted College Biology performance in order to partition out the specific "block" influence of high school academic and demographic mutable variables. They were Gender, Non-White, Regents Exam Biology, Parent with College Education, Pell Grant, Transfer Credit, HSGPA, and School Size. The purpose of the hierarchy was to determine the amount of change between models and their contribution to College Biology performance, which sought to answer the research question: Which model best accounts for the greatest proportion of explained variance in College Biology performance when controlling mutable variables?

Following is the hierarchical regression analysis for the first model regression, with College Biology performance as the outcome variable.

As displayed in Table 47, variables were entered into the regression models as per the following blocks: Model 1, Regents Biology Exam, School Size, Gender, Non-White, Transfer Credit; Model 2, Regents Biology Exam, School Size, Gender, Non-White, Transfer Credit, Pell Grant; Model 3, Regents Biology Exam, School Size, Gender, Non-White, Transfer Credit, Pell Grant, Parent with College Education; Model 4, Regents Biology Exam, School Size, Gender, Non-White, Transfer Credit, Pell Grant, Parent with College Education, and HSGPA . By entering the variables in block models, any

observed effect on College Biology scores can then be said to be independent of the effects of the variables previously controlled for.

Table 46

Hierarchical Regression Analyses Models for College Biology, College Chemistry, and College Mathematics

1st Model College Biology	2nd Model College Chemistry	3rd Model College Mathematics
School Size Gender Non-White Regents Exam Biology Transfer Credit	School Size Gender Non-White	School Size Gender Non-White Regents Exam Algebra Pell Grant
School Size Gender Non-White Pell Grant Regents Exam Biology Transfer Credit	School Size Gender Non-White Pell Grant	School Size Gender Non-White Regents Exam Algebra Pell Grant Transfer Credit
School Size Gender Non-White Pell Grant Regents Exam Biology Transfer Credit Parent with College Credit	School Size Gender Non-White Pell Grant Transfer Credit	School Size Gender Non-White Regents Exam Algebra Pell Grant Transfer Credit HSGPA
School Size Gender Non-White Pell Grant Regents Exam Biology Transfer Credit Parent with College Credit HSGPA	School Size Gender Non-White Pell Grant Transfer Credit HSGPA	
	School Size Gender Non-White Pell Grant Transfer Credit	

	HSGPA Regents Exam Chemistry	

Table 47

Model Summary of Hierarchical Analysis on College Biology Performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.345[a]	.119	.077	1.05806	.119	2.842	5	105	.019
2	.352[b]	.124	.073	1.06040	.005	.537	1	104	.465
3	.425[c]	.181	.125	1.03013	.057	7.201	1	103	.008
4	.548[d]	.300	.246	.95674	.119	17.408	1	102	.000

[a] Predictors: (Constant), Regents Exam Biology, School Size, Gender, Non-White, Transfer Credit

[b] Predictors: (Constant), Regents Exam Biology, School Size, Gender, Non-White, Transfer Credit, Pell

[c] Predictors: (Constant), Regents Exam Biology, School Size, Gender, Non-White, Transfer Credit, Pell, Parent with College Education

[d] Predictors: (Constant), Regents Exam Biology, School Size, Gender, Non-White, Transfer Credit, Pell, Parent with College Education, HSGPA

I examined the R square change in the model which determines the percentage of variability in the dependent variable that can be accounted for by all the predictors together. The change in R square indicates how much predictive power was added to the model by the addition of other variables. The hierarchical regression method will also determine if that R square change is significant, as each block model is introduced. In examination of the model summary for Model l, the R square change began at .119 and it explains 7.7% of the variance in College Biology performance. The analysis of the Adjusted R square indicates that the independent variable of Regents Exam Biology, School Size, Gender, Non-White, and Transfer Credit were statistically significant (F change = 2.842; df = 5, 105; $p \leq .019$).

When Pell Grant is added to Model 1, Model 2 became statistically not significant. This means the change to the third model was not significant. Non-White, Regents Biology Exam, and Transfer Credit are not statistically significant predictors for College Biology performance when mutable demographic variables are controlled for (F change = 0.537; df = 1, 104; $p = .465$).

When Parent with College Education was added to Model 2, Model 3 became statistically significant (see Table 47). For Model 3, the R square change is .057 and it explains 12.5% of the variance in College Biology performance. The analysis of the Adjusted R square indicates that the independent variable of Regents Exam Biology, School Size, Gender, Non-White, Transfer Credit, Pell Grant, and Parent with College Education were statistically significant (F change = 7.201; df = 1, 103; $p \leq .008$).

Model 4 is statistically significant with the addition of HSGPA to Model 3 (see Table 47). For Model 4, the R square change began at .119 and it explains 24.6% of the variance in College Biology performance. The analysis of the adjusted R square indicates that the independent variables of Regents Exam Biology, School Size, Gender, Non-White, Transfer Credit, Pell Grant, HSGPA, and Parent with College Education are statistically significant (F change = 17.408; df = 1, 102; $p \leq .000$).

Consequently, the changes from each model to the next are all significant changes except Model 2. Model 4 is the best model and explained the greatest proportion of variance in freshman College Biology performance.

The Anova reported in Table 48 confirms the previous results, as well as indicating that each model in and of itself is significant. The independent variables entered in Models 1, 2, and 3 predicted scores on the College Biology course are

statistically significant ($p \leq .05$). For College Biology (Model 1: F=2.842, df= 5, 105, $p \leq .05$; Model 2: F= 2.448, df= 6,104, $p \leq .05$; Model 3: F= 3.252, df= 7, 103, $p \leq .05$).

Table 48

ANOVA[a] for Hierarchical Analysis on College Biology Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.911	5	3.182	2.842	.019[b]
	Residual	117.546	105	1.119		
	Total	**133.457**	**110**			
2	Regression	16.514	6	2.752	2.448	.030[c]
	Residual	116.942	104	1.124		
	Total	**133.457**	**110**			
3	Regression	24.156	7	3.451	3.252	.004[d]
	Residual	109.300	103	1.061		
	Total	**133.457**	**110**			
4	Regression	40.091	8	5.011	5.475	.000[e]
	Residual	93.366	102	.915		
	Total	**133.457**	**110**			

[a] Dependent Variable: College Biology

[b] Predictors: (Constant), Regents Exam Biology, School Size, Gender, Non-White, Transfer Credit

[c] Predictors: (Constant), Regents Exam Biology, School Size, Gender, Non-White, Transfer Credit, Pell

[d] Predictors: (Constant), Regents Exam Biology, School Size, Gender, Non-White, Transfer Credit, Pell, Parent with College Education

[e] Predictors: (Constant), Regents Exam Biology, School Size, Gender, Non-White, Transfer Credit, Pell, Parent with College Education, HSGPA

Multicollinearity issues were examined in all three models (Table 49). Considering that the VIFs were within normal parameters (≤ 2) and were close to 1, multicollinearity was not considered to be an issue with these models.

The coefficients table provides a detailed analysis of the strength of each individual independent variable. An examination of the standardized beta coefficients in Table 49 indicates that Gender, Pell Grant, Parent with College Education, and HSGPA

are significant variables, whereas Non-White, Transfer Credit, School Size, and Regents Biology Exam are not significant.

In Model l, the independent variable of Gender is statistically significant, $p \leq .05$ with $t = 2.139$ and a $B = .198$. Independently, Gender is a weak predictor of student performance on College Biology because the closer the beta to 1, the stronger the strength of the predictor. Additionally, because the beta is positive, this indicates that female students are performing better than male students, contributing 3.9 % ($.198^2$) to the overall variance in College Biology performance for Model 1.

When the variables of Pell Grant and Parent with College Education were added to College Biology, the strength of the variable Gender increased by only .007 and .017, respectively (from .198 to .205 to .222), meaning that these variables have a minimal effect on the strength of Gender, as $B = .205$ is still a moderately weak predictor of student performance on College Biology, contributing between 4.2% $(.205)^2$ to 4.5%$(.211)^2$ of the overall variance in College Biology performance for this model.

When the HSGPA variable was added, Gender became no longer statistically significant, whereas Parent with College Education increased by .019 ($B = .293$) and Pell Grant became statistically significant, $p \leq .05$ with $t = 2.290$ and $B = .223$. HSGPA was statistically significant, $p \leq .000$ with $t = 4.172$ and $B = .423$ a moderately stronger predictor of student performance on College Biology, contributing 17.9% $(.423)^2$ of the overall variance in College Biology performance for this model. It is important to note that HSGPA was the strongest predictor in Model 4.

Table 49

Coefficients[a] Table for All Significant Variables on College Biology Performance

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Err.	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.821	1.506		1.873	.064					
	Gender	.446	.208	.198	2.139	.035	.213	.204	.196	.979	1.021
	Non-White	-.341	.250	-.136	-1.360	.177	-.196	-.132	-.125	.833	1.200
	School Size	-.401	.245	-.167	-1.636	.105	-.218	-.158	-.150	.803	1.245
	Transfer Credit	.008	.011	.075	.683	.496	.202	.066	.063	.699	1.431
	Regents Exam Biology	-.003	.018	-.018	-.176	.860	.072	-.017	-.016	.807	1.240
2	(Constant)	2.498	1.572		1.589	.115					
	Gender	.461	.210	.205	2.198	.030	.213	.211	.202	.969	1.032
	Non-White	-.358	.252	-.143	-1.420	.159	-.196	-.138	-.130	.826	1.211
	School Size	-.358	.253	-.149	-1.417	.159	-.218	-.138	-.130	.760	1.316
	Transfer Credit	.008	.011	.079	.721	.473	.202	.071	.066	.697	1.435
	Regents Exam Biology	-.001	.018	-.003	-.028	.977	.072	-.003	-.003	.775	1.290
	Pell	.166	.226	.073	.733	.465	.050	.072	.067	.860	1.163
3	(Constant)	1.408	1.580		.891	.375					
	Gender	.499	.204	.222	2.442	.016	.213	.234	.218	.964	1.037
	Non-White	-.231	.249	-.092	-.924	.358	-.196	-.091	-.082	.796	1.256
	School Size	-.242	.249	-.101	-.971	.334	-.218	-.095	-.087	.737	1.357
	Transfer Credit	.005	.011	.048	.443	.658	.202	.044	.040	.688	1.453
	Regents Exam Biology	.005	.018	.030	.293	.770	.072	.029	.026	.764	1.308
	Pell	.417	.239	.182	1.746	.084	.050	.170	.156	.728	1.374
	Parent with College Education	.624	.232	.274	2.684	.008	.265	.256	.239	.760	1.316
4	(Constant)	-6.673	2.430		-2.746	.007					
	Gender	.295	.196	.131	1.504	.136	.213	.147	.125	.904	1.106
	Non-White	-.181	.232	-.072	-.779	.438	-.196	-.077	-.065	.794	1.260
	School Size	-.168	.232	-.070	-.725	.470	-.218	-.072	-.060	.733	1.365
	Transfer Credit	-.001	.011	-.011	-.110	.913	.202	-.011	-.009	.675	1.482
	Regents Exam Bio.	-.023	.018	-.132	-1.287	.201	.072	-.126	-.107	.655	1.527
	Pell	.510	.223	.223	2.290	.024	.050	.221	.190	.721	1.388
	Parent with College Education	.666	.216	.293	3.081	.003	.265	.292	.255	.758	1.318
	HSGPA	.117	.028	.423	4.172	.000	.393	.382	.346	.669	1.495

[a] Dependent Variable: College Biology

Transfer Credit, School Size, Non-White, and New York State Regents Biology Exam were not found to be statistically significant predictors of student performance on College Biology *($p \geq .05$)*.

Findings for Subsidiary Research Question 9

When controlling for demographic mutable variables, which model best accounts for the greatest proportion of explained variance in College Chemistry performance?

The second model hierarchical regression analysis performed accounts for all significant variables used in the study that predicted College Chemistry performance in order to partition out the specific "block" influence of high school academic and demographic mutable variables. They were Gender, Non-White, Regents Chemistry Exam, Pell Grant, Transfer Credit, HSGPA, and School Size. The purpose of the hierarchy was to determine the amount of change between models and their contribution to College Chemistry performance which sought to answer the research question: Which model best accounts for the greatest proportion of explained variance in College Chemistry performance when controlling mutable variables? Following is the hierarchical regression analysis for the second model regression with College Chemistry performance as the outcome variable.

I examined the R square change in the model (see Table 50) which determines the percentage of variability in the dependent variable of College Chemistry that can be accounted for by all the predictors together. In examination of the model summary for Model 1, the R square change began at .069. The analysis of the adjusted R square indicates that the independent variables of School Size, Gender, and Non-White are statistically significant ($p \leq .05$) and accounts for approximately 4.9% of the variability. When the additional independent variable of Pell Grant is entered in Model 2, the R square change is .026, and the percentage of variability (adjusted R square) accounted for

changes from .069 (6.9%) to .095 (9.5%) or 2.6%. Although a significant change, this translates into Model 2 explaining a small proportion of the variance.

Table 50

Model Summary of Hierarchical Analysis on College Chemistry performance

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.262[a]	.069	.049	.99385	.069	3.484	3	142	.018
2	.308[b]	.095	.069	.98313	.026	4.112	1	141	.044
3	.494[c]	.244	.217	.90181	.149	27.577	1	140	.000
4	.576[d]	.331	.303	.85104	.088	18.201	1	139	.000
5	.619[e]	.384	.352	.82017	.052	11.662	1	138	.001

[a] Predictors: (Constant), School Size, Gender, Non-White

[b] Predictors: (Constant), School Size, Gender, Non-White, Pell

[c] Predictors: (Constant), School Size, Gender, Non-White, Pell, Transfer Credit

[d] Predictors: (Constant), School Size, Gender, Non-White, Pell, Transfer Credit, HSGPA

[e] Predictors:(Constant), School Size, Gender, Non-White, Pell, Transfer Credit, HSGPA, Regents Exam Chemistry

When Model 3 is added, which adds Transfer Credit, there is an R square change of .149 (14.9%), and the adjusted R square is .217, meaning that 21.7% of the variance is now accounted for when Transfer Credit, School Size, Pell Grant, Non-White, and Gender of the variables are entered into the regression.

When Model 4 is added, which adds the HSGPA, there is an R square change of .088 (8.8%), and the adjusted R square is .303, meaning that 30.3% of the variance is now accounted for when all of the variables are entered into the regression.

When Model 5 is added, which adds the New York State Regents Chemistry Exam, there is an R square change of .052 (5.2%), and the adjusted R square is .352, meaning that 35.2% of the variance is now accounted for when all of the variables are

entered into the regression.

Consequently, the changes from each model to the next are all significant. Model 5 is the best model and explained the greatest proportion of variance in freshman College Chemistry performance.

Table 51

ANOVA[a] for Hierarchical Analysis on College Chemistry Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.323	3	3.441	3.484	.018[b]
	Residual	140.257	142	.988		
	Total	150.580	145			
2	Regression	14.297	4	3.574	3.698	.007[c]
	Residual	136.284	141	.967		
	Total	150.580	145			
3	Regression	36.724	5	7.345	9.031	.000[d]
	Residual	113.856	140	.813		
	Total	150.580	145			
4	Regression	49.907	6	8.318	11.484	.000[e]
	Residual	100.674	139	.724		
	Total	150.580	145			
5	Regression	57.752	7	8.250	12.265	.000[f]
	Residual	92.829	138	.673		
	Total	150.580	145			

[a] Dependent Variable: College Chemistry

[b] Predictors: (Constant), School Size, Gender, Non-White

[c] Predictors: (Constant), School Size, Gender, Non-White, Pell

[d] Predictors: (Constant), School Size, Gender, Non-White, Pell, Transfer Credit

[e] Predictors: (Constant), School Size, Gender, Non-White, Pell, Transfer Credit, HSGPA

[f] Predictors: (Constant), School Size, Gender, Non-White, Pell, Transfer Credit, HSGPA, Regents Exam Chemistry

Table 51 confirms the previous results as well as indicating that each model in and of itself is significant. The independent variables entered in Models 1, 2, 3, 4, and 5 predicted scores on the College Chemistry course are statistically significant ($p \leq .05$): for

College Chemistry (Model I: F=3.484, df= 3, 142, $p \leq .018$; Model 2: F= 3.574, df= 4,141, $p \leq .007$; Model 3: F= 7.345, df= 5,140, $p \leq .000$; Model 4: F= 11.484, df= 6, 139, $p \leq .000$; and Model 5: F= 12.265, df= 7, 138, $p \leq .000$).

Multicollinearity issues were examined in all three models (Table 52). Considering that the VIFs were within normal parameters (≤ 2) and were close to 1, multicollinearity was not considered to be an issue with these models.

An examination of the standardized beta coefficients in Table 52 indicates that Model 5 has four statistically significant variables: Regents Chemistry Exam, HSGPA, Transfer Credit, and Pell Grant. Model 4 has three statistically significant variables: HSGPA, Transfer Credit, and Pell Grant. Model 3 has two statistically significant variables: Pell Grant and Transfer Credit. Model 2 has two statistically significant variables: Pell Grant and Non-White. Model 1 has no significant variables of College Chemistry course performance. The significant predictors explaining the greatest proportion of variance in College Chemistry course performance are Regents Chemistry Exam, HSGPA, Transfer Credit, and Pell Grant.

In Model 1, none of the variables were found to be significant. In Model 2, Non-White was found to be most predictive of performance on College Chemistry course performance in the model (β=-.190; t=-2.263; $p \leq .05$). It contributed approximately 3.6% $(.190)^2$ to 3.5 % $(.187)^2$ of the variance in College Chemistry course performance as indicated by the standardized beta and partial correlation values, respectively.

Table 52

Coefficients[a] Table for All Significant Variables on College Chemistry Performance

Model	Unstandardized Coefficients	Standardized Coefficients	Correlations	Collinearity Statistics

		B	Std. Err	Beta	t	Sig.	Zero-order	Partia	Part	Tolerance	VIF
1	(Constant)	2.432	.164		14.830	.000					
	Gender	.238	.169	.115	1.407	.162	.086	.117	.114	.983	1.018
	Non-White	-.412	.213	-.162	-1.931	.056	-.194	-.160	-.156	.933	1.071
	School Size	-.325	.180	-.152	-1.806	.073	-.179	-.15	-.146	.921	1.085
2	(Constant)	2.288	.177		12.911	.000					
	Gender	.246	.167	.119	1.470	.144	.086	.123	.118	.982	1.018
	Non-White	-.485	.214	-.190	-2.263	.025	-.194	-.187	-.181	.907	1.102
	School Size	-.259	.181	-.121	-1.431	.155	-.179	-.120	-.115	.891	1.122
	Pell	.369	.182	.167	2.028	.044	.157	.168	.162	.951	1.051
3	(Constant)	1.846	.183		10.093	.000					
	Gender	.142	.155	.068	.916	.361	.086	.077	.067	.966	1.035
	Non-White	-.320	.199	-.126	-1.607	.110	-.194	-.135	-.118	.885	1.130
	School Size	-.052	.170	-.024	-.306	.760	-.179	-.026	-.022	.844	1.185
	Pell	.392	.167	.177	2.351	.020	.157	.195	.173	.951	1.052
	Transfer Credit	.045	.009	.408	5.251	.000	.445	.406	.386	.894	1.119
4	(Constant)	-6.072	1.864		-3.257	.001					
	Gender	-.056	.153	-.027	-.364	.716	.086	-.031	-.025	.878	1.139
	Non-White	-.189	.190	-.074	-.993	.322	-.194	-.084	-.069	.862	1.161
	School Size	-.027	.161	-.013	-.170	.865	-.179	-.014	-.012	.843	1.186
	Pell	.419	.158	.189	2.660	.009	.157	.220	.184	.949	1.054
	Transfer Credit	.032	.009	.293	3.751	.000	.445	.303	.260	.787	1.270
	HSGPA	.089	.021	.343	4.266	.000	.458	.340	.296	.745	1.343
5	(Constant)	-6.303	1.798		-3.506	.001					
	Gender	.103	.155	.050	.663	.508	.086	.056	.044	.799	1.252
	Non-White	-.126	.184	-.050	-.685	.495	-.194	-.058	-.046	.853	1.172
	School Size	-.034	.155	-.016	-.221	.825	-.179	-.019	-.015	.843	1.187
	Pell	.434	.152	.196	2.854	.005	.157	.236	.191	.948	1.054
	Transfer Credit	.024	.009	.215	2.738	.007	.445	.227	.183	.721	1.386
	HSGPA	.064	.022	.244	2.952	.004	.458	.244	.197	.653	1.531
	Regents Exam Chemistry	.033	.010	.278	3.415	.001	.463	.279	.228	.676	1.479

[a] Dependent Variable: College Chemistry

White students seem to be performing better than Non-White students. Pell Grant was found statistically significant in the model (β=.167; t= 2.028; $p \leq .05$). It contributed approximately 2.78% $(.167)^2$ to 2.82 % $(.168)^2$ of the variance in Col

lege Chemistry course performance as indicated by the standardized beta and partial correlation values, respectively. Students who received a Pell Grant seem to be performing better than students who did not get a Pell Grant. Non-White and Pell Grant are weak predictors of student performance on College Chemistry.

In Model 3, Transfer Credit was found to be most predictive of performance on College Chemistry course performance in the model (β=.408; t= 5.251; p≤ .000). It contributed approximately 16. 6% $(.408)^2$ to 16.5 % $(.406)^2$ of the variance in College Chemistry course performance as indicated by the standardized beta and partial correlation values, respectively.

Though its contribution eliminated Non-White as a significant variable and strengthened Pell Grant by 1% when Transfer Credit was added, Pell Grant contributed 3.1% (.177) to 3.8 % (.195) of the variance in College Chemistry as indicated by the standardized beta and partial correlation values, respectively. Students who took college credits while in high school seem to be performing better than students who did not.

In Model 4, HSGPA was found to be most predictive of performance on College Chemistry course performance in the model (β=.343; t= 4.266; p≤ .000). It contributed approximately 11.8% $(.343)^2$ to 11.6 % $(.340)^2$ of the variance in College Chemistry course performance as indicated by the standardized beta and partial correlation values, respectively.

Though its contribution weakened Transfer Credit by 11.5 % when HSGPA was added, Transfer Credit contributed 8.6% $(.293)^2$ to 9.2 % $(.303)^2$ and Pell Grant 3.6 % $(.189)^2$ to 4.8 % $(.220)^2$of the variance in College Chemistry as indicated by the

standardized beta and partial correlation values, respectively. Students with higher high school GPA seem to be performing better than students with lower high school GPA.

In Model 5, New York State Regent Chemistry Exam was found to be most predictive of performance on College Chemistry course performance in the model (β=.278; t= 3.415; p≤ .001). It contributed approximately 7.73 % $(.278)^2$ to 7.78 % $(.279)^2$ of the variance in College Chemistry course performance as indicated by the standardized beta and partial correlation values, respectively. Regents Chemistry Exam's contribution weakened HSGPA by 9.9% and Transfer Credit by 7.8 % when Regents Chemistry Exam was added, while Pell Grant increased by .7 %. Students who scored high on the Regents Chemistry Exam seem to be performing better in the College Chemistry course.

Findings for Subsidiary Research Question 10

When controlling for demographic mutable variables, which model best accounts for the greatest proportion of explained variance in College Mathematics performance?

The third model hierarchical regression analysis performed accounts for all significant variables used in the study that predicted College Mathematics performance in order to partition out the specific "block" influence of high school academic and demographic mutable variables. They were Gender, Non-White, Regents Algebra Exam, Pell Grant, Transfer Credit, HSGPA, and School Size. The purpose of the hierarchy was to determine the amount of change between models and their contribution to College Mathematics performance, which sought to answer the research question: Which model best accounts for the greatest proportion of explained variance in College Mathematics performance when controlling mutable variables?

Following (Table 53) is the hierarchical regression analysis for the third model regression with College Mathematics performance as the outcome variable.

Table 53

Model Summary of Hierarchical Analysis on College Mathematics Performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.263[a]	.069	.029	1.12182	.069	1.713	5	115	.137
2	.348[b]	.121	.075	1.09492	.052	6.719	1	114	.011
3	.462[c]	.213	.164	1.04063	.092	13.207	1	113	.000

[a] Predictors: (Constant), Pell, Gender, School Size, Non-White, Regents Exam Algebra
[b] Predictors: (Constant), Pell, Gender, School Size, Non-White, Regents Exam Algebra, Transfer Credit
[c] Predictors: (Constant), Pell, Gender, School Size, Non-White, Regents Exam Algebra, Transfer Credit, HSGPA

I examined the R square change in the model (see Table 53) which determines the percentage of variability in the dependent variable of College Mathematics that can be accounted for by all the predictors together. In examination of the model summary, for Model l, the R square change began at .069. The analysis of the adjusted R square indicates that the independent variable of School Size, Gender, Pell Grant, Regents Algebra Exam, and Non-White are statistically not significant.

When Model 2 is added, which adds the Transfer Credit, there is an R square change of .052 (5.2%), and the adjusted R square is .121, meaning that 12.1% of the variance is now accounted for when Transfer Credit, School Size, Pell Grant, Regents Algebra Exam, Non-White, and Gender are entered into the regression and are statistically significant ($p<.011$).

When Model 3 is added, which adds HSGPA, there is an R square change of .092 (9.2%). The analysis of the adjusted R square indicates that the independent variables of School Size, Gender, Pell Grant, Regents Algebra Exam, HSGPA, and Non-White are

statistically significant (p<.000). Of the three models, the R^2 change in Model 3 explains the greatest proportion of variance in College Mathematics performance. Model 3 was the strongest predictive model overall.

Table 54

ANOVA[a] for Hierarchical Analysis on College Mathematics Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.779	5	2.156	1.713	.137[b]
	Residual	144.725	115	1.258		
	Total	155.503	120			
2	Regression	18.833	6	3.139	2.618	.020[c]
	Residual	136.670	114	1.199		
	Total	155.503	120			
3	Regression	33.135	7	4.734	4.371	.000[d]
	Residual	122.368	113	1.083		
	Total	155.503	120			

[a] Dependent Variable: College Mathematics

[b] Predictors: (Constant), Pell, Gender, School Size, Non-White, Regents Exam Algebra

[c] Predictors: (Constant), Pell, Gender, School Size, Non-White, Regents Exam Algebra, Transfer Credit

[d] Predictors: (Constant), Pell, Gender, School Size, Non-White, Regents Exam Algebra, Transfer Credit,HSGPA

The ANOVA reported in Table 54 indicates the models were statistically significant, except for the first model. The R^2 change in Model 3 explains the greatest proportion of variance in College Mathematics performance.

This table confirms the previous results as well as indicating that Models 2 and 3 are significant. The independent variables entered in Models 2 and 3 predicted scores on the College Mathematics course are statistically significant ($p \leq .05$): for College Mathematics (Model 2: $F=2.618$, df= 6, 114, $p \leq .020$; Model 3: $F= 4.371$, df= 7, 113, $p \leq .000$).

In examining all three models for multicollinearity issues (see Table 55), considering that the VIFs were within normal parameters (≤ 2) and were close to 1, multicollinearity was not considered to be an issue with these models.

An examination of the standardized beta coefficients in Table 55 indicates that Model 3 has two statistically significant variables: HSGPA and Transfer Credit. Model 2 has one statistically significant variable: Transfer Credit. Model 1 has no statistically significant variables of College Mathematics course performance. The significant predictor explaining the greatest proportion of variance in College Mathematics course performance is HSGPA.

In Model 1, none of the variables were found to be significant.

In Model 2, Transfer Credit was found to be most predictive of performance on College Mathematics course performance in the model (β=.273; t= 2.592; p$\leq$ .05). It contributed approximately 7.45% $(.273)^2$ to 5.56 % $(.236)^2$ of the variance in College Mathematics course performance as indicated by the standardized beta and partial correlation values, respectively. Students who took college courses during high school years seem to be performing better than students who did not.

Table 55

Coefficients[a] All Significant Variables on College Mathematics Performance

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-.562	1.402		-.401	.689					
	Gender	.264	.207	.116	1.276	.205	.132	.118	.115	.986	1.015
	Non-White	-.278	.249	-.107	-1.116	.267	-.137	-.103	-.100	.881	1.135

	School Size	.016	.234	.006	.069	.945	-.048	.006	.006	.928	1.078
	Regents Exam Algebra	.030	.016	.180	1.870	.064	.198	.172	.168	.873	1.145
	Pell	.255	.233	.105	1.094	.276	.039	.102	.098	.879	1.138
2	(Constant)	.415	1.419		.292	.771					
	Gender	.188	.204	.083	.924	.357	.132	.086	.081	.966	1.036
	Non-White	-.240	.243	-.093	-.987	.326	-.137	-.092	-.087	.878	1.139
	School Size	.250	.245	.100	1.019	.310	-.048	.095	.089	.802	1.246
	Regents Exam Algebra	.014	.017	.085	.845	.400	.198	.079	.074	.758	1.319
	Pell	.266	.227	.110	1.170	.244	.039	.109	.103	.879	1.138
	Transfer Credit	.031	.012	.273	2.592	.011	.298	.236	.228	.695	1.439
3	(Constant)	-7.150	2.480		-2.883	.005					
	Gender	-.045	.204	-.020	-.222	.824	.132	-.021	-.019	.870	1.150
	Non-White	-.175	.232	-.068	-.756	.452	-.137	-.071	-.063	.872	1.146
	School Size	.332	.234	.133	1.420	.158	-.048	.132	.118	.795	1.258
	Regents Exam Algebra	-.007	.017	-.039	-.386	.700	.198	-.036	-.032	.672	1.487
	Pell	.333	.217	.137	1.535	.128	.039	.143	.128	.872	1.146
	Transfer Credit	.027	.011	.246	2.447	.016	.298	.224	.204	.691	1.447
	HSGPA	.104	.029	.365	3.634	.000	.390	.323	.303	.690	1.450

[a] Dependent Variable: College Mathematics

In Model 3, HSGPA was found to be most predictive of performance on College Mathematics course performance in the model (β=.365; t= 3.634; p$\leq$ .000). It contributed approximately 13.3% $(.365)^2$ to 10.4 % $(.323)^2$ of the variance in College Mathematics course performance as indicated by the standardized beta and partial correlation values, respectively.

Transfer Credit's contribution weakened by 2.7% when HSGPA was added. Students who had higher HSGPA scores seem to be performing better than students who did not.

Both the simultaneous regression and the hierarchical regression make one fact clear: the independent variable HSGPA is the strongest predictor of student performance on the College Mathematics and Science courses and explains the largest proportion of the variance for these courses.

Table 56

Summary of Significant and Not Significant Variables

Dependent Variable	Statistically Significant Independent Variable	Statistically Not Significant Independent Variable
College Biology	HSGPA Pell Grant Parent with College Education	Regents Exam Biology Non-White Transfer Credit Gender School Size
College Chemistry	Regents Exam Chemistry HSGPA Pell Grant Transfer Credit	Non-White Gender School Size
College Mathematics	HSGPA Transfer Credit	Non-White Gender Pell Grant School Size Regents Exam Algebra

When the regression models were run for only demographic predictors, the dependent variables of College Biology and College Chemistry were significant. *Table 56* indicates that Gender and Parent with College Education have a significant influence on College Biology, but not on College Chemistry. For College Biology performance, Gender accounts for 3.5-4% of the variance and Parent with College Education accounts for 6.9-6.1% of the variance in College Biology (See Table 57).

For College Chemistry performance, Non-White accounts for 4.1% of the variance and Pell Grant for 3.3-2.7% of the variance in College Chemistry (See Table 57).

When the regression models were run for academic predictors while mutable demographic factors were controlled, the dependent variables of College Mathematics, College Biology and College Chemistry were significant.

Table 57

Summary of Significant Demographic Variables' Contribution to College Biology and College Chemistry (%)

	College Biology	College Chemistry
Gender	3.5 - 4	
Non-White		4.1 – 4.1
Pell Grant		3.3 – 2.7
School Size		
Parent with College Education	6.9 – 6.1	

Table 58 indicates that both Transfer Credit and HSGPA have a significant influence on College Mathematics. Pell Grant, Parent with College Education, and HSGPA have a significant influence on College Biology. Transfer Credit, HSGPA, Pell Grant, and NY Regents Chemistry Exam have a significant influence on College Chemistry.

Transfer Credit accounts for the following:

6.1% – 5% of the variance in College Mathematics

4.5 % – 5.1 % of the variance in College Chemistry

HSGPA accounts for the following:

13.3% – 10.4% of the variance in College Mathematics

17.9% – 14.6% of the variance in College Biology

6.2% – 6.1 % of the variance in College Chemistry

Pell Grant accounts for the following:

4.9% - 4.8% of the variance in College Biology

4.2 % – 5.8 % of the variance in College Chemistry

Parent with College Education accounts for the following:

8.6 % - 8.5 % of the variance in College Biology

New York State Regents Exam Chemistry accounts for the following:

7.4% of the variance in College Chemistry

Table 58

Summary of All Significant Variables' Contribution to College Mathematics, College Biology, and College Chemistry (%)

	College Mathematics	College Biology	College Chemistry
Gender			
Non-White			
Pell Grant		4.9 – 4.8	4.2 - 5.8
School Size			
Parent with College Education		8.6 – 8.5	
Transfer Credit	6.1 – 5		4.5 – 5.1
HSGPA	13.3 – 10.4	17.9 - 14.6	6.2 – 6.1
Regents Exam Biology			
Regents Exam Chemistry			7.4 – 7.4
Regents Exam Mathematics			

Chapter V

CONCLUSION AND RECOMMENDATIONS

The purpose of this research was to examine the influence of high school academic performance on freshman-level math and science course performance at SUNY Oswego, while controlling for the demographic factors affecting New York students. Additionally, a secondary purpose was to identify the potential factors, if any, at the secondary school level that best predicted and explained a student's chances of being successful and persisting in college freshman STEM major courses at SUNY Oswego.

In Chapter V, I discuss the conclusions for each of my 10 research questions, briefly delineating variables and summarizing indications based on my models. The research question discussion is followed by my recommendations for future research for each of the variables in my study. Chapter V concludes with summaries of limitations.

Subsidiary Research Questions and Hypotheses

Subsidiary Research Question 1

What influence, if any, do the factors of first-time college attendees and the student mutable variables of SES, parent with college education, gender, race, and high school typology (large population, small population) have on student performance in freshman college math and science courses at SUNY Oswego?

There were five independent variables out of fourteen used for the demographic variables model: Parent with College Education, Gender, Non-White, School Size, and Pell Grant. For College Biology performance, Gender and Parent with College Education were significant predictors. Female students have better College Biology performance than male students, and students whose parents have a college degree seem to perform

better in College Biology than students whose parents have no college degree.

For Chemistry, Pell Grant and Race (Non-White) were significant predictors. Students who received a Pell Grant seem to perform better in College Chemistry than students who did not, and White (coded 0) students have better College Chemistry performance than Non-White (coded 1) students.

When a similar model was run using College Mathematics and College Physics as the outcome variables, the models were not statistically significant.

Subsidiary Research Question 2

What high school academic factors are significantly related to first-year students' academic success in STEM disciplines?

The Pearson Correlation table (see Table 26) reveals the direction and the strength of the relationships. There is a positive moderate relationship between the predictor variable of HSGPA and the outcome variables (Pearson r for College Biology= .413, r for College Chemistry= .457, and r for College Mathematics= .398), which was found to be statistically significant ($p \leq .001$). However, Pearson r for College Physics was not significant.

There is a positive moderate relationship between the predictor variable of SAT and the outcome variables (Pearson r for College Biology= .235, r for College Chemistry= .402, r for College Mathematics= .206, and r for College Physics= .455), which was found to be statistically significant ($p \leq .001$). However, SAT has a higher correlation with Regents Algebra Exam r= .654, Regents Biology r=620, and Regents Chemistry r= .556.

The relationship between the independent variable of School Size and the

dependent variables of College Chemistry, College Mathematics, and College Physics was found not to be statistically significant ($p \leq .05$) and had a weak negative relationship with College Biology (Pearson $r = -.203$) which was found to be statistically significant ($p \leq .05$).

The relationship between the independent variable of Non-White and the dependent variables of College Mathematics and College Physics was found not to be statistically significant ($p \leq .05$) and had a weak negative relationship with College Biology (Pearson $r = -.239$) and with College Chemistry (Pearson $r = .250$), which was found to be statistically significant ($p \leq .001$).

The relationship between the independent variable of EFC, Gender, Non-Suburban, and Pell Grant and the dependent variables of College Biology, College Chemistry, College Mathematics, and College Physics was found to be not statistically significant ($p \leq .05$).

The relationship between the independent variable of Parent with College Education and the dependent variables of College Chemistry, College Mathematics, and College Physics was found not to be statistically significant ($p \leq .05$) and had a weak positive relationship with College Biology (Pearson $r = .283$), which was found to be statistically significant ($p \leq .05$).

The relationship between the independent variable of Transfer Credit and the dependent variables of College Biology and College Physics was found not to be statistically significant ($p \leq .05$) and had a weak positive relationship with College Mathematics (Pearson $r = .290$) and a stronger relationship with College Chemistry (Pearson $r = .391$), which was found to be statistically significant ($p \leq .001$).

Subsidiary Research Question 3

What pre-college factors indicate first-year student retention (from the fall of enrollment to the beginning of the first spring term) in STEM disciplines?

Logistic regression was conducted to assess whether the three predictor variables HSGPA, Transfer Credit, and Regents Chemistry Exam significantly predict that a student would continue his or her major for spring or not.

The Omnibus Tests of Model Coefficients table indicates that when we consider all three predictors together, the model is statistically significant. HSGPA is significant among the three variables in the model which relates to the literature. Researchers consistently determine a positive relationship between high school GPA and persistence and performance in college and find that it is a more consistent predictor of student success than demographic factors (Cabrera, Nora & Castaneda, 1993; Cambiano, Denny, & DeVore, 2000; DesJardins, Ahlburg, & McCall, 1999; Hu & St. John, 2001; Perna, 1998).

Subsidiary Research Question 4

What is the nature of the relationship between New York State high school students' overall high school GPA and their final grades in college freshman mathematics and science courses at SUNY Oswego, when mutable demographic variables are controlled for?

The null hypothesis states there is no statistically significant relationship between New York State high school students' overall GPA and their final grades in freshman College Mathematics and Science courses at SUNY Oswego when student mutable demographic variables are controlled for.

College Biology.

The independent variable of HSGPA is a significant predictor, and the result indicates that students who had a high HSGPA seem to perform better in College Biology than students who did not. As a result, the null hypothesis was rejected when College Biology was the dependent variable.

College Chemistry.

The independent variable of HSGPA is a significant predictor, and the result indicates that students who had a high HSGPA seem to perform better in College Chemistry than students who did not. As a result, the null hypothesis was rejected when College Chemistry was the dependent variable.

College Mathematics.

The independent variable of HSGPA is a significant predictor, and the result indicates that students who had a high HSGPA seem to perform better in College Mathematics than students who did not. As a result, the null hypothesis was rejected when College Mathematics was the dependent variable.

College Physics.

The multiple regression model run for College Physics was not statistically significant.

Subsidiary Research Question 5

What is the nature of the relationship between students' overall New York State Regents Exam scores and their final grades in freshman College Mathematics and Science courses at SUNY Oswego when mutable demographic variables are controlled for?

The null hypothesis states there is no statistically significant relationship between students' New York State Regents Exam scores and their final grades in freshman College Mathematics and Science courses at SUNY Oswego when mutable demographic variables are controlled for.

College Biology.

The independent variable of New York State Regents Biology Exam is not a significant predictor. As a result, the null hypothesis is retained when College Biology is the dependent variable.

College Chemistry.

The independent variable of New York State Regents Chemistry Exam is a significant predictor, and the result indicates that students who had a high New York State Regents Chemistry Exam score seem to perform better in College Chemistry than students who did not. As a result, the null hypothesis was rejected when College Chemistry was the dependent variable.

College Mathematics.

The independent variable of New York State Regents Biology Exam is not a significant predictor. As a result, the null hypothesis is retained when College Mathematics is the dependent variable.

Subsidiary Research Question 6

What is the nature of the relationship between students' college credits earned in high school (Transfer Credits) and their final grades in freshman College Mathematics and Science courses at SUNY Oswego when mutable demographic variables are controlled for?

The null hypothesis states there is no statistically significant relationship between students' transfer credits and their final grades in freshman College Mathematics and Science courses at SUNY Oswego when mutable demographic variables are controlled for.

College Biology.

The independent variable of Transfer Credit is not a significant predictor. As a result, the null hypothesis is retained when College Biology is the dependent variable.

College Chemistry.

The independent variable of Transfer Credit is a significant predictor, and the result indicates that students who transferred college credits to SUNY Oswego seem to perform better in College Chemistry than students who did not. As a result, the null hypothesis was rejected when College Chemistry was the dependent variable.

College Mathematics.

The independent variable of Transfer Credit is a significant predictor, and the result indicates that students who transferred college credits to SUNY Oswego seem to perform better in College Mathematics than students who did not. As a result, the null hypothesis was rejected when College Mathematics was the dependent variable.

Subsidiary Research Question 7

What is the nature of the relationship between New York State high school students' SAT scores and their final grades in college freshman mathematics and science courses at SUNY Oswego, when mutable demographic variables are controlled for?

The null hypothesis states there is no statistically significant relationship between New York State high school students' SAT scores and their final grades in freshman

College Mathematics and Science courses at SUNY Oswego when mutable demographic variables are controlled for.

Due to issues of multicollinearity, simple regression models were run for students' SAT score. The independent variable was significant for all dependent variables (College Mathematics, Biology, Chemistry and Physics) with the highest adjusted R^2 in College Chemistry 15.6 % and in College Physics 16.5 % (see Table 45). Therefore, taken separately, the predictor variable accounted for the reported amount of variance in the outcome variable. The sample regressions were a limitation of my findings.

Subsidiary Research Question 8

When controlling for demographic mutable variables, which model best accounts for the greatest proportion of explained variance in College Biology performance?

Model 4 (including the independent variable of Regents Biology Exam, School Size, Gender, Non-White, Transfer Credit, Pell Grant, HSGPA, and Parent with College Education) is the best model after hierarchical multiple regression analyses were run to find the greatest proportion of variance in freshman College Biology performance. It explains 24.6% of the variance in College Biology performance. HSGPA was the best predictor of College Biology performance in the model. Pell Grant and Transfer Credit were two significant contributors to the model, whereas Gender, Non-White, School Size, New York State Regents Biology Exam, and Parent with College Education were not.

Subsidiary Research Question 9

When controlling for demographic mutable variables, which model best accounts for the greatest proportion of explained variance in College Chemistry performance?

Model 5 (including the independent variable of Regents Chemistry Exam, School Size, Gender, Non-White, Transfer Credit, Pell Grant, and HSGPA) is the best model and explained the greatest proportion of variance in freshman College Chemistry performance. It explained 35.2% of the variance in College Chemistry performance. New York State Regents Chemistry Exam was the best predictor of College Chemistry performance in the model. HSGPA, Transfer Credit and Pell Grant were all significant contributors to the model, whereas Gender, School Size, Non-White, and Parent with College Education were not.

Subsidiary Research Question 10

When controlling for demographic mutable variables, which model best accounts for the greatest proportion of explained variance in College Mathematics performance?

Model 3 (including Transfer Credit, School Size, Pell Grant, Regents Exam Algebra, Non-White, HSGPA, and Gender) is the best model and explained the greatest proportion of variance in freshman College Mathematics performance. It explains 12.1% of the variance in College Mathematics performance. HSGPA was the best predictor of College Mathematics performance in the model. Transfer Credit was a significant contributor to the model, whereas Gender, Non-White, School Size, Pell Grant, and Parent with College Education were not.

Review of Findings and Interpretations

Findings of this study indicate that HSGPA is the strongest significant predictor of College Mathematics and Science performance among all the independent variables, Transfer Credit is a significant predictor of College Chemistry and College Mathematics performances but is not a significant predictor of College Biology and Physics

performance. Pell Grant is a significant predictor of College Chemistry. Parent with College Education is a significant predictor of College Biology performance. New York State Regents Chemistry Exam is a significant predictor of College Chemistry performance (see Table 38) but New York State Regents Algebra Exam and New York State Regents Biology Exam are not significant predictors for College Mathematics and College Biology, respectively.

The overarching research question explored in this study was the following: What is the nature of the relationship between New York State high school students' academic performance and final grades in freshman college mathematics and science courses at SUNY Oswego when controlling for student demographic and school factors?

This study is limited to the northern New York State region, specifically the freshman class enrolled at SUNY Oswego during the Fall 2011 semester. All high school GPAs are assumed to be objective.

This study included only subjects who remained enrolled for the entire academic year 2011-2012. Consequently, the findings presented in this study may not be generalizable to all students majoring in science and math, since results are based on freshman students attending SUNY Oswego, a mid-sized, four-year public university in the northeastern section of the United States. However, findings from this study may be applicable to students in similar settings or in conditions similar to those of the northern New York State region.

Since this study was limited to one college, SUNY Oswego, future research should examine the impact of the current placement policy at other institutions within the state. Additional studies should also be conducted to identify other possible variables that

may produce some accurate course-placement criteria, including New York State Regents exams, Transfer Credit, HSGPA, and SAT score.

A report prepared by the American Association of Colleges and Universities indicated that over 50 % of students entering post-secondary education are not ready for future coursework due to lacking basic academic skills (Miller & Murray, 2005).

The results of this study provide an opportunity to reflect on factors that may indicate the academic success of students in freshman College Mathematics and Science courses. This study raises important questions for future researchers, such as the impact of high school academics (New York State Regents exams, Transfer Credit, HSGPA, SAT scores and Demographic variables) on freshman College Mathematics and Science courses. Replication of this study could include other potential predictors of academic success such as an analysis of SAT verbal scores versus SAT quantitative scores.

Data for students enrolled in the Fall 2011 semester were extracted from the student enrollment database. The sample was drawn from records of Fall 2011 SUNY Oswego freshman students who were at least 18 years of age and attending a medium-sized, public four-year institution in the northwestern New York State region of the United States.

A total of 237 participants in this study were full-time, first-time (attending college for the first time right after high school), first-year New York State students enrolled in undergraduate STEM programs at SUNY Oswego.

To determine whether high school academics have any impact on freshman College Mathematics and Science courses, descriptive statistics, correlation analyses, multiple regressions, and binomial logistic regression statistical analyses were conducted

to address the null hypotheses and assess the impact of variables on the likelihood of persistence of STEM majoring students and their success in freshman College Mathematics and Science courses.

Findings from this study can offer practical information for education professionals in both K-12 and higher education systems. Results may also be used to renovate and strengthen existing recruitment and retention strategies aimed at increasing and retaining the number of students entering the STEM career pipeline.

The findings of this study indicate that when demographic factors were run in the analyses, the variables Gender and Parent with College Education have a significant influence on College Biology, but not on College Chemistry. For College Biology performance, Gender accounts for 3.5-4% of the variance and Parent with College Education accounts for 6.9-6.1% of the variance in College Biology (See Table 59).

For College Chemistry performance, Non-White accounts for 4.1% of the variance and Pell Grant 3.3-2.7% of the variance in College Chemistry (See *Table 59*).

Table 59

Summary of Significant Demographic Variables' Contribution to College Biology and College Chemistry (%)

Demographic	College Biology	College Chemistry
Gender	3.5 - 4	
Non-White		4.1 – 4.1
Pell Grant		3.3 – 2.7
School Size		
Parent with College Education	6.9 – 6.1	

Findings of this study indicate that HSGPA is the strongest significant predictor of College Mathematics and Science performance among all the independent variables,

Transfer Credit is a significant predictor of College Chemistry and College Mathematics performances, Pell Grant is a significant predictor of College Chemistry and College Biology, Parent with College Education is a significant predictor of College Biology performance, and New York State Regents Chemistry Exam is a significant predictor of College Chemistry performance (See Table 60).

The admissions officers are using the HSGPA and SAT scores as predictive data. In this research, in addition to utilizing those variables, we also analyzed transfer credits and New York State Regents Exam performance to determine their relationship to student performance in freshman college biology, chemistry, and math courses. It is valuable to disaggregate the data to discover if the HSGPA and SAT score implications vary according to race, gender, socioeconomic status, and other categories into which students are slotted, such as graduation from schools with a small or large population.

Table 60

Summary of All Significant Variables' Contribution to College Mathematics, College Biology and College Chemistry (%)

	College Mathematics	College Biology	College Chemistry
Gender			
Non-White			
Pell Grant		4.9 – 4.8	4.2 - 5.8
School Size			
Parent with College Education		8.6 – 8.5	
Transfer Credit	6.1 – 5		4.5 – 5.1
HSGPA	13.3 – 10.4	17.9 - 14.6	6.2 – 6.1
Regents Exam Biology			
Regents Exam Chemistry			7.4 – 7.4
Regents Exam Mathematics			

This study is one method that evaluates performance of students in freshman college biology, chemistry and math courses while controlling for mutable demographic factors. In this study, HSGPA and SAT scores were significant predictors of STEM college course performance, with moderate predictive value from transfer credits, New York State Regents Chemistry Exam performance, socioeconomic status, and race.

Gender

Similar to these findings, other research confirms that students' gender is an insignificant success factor in college STEM courses. Boyer (2005) states that gender does not have a significant influence on the educational experience, and Hyde and Mertz (2009) demonstrated equal results between males and females in a study of state math exam results of over seven million students.

School Size

As in our study, Samuel Rohr (2009) also looked at students' high school size to discover if the size of the school (i.e., variety of curricular offerings) could be used to determine whether a person is likely to remain and succeed in STEM careers. Similarly, he found that attending a specific size of high school (e.g., a large school with many electives and advanced courses versus a small school with few electives or advanced courses) was not a reliable predictor of retention or failure in STEM careers. Similarly, in our study, school size was not a predictive factor in students' success in a STEM major.

Parent with College Education

Other research supports our finding in respect to the influence of parents' level of education. In a study of the relationship between parents' level of education and GPAs of college freshman, Regina Vincent Clark's study in Tennessee (2007) found no

statistically significant relationship. Students performed well or poorly irrespective of their parents' educational achievement or attainment. Choy (2001) indicates that first-generation students' variable is a significant predictor for dropping out of college. While 23% of first-generation college students tend to drop out, only 10% of students whose parents had attended college drop out (Choy, 2001).

Results from this study show Parent with College Education as a significant predictor of College Biology performance. Parent with College Education accounts for the following:

8.6 % - 8.5 % of the variance in College Biology

In our research a parent's level of college education was a significant predictor of students' success in College Biology courses, but had no significant impact in students' academic performance in college chemistry or math courses. Many studies hold out a broader conclusion that a parents' level of educational attainment impacts enrollment, demonstrating that when parents had completed college, their children were more likely to enroll (Choy, 2001, 2002; Horn & Nunez, 2000; Pathways to College Network, 2004).

Ramos-Sanchez and Nichols (2007) note that first-generation students are generally outperformed by non-first-generation peers despite evidence of first-generation students' academic confidence or self-efficacy. Bui (2002) discovered that first-generation students have a great chance of earning a bachelor's degree if they attend a four-year institution (40% graduate) instead of transferring from a two-year institution (10% graduate).

Socioeconomic Status

Students from the most affluent families (the uppermost income quartile) have seven times the probability of earning a baccalaureate degree as students from families in the lowest quartile (Lerner & Brand, 2006). SES even appears to neutralize the impact of race and ethnicity on educational achievement (Lee et al., 2008). At the same time, low-income, minority, and first-generation college student characteristics frequently overlap, forming a triple jeopardy for students aspiring to earn a college degree (Barefoot, 2004; Carter, 2006; Green, 2006). Middle-income students tend to have lower college completion/persistence rates due to financial burdens. While low-income students are given grants, middle income students rarely qualify, yet their parents often can contribute very little, resulting in overwhelming debt in the form of college loans (Peng & Fetters, 1978; DesJardins, Ahlburg, & McCall, 1999).

Results from this study show Socioeconomic Status (Pell Grant combined with Estimated Family contribution) as a significant predictor of College Biology and College Chemistry performance. SES accounts for the following:

4.9% - 4.8% of the variance in College Biology

4.2 % – 5.8 % of the variance in College Chemistry

Ethnicity

Sinha 's research also supports our finding that white students have consistently greater academic success in collegiate Biology courses (Sinha, 2010).

Students who are African American or Hispanic have consistently been found to be considerably less likely to continue their education to the postsecondary level than their White peers (ACT, 2004; Allensworth, 2006; National Center for Education

Statistics, 2010; Perna & Titus, 2005; Roderick et al., 2008). Researchers have presented conflicting data regarding the relationship between ethnicity and persistence in completing a college degree. Research has shown both no significant differences between Whites and Non-Whites in terms of college persistence (Allen & Robbins, 2008; Chen & DesJardins, 2008), and significant differences between Whites' and Non-Whites' success in college (Wohlgemuth, Whalen, Sullivan, Nading, Shelley & Wang, 2007), particularly in STEM majors (Seymour & Hewitt, 1997).

Results from this study show Race as a not significant predictor for college mathematics and science courses. This might be due to fewer minorities attending SUNY Oswego and the ones who are attending having high HSGPA and SAT composite scores.

New York State Regents (Exit) Exams

In this study, Regents Chemistry Exam had a significant impact on College Chemistry, whereas Regents Algebra Exam was not significant. This may be due to the small number of students who were accepted to SUNY Oswego. Researchers from the City University of New York (CUNY) found that students who earned at least an 80 on the Math A Regents were likely to pass College Mathematics with a C or better (2008). Sixty-six percent of math exit exams are not aligned properly with college math expectations, resulting in student failure in entry-level college math courses (Brown & Conley, 2007).

Results from this study show Regents Chemistry Exam performance as a significant predictor of College Chemistry performance. New York State Regents Chemistry Exam accounts for: 7.4% of the variance in College Chemistry.

College chemistry is required by more majors and may be better aligned with the New York State Regents Chemistry exam. More students who have taken the Regents Chemistry Exam take College Chemistry, whereas College Mathematics (which represents all math courses, especially Calculus I) may not be aligned with the New York State Integrated Algebra Regents Exam. Also, some of the students already had their college credits before coming to SUNY Oswego; therefore, they did not take freshman college biology and mathematics courses.

With only Regents Chemistry Exam results functioning as a consistent predictor of college performance, this study supports the necessity of alignment between entry-level college academic expectations and exit levels in terms of high school student academic performance. American students' math and English skills when exiting high school is the equivalent of what most students in economically comparable countries learn in eighth grade (Achieve, 2004). In contrast, an examination of the alignment between Arizona's high school exit exams showed a one-to-one relationship between a student passing the math exit exam and earning a 3.0 in a college entry-level math course (D'Agostino & Cimetta, 2008). With the increasing rigor of standards addressed through the recent implementation of Common Core State Standards (CCSS), this study could be conducted again using results from CCSS exams to see if raising the standards also improves college readiness and academic performance in STEM freshman college courses.

Transfer Credit

In a 2011 study, researchers confirmed results of our study in respect to the effectiveness of dual registration in college and high school courses while still in high

school. Both studies conclude that dual credit participation results in greater first-year persistence and college graduations rates. The 2011 study indicates that the strongest positive relationship occurs when students completed more than 12 dual credit hours (Appleby, Ashton, Ferrell, Gesing, Jackson, Lindner, Mata, Shelnutt, & Wu, 2011).

While Kuh et al. noted that transfer status was negatively related to persistence, they did not separately identify dual registration courses taken through two-year colleges while still attending high school from high school graduates who completed credits at a two-year college (Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008) to analyze the variation. Hughes et al. also considered dual registration in their study of ways to help all youth make a successful transition to college and determined that while dual registration programs for high school students typically target high-achieving students, middle and low-achieving students would benefit from participation (Hughes, Karp, Fermin, & Bailey, 2006). Hughes' study indicated that students benefit from earning free college credit, gaining a college experience, and increasing their academic confidence.

Results from this study show Transfer Credit as a reliable predictor of College Mathematics and College Chemistry performance. Transfer Credit accounts for the following:

6.1% – 5% of the variance in College Mathematics

4.5 % – 5.1 % of the variance in College Chemistry

Swanson (2008) also concurred that dual enrollment participants were more likely than non-participants to remain in college, and specified that dual enrollment participants were more likely to complete consecutive semesters without stopping for more than one semester within the first two years of college.

Eimers and Mullen (2003) concurred with positive aspects of dual enrollment, noting that participants are more likely to return for their second year of college. They also found that students earning dual credit at colleges awarding only two-year degrees tended to have lower GPAs than dual credit participants earning credits from four-year institutions.

High School Grade Point Average

Researchers consistently determine a positive relationship between high school GPA and persistence and performance in college and find that it is a more consistent predictor of student success than demographic factors (Cabrera, Nora, & Castaneda, 1993; Perna, 1998; DesJardins, Ahlburg, & McCall, 1999; Cambiano, Denny & DeVore, 2000; Hu & St. John, 2001). However, there are some dissenters of this widely accepted relationship between HSGPA and freshman college performance, with Weissberg, Owen, Jenkins and Harburg (2003), and Jones and Watson (1990) suggesting that because of the variance in high school course offerings and grading standards, this predictive relationship is inaccurate.

Regina Vincent Clark's study in Tennessee (Clark, 2007) found a statistically significant relationship between students' first semester college GPAs and their high school GPAs, demonstrating that students who performed well in high school had similar academic success in their freshman year of college. Clark's findings were consistent with data in other literature (Banerj, 2006; Hoyt, 1998; Schwartz and Washington, 1999). Because of this consistent correlation, most colleges and universities consider high school GPAs as indicators of college readiness. Clark's results correspond with the results in this study regarding GPAs.

Results from this study show high school grade point average (HSGPA) as a reliable predictor of College Mathematics, College Biology, and College Chemistry performance. HSGPA accounts for the following:

13.3% – 10.4% of the variance in College Mathematics

17.9% – 14.6% of the variance in College Biology

6.2% – 6.1 % of the variance in College Chemistry

After completing a four-year study of approximately 80,000 students entering the California University System, researchers concluded that high school GPA was a far more reliable and equitable predictor of students' success in college than SAT scores (Geiser & Santelices, 2007). These results are verified in our study.

As in our study, other studies support the predictive value of students' high school GPA when determining students' potential for success in special college programs. In a study of factors determining success in a collegiate honors program, researchers determined that students who have higher GPAs, higher school class ranking, higher first-semester GPAs, and live in honors housing are more likely to succeed and complete or partially complete the colleges' or universities' honors programs (Campbell & Fuqua, 2009).

Students' high school GPAs were also studied by Samuel Rohr (2009) to determine if they could be used to predict whether a person is likely to remain and succeed in STEM careers. In Roth's study, he noted that every point increase in a student's GPA was linked to his or her retention in a STEM career. Even though our study focused on success within STEM majors as opposed to STEM careers, the

indicators Rohr researched behaved in the same manner of predictability in STEM majors as they did in STEM careers.

Astin (1993) and Seidman (2005) also support our findings that the most significant predictive factor for college success is high school GPA.

Student Aptitude Test (SAT)

Samuel Rohr (2009) studied SAT scores to discover if they could be used to determine whether a person is likely to remain and succeed in STEM careers. According to Roth, every point increase in SAT score was linked to retention in a STEM career. While our study focused on success within STEM majors in college, the SAT indicator Rohr researched behaved in the same manner of predictability in STEM majors as it did in STEM careers. Students with higher SAT scores performed better in STEM majors.

Results from this study show SAT has a positive influence on freshman College Mathematics, Chemistry, Physics, and Biology performance. When the simple regression was run for SAT composite score, it accounts for the following:

4.7 % of the variance in College Biology

15.6% of the variance in College Chemistry

3.5 % of the variance in College Mathematics

Researchers from Binghamton University corroborate our findings regarding students' SAT scores and high school GPAs serving as predictors of success in freshman chemistry, biology and math classes (Sinha, 2010).

Recent research in Texas (Nayani, 2012) also strengthens our findings in regard to SAT scores' predictability in STEM subjects. Nayani found that higher SAT scores correlated with success in freshman math and biology courses, making a specific point

that high scores in both the math and verbal portions of the SAT are necessary for success in freshman college biology.

Geiser and Santelices (2007), having completed a study of 80,000 students entering the California University System, concluded that performance on SAT exams was more closely tied to students' socioeconomic status than academic ability and therefore was a less reliable predictor of students' abilities to succeed in college. Our research substantiates these findings.

In a significant longitudinal study involving over 87,000 STEM students, Zhang et al. (2004) determined that high school GPAs and SAT math scores were the two most reliable predictors for students' college and career success in STEM majors and STEM careers. Their findings corroborate the conclusions of our research.

Conclusions and Recommendations

As policymakers, principals should remain focused on encouraging students to attain excellent HSGPAs and emphasize the importance of registering for the college courses in their schools and achieving mastery level performance on the Regents Chemistry Exam with its strong relationship to college students passing freshman college chemistry. Research and studies should be completed in the near future to determine alignment between Regents Living Environment, Earth Science, Physics, and Algebra Exams and students' performance in 100s-level courses on similar topics in college. Principals can expose students to these college courses through partnerships with community colleges and surrounding universities where students can complete classes in their home school or by attending the college. Where a predictive relationship is absent between student performance on the Regents Exam and the associated college course, the

curriculum and exams should be altered so that future student Regents performance will reflect student preparedness for college level work in associated subjects.

This research is focused on understanding success in entry-level college mathematics and science courses and understanding the roles of various demographic factors, including the school typology. It is a necessary and valuable study because in college STEM courses, there are much higher rates of failure, drop out, and switching of majors when compared to non-STEM courses (Gainen, 1995; Seymour & Hewitt, 1997; Wood & Gentile, 2003). Based on these findings, guidance counselors, science educators, and education institutions can develop a framework to determine which measurements are meaningful and which factors lead to particular tendencies, and advise students to focus on achieving excellent performance in the Regents Chemistry Exam and maintaining a GPA above 3.2 in order to improve students' graduation rates from STEM programs.

Results from this study can guide college readiness and college persistence policies at school, district, and state levels. At the school level, guidance counselors and mentors should make sure students are given coursework that leads to college readiness from seventh grade onward. Beginning challenging coursework, such as Regents Algebra 1 and Regents Living Environment as early as seventh grade will allow students to fill their schedules with college preparatory and dual registration courses throughout high school. Based on findings in this study and supported by many other studies, students who transfer dual-registered college credits are more likely to perform well during their freshman year of college and persist through graduation. Therefore, high

schools should partner with local two-year and four-year colleges to provide as many entry-level courses as possible.

In addition, parents, guidance counselors, teachers and administrators should help students to understand the correlation between high HSGPAs and increased potential for success in college. While many studies make the point that HSGPAs can be very subjective, a high HSGPA indicates that the student consistently takes the responsibility for those classes. HSGPA is a significant predictor for all other dependent variables in determining success and persistence in college. A high HSGPA indicates a longitudinally sustained underlying work ethic throughout all a student's high school years. Conversely, studies, including this one, have noted that a student with an SAT score of 1460 had a freshman fall GPA of 2.77, which in turn indicates a lower potential of persistence. Therefore, policymakers, guidance counselors, and administrators should encourage disciplined, consistent study habits through incentives, recognition, and message focus.

Wherever and whenever possible, it is also to high school students' advantage to participate in college summer bridge programs that include college visits with exposure to staying overnight to familiarize themselves with college life. Studies have shown that creating a sense of belonging in the collegiate environment is tied to persistence in degree completion. In conjunction, as part of college persistence programs, studies demonstrate the effectiveness of establishing support groups for incoming freshman so that they have a mentorship program for a successful freshman year, as the research indicates that a successful freshman year leads to degree completion.

With the correlation between Regents Chemistry Test performance and successful course completion in freshman chemistry, the state should work to hone its Regents Exams so that each exam is a reliable predictor of success in related freshman-level college coursework. Additionally, New York State should revert to its statewide incentive policy for high performing Regents scholars by awarding mastery level Regents performers meaningful Regents scholarships that will significantly help to defray the cost of college.

Recommendations for Future Research

This research adds to the extant literature on factors that influence freshman college mathematics and science courses final grades. Preparing students for college is a multifaceted and complex task. However, one exploratory study cannot provide complete answers as to which variables most influence student achievement. The variables in this study are useful as a guide for further research. To make the literature complete, research topics deserving exploration are considered below:

1. The replication of this study with other SUNY universities. Since this study includes data from only one state and one university, the findings are limited and weakened. By including data from additional states and universities, results would have greater implications and applicability
2. The replication of this study at the community college level.
3. A comparison of students' high school academics in SUNY universities and private universities in New York.
4. A study comparison of different state universities freshman college STEM majors.

5. A deeper analysis of the extant research between New York State Regents Exam and freshman college mathematics and science courses to find the effect size of each variable among all SUNY universities.
6. A study of the influence of New York State Regents Exam variables on freshman college mathematics and science course performance in SUNY universities
7. A deeper analysis or more expansive analysis on racial factors' influence on freshman college STEM course performance
8. A deeper analysis or more expansive analysis on gender factors' influence on freshman college STEM course performance
9. A study of students' perception of the influence of race and socioeconomic status on freshman college STEM course performance.
10. A study of students' perception of the influence of their school size on freshman college STEM course performance.
11. A qualitative study in which students could provide input regarding the effectiveness of particular teaching methods that lead to better comprehension and academic performance.

Closing Thought

The transition from high school to college presents social and educational challenges for many students, and these challenges are especially difficult for economically and educationally disadvantaged students. The academic success or failure of students depends upon the characteristics they bring with them to college and their experiences while attending. Jenkins (2001) indicated that retaining students does not

depend only on students' academic preparedness but their commitment to the educational process as well as institutional initiatives and programs for incoming freshman students. This study explored the significance of high school academics and demonstrated their relationship to the transition to college during the freshman year mathematics and science courses of STEM majors.

Many studies have used students' high school transcripts to gather information on state exam scores, high school overall grade point averages, and SAT and/or ACT scores. The comprehensive study *Factors Contributing to the Success of Undergraduate Business Students in Management Science Courses* examined transcripts for SAT scores, college GPAs and college calculus and statistics grades and found GPA to be the most significant predictor for the course grade (Brookshire & Palocsay, 2005).

The results of their study can be utilized by high school administrators, math and science teachers, and guidance counselors to better understand the long-term impact of high school mathematics and science achievement. The results can also be used to shape advice that should be distributed to students and their parents, to guide them in preparing schedules or to motivate them to do their best when they see that their efforts can have long-term effects. The findings of this study have the potential to help high school students who will major in STEM programs better prepare for college before leaving high school. Results can be used to aid in future recruiting and advising students and planning first-year curriculum. Additionally, the results of this study will provide data useful to SUNY Oswego and similar New York State universities in developing effective interventions to increase first-year persistence. Administrators may use the findings to develop policies and procedures for establishing STEM major program development.

Finally, the country has a need for STEM graduates to enter STEM careers (Kaste, 2013). The United States has a deficit of qualified graduates to fill thousands of open STEM jobs at places such as Facebook and Intel, forcing Congressional alteration of immigration policy to allow a flood of foreign workers into the country to staff these positions. If students, parents, guidance counselors, and teachers understood and promoted the long-term importance of effort and success in high school and college STEM courses and exams, it would improve the outlook for individuals, families, corporations, communities, and our country.

REFERENCES

Achieve. (2009). *Race to the top: Accelerating college and career readiness in states, Washington, DC: Longitudinal Data Systems.*

Achieve. (2010). *How well is Massachusetts preparing all students for college, careers and life?* Washington, DC: American Diploma Project Network.

ACT. (2004). *Crisis at the core: Preparing all students for college and work.* Iowa City, IA: Author.

ACT. (2006). *COMPASS reference manual,* Iowa City, IA: Author.

ACT. (2007). *COMPASS guide to effective student placement and retention in mathematics,* Iowa City, IA: Author.

ACT. (2008). National Profile of High School Report. *High school graduating class of 2008 –District report, Springfield SD R-12.* Springfield, MO: Springfield Public Schools.

ACT, Inc. (2007). *Rigor at risk: Reaffirming quality in the high school core curriculum.* Iowa City, IA: Author.

ACT, Inc. (2012). *The condition of college & career readiness.* Retrieved from http://media.act.org/documents/CCCR12-NationalReadinessRpt.pdf

ACT Newsroom. (2000). High school sophomores need help planning upper level courses, college and careers. Retrieved from http://www.act.org/news/releases/2000/06-05-00.html

Adelman, C. (1999). *Answers in the toolbox: Academic intensity, attendance patterns, and bachelor's degree attainment.* Washington, DC: U.S. Department of Education.

Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school through college*. Washington, DC: U.S. Department of Education.

Alexander, K. A., Riordan, C., Fennessey, J., & Pallas, A. M. (1982) Social background, academic resources, and college graduation: Recent evidence from the national longitudinal survey. *American Journal of Education, 90*(4): 315-333.

Allen, J., Robbins, S. B., Casillas, A., & Oh, I. S. (2008). Third-year college retention and transfer: Effects of academic performance, motivation, and social connectedness. *Research in Higher Education, 49*(7), 647-664.

Allensworth, E. M. (2006). *Update to: From high school to the future, a first look at Chicago public school graduates' college enrollment, college preparation, and gradation from four-year colleges*. Chicago, IL: University of Chicago, Consortium on Chicago School Research.

Alting, A., & Walser, A. D. (2006). *The influence of mathematics preparation on the retention and academic achievement of underrepresented engineering students.* Paper presented at the annual ASEE Conference and Exposition, Chicago, IL.

American Diploma Project Network. (2006). *Preparing today's high school students for tomorrow's opportunities*. Retrieved from http://www.eric.ed.gov/PDFS/ED499841.pdf

Astin, A.W. (1993). *What matters in college? Four critical years revisited.* San Francisco, CA: Jossey-Bass.

Astin, A.W., & Oseguera, L. (2005) *Pre-college and institutional influences on degree attainment in college student retention: Formula for student success,* edited by Allen Seidman, 245-276. Westport, CT: Praeger Press.

Aughinbaugh, A. (2008). Who goes to college? Evidence from the NLSY97. *Monthly Labor* Review, *131*(8), 33-43. Retrieved from http://search.proquest.com/docview/235604202?accountid=13793

Bill and Melinda Gates Foundation. (2009, November). *Postsecondary success fact sheet.* Seattle, WA: Author.

Blatchford, P., Bassett, P., Goldstein, H., & Martin, C. (2003). Are class size differences related to pupils' educational progress and classroom processes? *British Educational Research Journal, 29*(5), 709.

Boyer, P. (2005). College student persistence of first-time freshmen at a Midwestern university: A longitudinal study. *Research for Educational Reform, 10*(1), 16-27.

Braxton, J. M., Hirschy, A. S., & McClendon, S. A., (2004). *Understanding and reducing college student departure: ASHE-ERIC Higher Education Report. 30*(3).

Braxton, J. M., & Hirschy, A. S. (2005). Theoretical developments in the study of college student departure. In A. Seidman (Ed.), *College student retention: Formula for student success* (pp. 61-88). Westport, CT: Praeger Press.

Bridgeman, B. (1982). Comparative validity of the College Board scholastic aptitude test--mathematics and the descriptive tests of mathematics skills for predicting performance in college mathematics courses. *Educational and Psychological Measurement, 42*(1), 361-366. Retrieved from http://search.proquest.com/docview/63583691?accountid=13793

Brookshire, R. G., & Palocsay, S. W. (2005). Factors contributing to the success of undergraduate business students in management science courses. *Decision Sciences Journal of Innovative Education*, *3*(1), 99-108.

Cabrera, A. F., La Nasa, S. M., & Perna, L.W. (2004) The key to college access: Rigorous academic preparation. In W. G. Tierney, Z. B. Corwin, & J. E. Colyar (Eds.), *Preparing for college: Nine elements of effective outreach* (113-134). Albany, NY: State University of New York Press.

Cabrera, A. F., Nora , A., & Castaneda, M. B. (1993). College persistence: Structural equations modeling test of an integrated model of student retention. *The Journal of Higher Education*, *64*(2), 123-139. Retrieved from http://www.jstor.org/discover/10.2307/2960026

Cambiano, R., Denny, G., & DeVore, J. (2000). College student retention at a mid-western university: A six-year study. *Journal of College Admission*, *166,* 22-29.

Carnegie Corporation of New York (2011). *A Two-Year Update on the opportunity equation: Transforming mathematics and science education for citizenship and the global economy.* Retrieved from http://opportunityequation.org/uploads/GrowingOpportunity_ATwo-YearUpdate.pdf

Carnevale, A. P., Smith, N., & Strohl, J. (2010). *Projections of jobs and education requirements through 2018.* Washington, DC: Georgetown University, Center on Education and the Workforce.

Carter, D. (2006). Key issues in the persistence of underrepresented minority students. *New Directions for Institutional Research*, *130*, 33-46.

Cech, S. J. (2008). SAT scores for class of 2008 halt slide of recent years. *Education Week, 28*(2), Retrieved from http://search.proquest.com/ docview/ 202721447?accountid=13793

Center for Postsecondary Research. (2005). *National survey of student engagement.* Bloomington, IN: Indiana University.

Chapman, D. W. (1981). A model of student college choice‖. *The Journal of Higher Education*, 52(5), 490-505.

Chen, R., & DesJardins, S. L. (2008). Exploring the effects of financial aid on the gap in student dropout risks by income level. *Research in Higher Education*, *49*(1), 1-18.

Choy, S. P. (2001). *Students whose parents did not go to college: Postsecondary access, persistence, and attainment.* Washington, DC: U.S. Department of Education,National Center for Education Statistics.

Choy, S. P. (2002) *Access and persistence: Findings from 10 years of longitudinal research on students.* Washington, DC: American Council on Education, Center for Policy Analysis.

Choy, S. (2002). *Nontraditional undergraduates* (Report No. NCES 2002-012). Washington, DC: National Center for Education Statistics.

Cohen, A. M. & Brawer, F. B. (2008). *The American community college,* 5th ed. San Francisco, CA: Jossey-Bass.

College-Bound Seniors 2011 Total group profile report. (2011). Retrieved from http://professionals.collegeboard.com/profdownload/cbs2011_total_group_report.pdf

Collier, P., & Morgan, D. (2008). "Is that paper really due today?": Differences in first generation and traditional college students' understandings of faculty expectations. *Higher Education, 55*, 425-446. doi 10.1007/s10734-007-9065-5

Conley, D. T. (2003). *Understanding university success: A project of the AAU and the Pew*

charitable trust. Retrieved from http://www.ode.state.or.us/teachlearn/subjects/science/curriculum/uusintroduction.pdf

Conley, D. T. (2007). *Redefining college readiness, Vol. 4*: A report prepared for the Bill and Melinda Gates Foundation. Eugene, OR: Educational Policy Improvement Center.

Conley, D. T. (2010). *College and career ready: Helping all students succeed beyond high school*. San Francisco, CA: Jossey-Bass.

Council on Competitiveness. (2005). *Innovate America: Thriving in a world of challenge and change. National innovation initiative summary and report*. Retrieved from http://www.compete.org/images/uploads/File/PDF%20Files/NII_Innovate_America.pdf

DeBerard, M. S., Spielmans, G. I., & Julka, D. L. (2004). Predictors of academic achievement and retention among college freshmen: A longitudinal study. *College Student Journal, 38*(1), 66-80. Retrieved from http://search.proquest.com/docview/236592411?accountid=13793

Dee, T. S., Jacob, B. A., Hoxby, C. M., & Ladd, H. F. (2010). The impact of no child left behind on students, teachers, and schools/Comments and discussion. *Brookings*

Papers on Economic Activity, 149-207. Retrieved from http://search.proquest.com/docview/859360413?accountid=13793

DesJardins, S. L., Ahlburg, D. A., & McCall, B. P. (1999). *An event history model of student departure. Economics of Education Review, 18*(3), 375-390.

DesJardins, S. L., Alburgh, D. A., & McCall, B. P. (2002). *Simulating the longitudinal effects of changes in financial aid in student departure from college. Journal of* Human Resources, 37(3), Retrieved May 12, 2012 from http://www.jstor.org/stable/3069685

Donohue, G. (2012). *On point for college, changing Syracuse degree by degree.* Retrieved from http://www.onpointforcollege.org/successstories.htm

Drew, D. E. (1996). *Aptitude revisited: Rethinking math and science education for America's next century.* Baltimore, MD: Johns Hopkins University Press.

Engstrom, C., & Tinto, V. (2008). *Access without support is not opportunity. C hange: The Magazine of Higher Learning, 40*(1), 46-50.

Fogg, N. (2010). *Analysis of statewide data.* Boston, MA: Northeastern University: Center for Labor Market Studies.

Friedman, T. (2005).*The world is flat: A brief history of the twenty-first century.* New York: Farrar, Straus, and Giroux.

Gainen, J. (1995). *Barriers to success in quantitative gatekeeper courses. New Directions for Teaching and Learning, 1995*(61), 5-14.

Gates, S. J., & Mirkin, C. (2012). Encouraging STEM students is in the national interest. *The Chronicle of Higher Education*. Retrieved from http://search.proquest.com/docview/1023759691?accountid=13793

Geiser, S, & Santelices, M.V. (2007). *Validity of high school grades in predicting student success beyond the freshman year: High-school record vs. standardized tests as indicators of four-year college outcomes.* (Research and Occasional Paper Series No. CSHE.6.07). Berkley, CA: University of California Berkeley, Center for Studies in Higher Education.

Gilmer, T. C. (2007). An understanding of the improved grades, retention, and graduation rates of STEM majors at the academic investment in math and science (AIMS) program of Bowling Green State University (BGSU). *Journal of STEM Educatio: Innovations and Research, 8*(1), 11-21. Retrieved from http://search.proquest.com/docview/222790295?accountid=13793

Goenner, C. F., & Snaith, S. M. (2004). Assessing the effects of increased admission standards. *College and University, 80*(1), 29-34. Retrieved from http://search.proquest.com/docview/225614373?accountid=13793

Green, D. (2006). Historically underserved students: What we know, what we still need to know. *New Direction Faro Community Colleges*, 135, 21-28.

Hawkins, D. A., & Lautz, J. (2005). *NACAC: State of college admission.* Alexandria, VA: NACAC. Retrieved from http://search.proquest.com/docview/62073245?accountid=13793

Helmick, F. (1983). *Evaluation of the placement test of mathematics at University of Akron.* [Abstract]. Retrieved from UMI Proquest Digital Dissertation Database (AAT 8314828).

Hertel, J. (2002). College student generational status: Similarities, differences, and factors in college adjustment. *The Psychological Record*, *52*(1), 3-18.

Horn, L. (1998). *Stopouts or stayouts? Undergraduates who leave college in their first year.* Washington, DC: U.S. Department of Education, National Center for Education Statistics.

Horn L. & Nunez, A. (2000). *Mapping the road to college: First generation students' math track, planning strategies, and context of support.* Washington, DC: U. S. Department of Education, Office of Educational Research and Improvement.

Hu, S., & St. John, E. P. (2001). *Student persistence in a public higher education system: Understanding racial and ethnic differences. Journal of Higher Education*, 265-286.

Hutson, T. L. (1999). *An assessment of a mathematics program including the scheme for placing students into developmental courses.* [Abstract]. Retrieved from UMI Proquest Digital Dissertation database (AAT 9949968)

Hyde, J. S., & Mertz, J. E. (2009). Gender, culture, and mathematics performance. *Proceedings of the National Academy of Sciences of the United States of America, 106*(22), 8801. Retrieved from http://search.proquest.com/docview/201335006?accountid=13793

Ingels, S. J., Burns, l. J., Charleston, S., Chen, X., & Cataldi. (2005). *A profile of the American high school sophomore in 2002: Initial results from the base year of the longitudinal study of 2002.* Washington, DC: National Center for Education Statistics.

Ingels, S. and Dalton, B. (2008). *Trends Among High School Seniors, 1972-2004 (NCES 2008-320).* Washington, DC: U.S. Department of Education, National Center for Education Statistics, Institute of Education Science.

Ishitani, T. (2003). A longitudinal approach to assessing attrition behavior among first-generation students: Time-varying effects of pre-college characteristics. *Research in Higher Education*, *44*(4), 433-586.

Jamelske, E. (2009). *Measuring the impact of a university first-year experience program on student GPA and retention. Higher Education*, *57*, 373-391.

Jenkins, Y. S. (2001). *Ethnic identification, racial climate, and African American undergraduate educational outcomes in a predominantly white university.* Retrieved from http://search.proquest.com/docview/62264933?accountid=13793.

Johnson, I. (2008). Enrollment, persistence, and graduation of in-state students at a public research university: Does high school matter? *Research in Higher Education*, *49*, 776-793. doi 10.1007/s11162-008-9105-8

Johnson, W. B. (2000). The intentional mentor: Strategies and guidelines for the practice of mentoring. *Professional Psychology Research and Practice*, *33*(1), 88-96.

Jones, D. J., & Watson, B. C. (1990). *" High risk" students and higher education: Future trends.* ERIC Digest. Washington, DC: ERIC Clearinghouse on Higher Education.

Kelly, A. P., & Schneider, M. (2011). *Beyond the rhetoric: Improving college readiness through coherent state policy.* San Jose, CA: National Center for Public Policy and Higher Education.

Kezar, A. J., Eckel, P., Contreras-McGavin, M., & Quaye, S. J. (2007). Creating a web of support: An important leadership strategy for advancing campus diversity. *Higher Education*, *55*, 69-92.

Kim, E., Newton, F., Downey, R., & Benton, S. (2010). Personal factors impacting college student success: Constructing college learning effectiveness inventory (CLEI). *College Student Journal*, 44(1), 112-125.

Kuh, G. D., Cruce, T., Shoup, R., Kinzie, J., & Gonyea, R. (2008). Unmasking the effects of student engagement on first-year college grades and persistence. *The Journal of Higher Education*, *79*(5) 540-563.

Kuh, G. D., Kinzie, J., Buckley, J. A., Bridges, B. K., & Hayek J. C. (2006). *What matters to student success: A review of the literature.* (Commissioned Report for the National Symposium on Postsecondary Student Success: Spearheading a Dialog on Student Success). Bloomington, IN: Indiana University Center for Postsecondary Research.

Lederman, L. M. (2004). *Science is a social enterprise: The chronicle of higher education*. Retrieved from http://chronicle.com/article/Science-Is-a-Social-Enterprise/11055

Lee, J. M., & Rawls, A. (2010). *The college completion agenda 2010 progress report.* New York, NY: The College Board.

Leech, L. N., Barrett, C. K., & Morgan, A. G. (2011). *IBM SPSS for Intermediate Statistics use and interpretation.* (4th ed.). New York, NY: Routledge, Taylor & Francis Group.

Lerner, J. B.. & Brand, B. (2006). *The college ladder: Linking secondary and postsecondary education for success for all students*. Washington, DC: American Youth Policy Forum. Retrieved from http://www.aypf.org/publications/

The%20College%20Ladder/TheCollegeLadderlinkingsecondaryandpostsecondary education.pdf

Lotkowski, V. A., Robbins, S. B., & Noeth, R. J. (2004). *The role of academic and non-academic factors in improving college retention*. Iowa, IA: ACT Policy Report.

MacAllum, K., Yoder, K., Kim, S. & Bozick, R. (2002). *Moving forward: College and career transitions of LAMP graduates*. Washington, DC: National Institute for Work and Learning, Academy for Educational Development.

Maggio, J. C., White, W. G., Molstad, S., & Kher, N. (2005). Prefreshman summer programs' impact on student achievement and retention. *Journal of Developmental Education, 29*(2), 2.

Manna, P. (2006). *School's in: Federalism and the national education agenda.* Washington, DC: Georgetown University Press.

MacDonald, M. F., & Dorr, A. (2006).*Creating a college-going culture, a resource guide*. Los Angeles, CA: UCLA.

McGrath, M., & Braunstein, A. (1997, September). The prediction of freshmen attrition: An examination of the importance of certain demographic, academic, financial and social factors. *College Student Journal, 31*(3), 396-408.

McGrath, E., & Richards, C. E. (2001).*Welcome, freshmen!* Retrieved from http://www.time.com/time/magazine/article/0,9171,1000721,00.html

Murtaugh, P., Burns, L., & Schuster, J. (1999). Predicting the retention of university students. *Research in Higher Education, 40 (3)*, 355-371.

The National Academies of Science. (2006). *Rising above the gathering storm: Energizing and employing America for a brighter economic future*. Retrieved from http://www.nap.edu/catalog.php?record_id=11463

National Center for Education Statistics (NCES). (2004). *The high school transcript study: A decade of change in curricula and achievement, 1990-2000.* Retrieved from http://nces.ed.gov/pubs2004/2004455_a.pdf

National Center for Education Statistics (NCES). (2010). *The Condition of Education 2010.* Washington, DC: United States Department of Education.

National Center for Education Statistics (NCES), (2011). *The Nation's Report Card: Science 2009.* Retrieved from http://nces.ed.gov/nationsreportcard/pdf/main2009/2011451.pdf

National Center for Education Statistics (NCES). (2010). *Highlights from PISA 2009: Performance of U.S. 15- year-old students in reading, mathematics, and science literacy in an international context.* Washington, DC: U.S. Department of Education.

National Center for Public Policy and Higher Education. (2009). *States, schools, and colleges: Policies to improve student readiness for college and strengthen coordination between schools and colleges.* Retrieved from http://www.highereducation.org/reports/ssc/ssc_k16.pdf

National Center for Public Policy and Higher Education. (2010). *Measuring up 2008: The national report card on higher education* (Vol. 2010). San Jose, CA: Author.

National Science Board. (2006). *Science and engineering indicators 2006.* Retrieved from http://www.nsf.gov/nsb/publications/landing/nsb0601.jsp

National Science Board. (2010). *Science and engineering indicators 2010.* Arlington, VA: National Science Foundation.

Nagaoka, J., Roderick, M., & Coca, V. (2009). *Barriers to college attainment: Lessons from Chicago.* Chicago, IL: University of Chicago, The Consortium on Chicago School Research.

Obama, B. (2009, March 10). *Fact sheet: Expanding the promise of education in* America. Retrieved from http://www.whitehouse.gov/the_press_office/Fact-Sheet-Expanding-the-Promise-of-Education-in-America

OECD. (2007). *PISA 2006 Science Competences for Tomorrow's World* (Vol.1). Paris, France: OECD.

OECD (2010), *PISA 2009 Results: Executive Summary.* Paris, France:OECD.

Osborn, P. B. (2002*). A comparison of academic performance in college algebra between high school dual-enrolled and traditional college students.* [Abstract]. Retrieved from UMI Proquest Digital Dissertation database (AAT 3055341).

Pathways to College Network. (2004). *A shared agenda: A leadership challenge to improve college access and success.* Boston, MA: Author.

Pascarella, E., Duby, P., Miller, V., & Rasher, S. (1981). Pre-enrollment variables and academic performance as predictors of freshman year persistence, early withdrawal, and drop out behavior in an urban, nonresidential university. *Research in Higher Education*, *15(4)*, 329-349.

Pascarella, E., Pierson, C., Wolniak, G., & Terenzini, P. (2004). First-generation college students: Additional evidence on college experiences and outcomes. *The Journal of Higher Education*, 75(3), 249-284.

Pauley, B. A. (2011). *A case study of first-year persistence of Marshall University freshmen*. *ProQuest Dissertations and Theses* (887711898). Retrieved from http://search.proquest.com/docview/887711898?accountid=13793. (887711898).

Paulson, A. (2010). No child left behind embraces college and career readiness. *Christian Science Monitor Online.* Retrieved from http://www.csmonitor.com/USA/Society/2010/0323/No-Child-Left-Behind-embraces-college-and-career-readiness

Peng, S. S., & Fetters, W. B. (1978, June 20). Variables involved in withdrawal during the first two years of college: Preliminary findings from the national longitudinal study of the high school class of 1972. *American Educational Research Journal,* 15(3), 361-372. Retrieved from http://aer.sagepub.com/content/15/3/361.short

Perna, L. W. (1998). Retaining Minority Students in Higher Education. *ASHE-ERIC Higher Education Report*, 30(2).

Perna, L.W. (2000). Differences in the decision to attend college among African Americans, Hispanics, and Whites. *Journal of Higher Education,* 71(2) (2000): 117-141.

Perna, L. W. & Titus, M. A. (2005). The Relationship between parental involvement as social capital and college enrollment: An examination of racial/ethnic group difference. *Journal of Higher Education,*76(5), 485-518.

Powell, A. (2007). *How sputnik changed U.S. education*. Retrieved from http://news.harvard.edu/gazette/story/2007/10/how-sputnik-changed-u-s-education/

President's Council of Advisors on Science and Technology. (2012). *Engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics* (Report to the President). Retrieved from http://www.whitehouse.gov/sites/default/ files/microsites/ostp/pcast-engage-to-excel-final_feb.pdf

Reinarz, A. (1991). Gatekeepers: Teaching introductory science. *College Teaching, 39*(3), 94.

Renick, J. C. (2006). A call to action for promoting EXPANDED ACCESS. *The Presidency*, 9(3), 21-25. Retrieved from http://search.proquest.com/docview/216481026?accountid=13793

Risku, M. (2002). *A bridge program for educationally disadvantaged Indian and African Americans.* Paper presented at the University of Minnesota. Retrieved from ERIC database (ED477417)

Rohr, S. L. (2009). *Improving student retention of future members of the science, technology, engineering, mathematics, and business workforce.* Indiana State University. *ProQuest Dissertations and Theses*, 97-n/a. Retrieved from http://search.proquest.com/docview/304899976?accountid=13793. (304899976).

Roderick, M., Nagaoka, J., Coca, V., Moeller, E. with Roddie, K., Gilliam, J., & Patton, D. (2008). *From high school to the future: Potholes on the road to college.* Chicago, IL: University of Chicago, Consortium on Chicago Schools Research.

Rosin, H. (2010) The end of men. *Atlantic Monthly Online.* Retrieved from http://www.theatlantic.com/magazine/archive/2010/07/the-end-of-men/308135/2/

Sanders, L., & Burton, J. (1996). From retention to satisfaction: New outcomes for

assessing the freshman experience. *Research in Higher Education 37(5)*, 555-567.

Seidman, A. (2005). *College student retention: Formula for student success*. Westport, CT: Praeger Publishers.

Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview Press.

Schneider, M. (2010). *Finishing the first lap: The cost of first-year student attrition in America's four year colleges and universities*. Washington, D.C.: American Institute for Research.

Smith, B. L., MacGregor, J., Matthews, R. S., & Gabelnick, F. (2004). Learning communities: Reforming undergraduate education. San Francisco, CA: Jossey-Bass.

Somers, P. (1995). *A comprehensive model for examining the impact of financial aid on enrollment and persistence. Journal of Student Financial Aid*, *25*(1), 13-27.

Stoel, C. F. (1988). History of the high school connection. *New Directions for Community Colleges*, *63*, 13-23.

Stratton, L., O'Toole, D., & Wetzel, J. (2007). Are the factors affecting dropout behavior related to initial enrollment intensity for college undergraduates? *Research in Higher Education, 48(4),* 453-485. doi 10.1007/s11162-006-9033-4

Strong American School's Project.(2008). *Diploma to nowhere*. Washington, DC. The Gates Foundation.

Symonds, W. C., Schwartz, R. B. & Ferguson, R. (2011). *Pathways to prosperity:*

Meeting the challenge of preparing young Americans for the 21st century. Cambridge. MA: Harvard Graduate School of Education, Pathways to Prosperity Project.

Thomas, G. E., Alexander, K. L., & Eckland, B. K. (1979). *Access to higher education: The importance of race, sex, social class, and academic credentials. School Review, 87*, 133–156.

Tinto, V. (1993). *Leaving college: Rethinking the cause and cures of student attrition* (2nd ed.). Chicago, IL: University of Chicago.

Tyack, D. & Cuban, L., (1995). *Tinkering toward utopia: A century of public school reform*. Cambridge, MA: Harvard University Press.

U.S. News & World Report. (2008). The future of high school reform. Retrieved from http://www.usnews.com/articles/education/high-schools/2008/12/04/the-future-of-high-schools.html

U.S. Department of Education. (2002). *Coming of age in the 1990s: The eighth grade class of 1988 12 years later.* Washington, DC:

U.S. Department of Education. (2004). A profile of the upward bound program: 2000-2001. Washington, DC:

Wagner, M., Newman, L., & Cameto, R. (2004) *Changes over time in the secondary school experiences of students with disabilities: A report of findings from the national longitudinal transition study and the national longitudinal transition study-2.* Washington, DC: U.S. Department of Education, Office of Special Education Programs.

Wagner, T. (2008). *The global achievement gap*. New York, NY: Basic Books.

Walton, A. R., Berkner, L., Wheeless, S. C., Shepherd, B, & Hunt-White, T. (2010). *Persistence and attainment of 2003–04 beginning postsecondary students: After 6 years first look.* Washington, DC: U.S. Department of Education, National Center for Education Statistics.

Wang, C., & Casteneda-Sound, C. (2008, Fall). The role of generational status, self-esteem, academic self-efficacy, and perceived social support in college students' psychological well-being. *Journal of College Counseling*, 11, 101-118.

Watkins, C. (2010). Learning, performance and improvement. *Research Matters, 34*, 1-16.

Weissberg, N. C., Owen, D. R., Jenkins, A. H., & Harburg, E. (2003). The incremental variance problem: enhancing the predictability of academic success in an urban, commuter institution. *Genetic, Social, and General Psychology Monographs, 129*(2), 153.

Wohlgemuth, D., Whalen, D., Sullivan, J., Nading, C., Shelley, M., & Wang, Y. (2007). Financial, academic, and environmental influences on the retention and graduation of students. *Journal of College Student Retention: Research, Theory and Practice, 8*(4), 457-475.

Wood, W., & Gentile, J. (2003). Meeting report: The first national academies summer institute for undergraduate education in biology. *Cell Biology Education*, 2003(2), 207-209. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC256984/

Zhang, G., Anderson, T., Ohland, M., & Thorndyke, B. (2004). Identifying factors influencing engineering student graduation: A longitudinal and cross-institutional study. *Journal of Engineering Education*, 93(10), 313-320.

Zwick. R., (2007). *College Admission Testing*. Santa Barbara, CA: National Association for College Admission Counseling. Retrieved from http://education.ucsb.edu/rzwick/ FinalNACAC.pdf

Appendix A

STEM MAJOR DISTRIBUTION BY GENRE AND RACE

Table 61 Female STEM Major Distribution by Race Table 1

Female			RACE / Ethnicity				Total
MAJOR DESCRIPTION	A	B	I	M	P	U	W	Female
Applied Mathematics BS							1	1
Biochemistry BS	.	2	.	.	.	.	8	10
Biology BA	.	4	1	2	1	4	20	32
Biology BA (Pre Health)	2	.	.	.	.	.	14	16
Biology BS	.	.	.	.	.	.	1	1
Chemistry BA	.	.	.	.	.	.	3	3
Chemistry BS	1	.	.	.	.	.	.	1
Chemistry BS (Environmental Track)	.	.	.	.	.	.	.	0
Cognitive Science BS	.	1	.	.	.	.	1	2
Computer Science BA	.	.	.	.	.	.	.	0
Computer Science BS	.	.	.	.	.	.	.	0
Geochemistry BS	.	.	.	.	.	.	.	0
Geology BS	.	.	.	.	.	.	2	2
Information Science BA	.	.	.	.	.	.	1	1
Mathematics BA	.	.	.	.	.	.	1	1
Meteorology BS	.	1	.	.	.	1	8	10
Physics BA	.	.	.	.	.	.	1	1
Physics BS	.	.	.	.	.	.	.	0
Physics BS (Pre Engineering)	.	.	.	.	.	1	.	1
Pre-Optometry (Chemistry BA)	.	.	.	.	.	.	.	0
Software Engineering BS	.	.	.	.	.	.	.	0
Zoo Technology (Zoology BS)	.	.	.	.	.	1	.	1
Zoology BS	.	.	.	5	.	.	20	25
Total								108

Table 62 Male STEM Major Distribution by Race Table 2

Male	RACE / Ethnicity							Total
MAJOR DESCRIPTION	A	B	I	M	P	U	W	Male
Applied Mathematics BS	1						1	2
Biochemistry BS	.	1	.	.	.	.	9	10
Biology BA	.	2	.	2	.	2	15	21
Biology BA (Pre Health)	1	3	1	.	.	.	5	10
Biology BS	.	.	.	.	.	.	2	2
Chemistry BA	.	.	.	.	.	.	3	3
Chemistry BS	.	.	.	.	.	.	1	1
Chemistry BS(Envrnmntl Track)	.	.	.	.	.	.	1	1
Cognitive Science BS	.	.	.	.	.	.	1	1
Computer Science BA	1	1	.	1	.	2	7	12
Computer Science BS	.	.	.	.	.	.	1	1
Geochemistry BS	.	.	.	.	.	.	3	3
Geology BS	.	.	.	1	.	.	3	4
Information Science BA	.	2	.	.	.	.	3	5
Mathematics BA	.	.	.	.	.	.	4	4
Meteorology BS	.	.	.	.	.	.	5	5
Physics BA	.	.	.	1	.	.	7	8
Physics BS	.	.	.	.	.	.	1	1
Physics BS (Pre Engineering)	1	.	.	.	.	1	5	7
Pre-Optometry (Chemistry BA)	.	1	.	.	.	.	1	2
Software Engineering BS	.	.	1	.	1	.	12	14
Zoo Technology (Zoology BS)	.	.	.	.	.	.	.	0
Zoology BS	.	1	.	1	.	1	9	12
Total								129

Appendix B

DEMOGRAPHIC

College Biology

Table 63

Model Summary of Demographic Variables on College Biology Performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Sq. Change	F Change	df1	df2	Sig. F Change
1	.406[a]	.165	.127	1.01673	.165	4.385	5	111	.001

[a] Predictors: (Constant), Parent with College Education, Gender, School Size, Non-White, Pell

Table 64

ANOVAa for Demographic Variables on College Biology Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22.663	5	4.533	4.385	.001[b]
	Residual	114.745	111	1.034		
	Total	137.408	116			

[a] Dependent Variable: College Biology

[b] Predictors: (Constant), Parent with College Education, Gender, School Size, Non-White, Pell

<u>College Chemistry</u>

Table 65

Model Summary of Demographic Variables on College Chemistry Performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Sq. Change	F Change	df1	df2	Sig. F Change
1	.301[a]	.091	.062	1.00847	.091	3.115	5	156	.010

[a] Predictors: (Constant), Parent with College Education, Gender, School Size, Pell, Non-White

Table 66

ANOVAa for Demographic Variables on College Chemistry Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.839	5	3.168	3.115	.010[b]
	Residual	158.652	156	1.017		
	Total	174.492	161			

[a] Dependent Variable: College Chemistry

[b] Predictors: (Constant), Parent with College Education, Gender, School Size, Pell, Non-White

College Mathematics

Table 67

Model Summary of Demographic Variables on College Mathematics Performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.208[a]	.043	.004	1.13535	.043	1.107	5	123	.360

[a] Predictors: (Constant), Parent with College Education, School Size, Gender, Non-White, Pell

Table 68

ANOVA[a] for Demographic Variables on College Mathematics Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.134	5	1.427	1.107	.360[b]
	Residual	158.549	123	1.289		
	Total	165.684	128			

[a] Dependent Variable: College Mathematics

[b] Predictors: (Constant), Parent with College Education, School Size, Gender, Non-White, Pell

Table 69

Coefficients[a] Table for Demographic Variables on College Mathematics Performance

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	1.920	.303		6.330	.000					
	Gender	.249	.202	.109	1.232	.220	.106	.110	.109	.991	1.009
	Non-White	-.326	.238	-.127	-1.369	.173	-.121	-.123	-.121	.907	1.103
	Pell	.302	.233	.127	1.299	.196	.079	.116	.115	.812	1.232
	School Size	-.069	.228	-.028	-.305	.761	-.071	-.027	-.027	.927	1.079
	Parent with College Education	.153	.225	.066	.682	.497	.062	.061	.060	.833	1.200

[a] Dependent Variable: College Mathematics

College Physics

Table 70

Model Summary of Demographic Variables on College Physics Performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.494[a]	.244	-.008	1.08642	.244	.969	5	15	.467

[a] Predictors: (Constant), Parent with College Education, Gender, Non-White, School Size, Pell

Table 71

ANOVAa for Demographic Variables on College Physics Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.721	5	1.144	.969	.467[b]
	Residual	17.705	15	1.180		
	Total	23.426	20			

[a] Dependent Variable: College Physics

[b] Predictors: (Constant), Parent with College Education, Gender, Non-White, School Size, Pell

Table 72

Coefficients[a] Table for Demographic Variables on College Physics Performance

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.777	.741		3.749	.002					
	Gender	.888	1.315	.179	.675	.510	.206	.172	.152	.717	1.395
	Non-White	.863	.724	.321	1.191	.252	.047	.294	.267	.695	1.439
	Pell	-.790	.641	-.338	-1.233	.237	-.313	-.303	-.277	.671	1.490
	School Size	-.539	.714	-.200	-.754	.462	-.218	-.191	-.169	.715	1.399
	Parent with College Education	.596	.609	.274	.979	.343	.157	.245	.220	.643	1.554

[a] Dependent Variable: College Physics

College Physics

Table 73

Model Summary of All Variables on College Physics Performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Sq. Change	F Change	df1	df2	Sig. F Change
1	.725[a]	.526	-.106	.87186	.526	.832	8	6	.606

[a] Predictors: (Constant), Regents Exam Physics, Pell, Gender, HSGPA, Transfer Credit, Parent with College Education, Non-White, School Size

Table 74

ANOVA[a] for All Variables on College Physics Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.062	8	.633	.832	.606[b]
	Residual	4.561	6	.760		
	Total	9.623	14			

[a] Dependent Variable: College Physics

[b] Predictors: (Constant), Regents Exam Physics, Pell, Gender, HSGPA, Transfer Credit, Parent with College Education, Non-White, School Size

Table 75

Coefficients[a] Table for All Variables on College Physics Performance

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.716	6.757		.402	.702					
	Gender	1.308	1.375	.407	.952	.378	.274	.362	.267	.431	2.321
	Non White	1.014	.912	.506	1.111	.309	.445	.413	.312	.380	2.628
	Pell	-.308	.664	-.170	-.464	.659	-.101	-.186	-.130	.587	1.703
	School Size	-.164	1.041	-.082	-.157	.880	-.236	-.064	-.044	.292	3.424
	Parent with College Education	.616	.675	.363	.913	.397	-.079	.349	.257	.500	2.000
	Transfer Credit	-.015	.045	-.171	-.328	.754	.079	-.133	-.092	.291	3.431
	HSGPA	-.040	.064	-.216	-.623	.556	-.224	-.247	-.175	.656	1.525
	Regents Exam Physics	.039	.050	.418	.796	.456	.351	.309	.224	.287	3.486

[a] Dependent Variable: College Physics

Appendix C

SAT TOTAL SCORE

Table 75

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.320[a]	.102	.094	.83687	.102	12.298	1	108	.001

[a] Predictors: (Constant), SATTotal

Table 76

Anova[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.613	1	8.613	12.298	.001[b]
	Residual	75.638	108	.700		
	Total	84.251	109			

[a] Dependent Variable: BIO110BiologySeminar

[b] Predictors: (Constant), SATTotal

Table 77

Coefficients[a] Table

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.230	.702		.328	.743					
	SATTotal	.002	.001	.320	3.507	.001	.320	.320	.320	1.000	1.000

[a] Dependent Variable: BIO110BiologySeminar

College Chemistry

Table 78

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.327[a]	.107	.101	.860359	.107	17.600	1	147	.000

[a] Predictors: (Constant), SATTotal

Table 79

Anova[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.028	1	13.028	17.600	.000[b]
	Residual	108.812	147	.740		
	Total	121.840	148			

[a] Dependent Variable: TotalChem

[b] Predictors: (Constant), SATTotal

Table 80

Coefficients[a] *Table*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-.581	.720		-.807	.421					
	SATTotal	.003	.001	.327	4.195	.000	.327	.327	.327	1.000	1.000

[a] Dependent Variable: TotalChem

College Mathematics

Table 81

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.226[a]	.051	.043	.88575	.051	6.202	1	115	.014

[a] Predictors: (Constant), SATTotal

Table 82

Anova[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.866	1	4.866	6.202	.014[b]
	Residual	90.224	115	.785		
	Total	95.090	116			

[a] Dependent Variable: TotalMath

[b] Predictors: (Constant), SATTotal

Table 83

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.514	.754		.682	.497					
	SATTotal	.002	.001	.226	2.490	.014	.226	.226	.226	1.000	1.000

[a] Dependent Variable: TotalMath

College Physics

Table 84

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.325[a]	.105	.058	1.059787	.105	2.239	1	19	.151

[a] Predictors: (Constant), SATTotal

Table 85

Anova[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.515	1	2.515	2.239	.151[b]
	Residual	21.340	19	1.123		
	Total	23.855	20			

[a] Dependent Variable: TotalPhysics

[b] Predictors: (Constant), SATTotal

Table 86

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.083	1.742		.048	.963					
	SATTotal	.002	.002	.325	1.496	.151	.325	.325	.325	1.000	1.000

[a] Dependent Variable: TotalPhysics

Appendix D

IRB

SETON HALL UNIVERSITY

September 19, 2012

Tolga Hayali
5100 Highbridge St.
Fayetteville, NY 13066

Dear Mr. Hayali,

The Seton Hall University Institutional Review Board has reviewed your research proposal entitled "An Examination on the nfluence of NY Students' Demographic Factors and High School Academic Preformance on Freshman Level Mathematics and Science Course Preformance at SUNY Oswego" and has approved it as submitted under exempt status.

Enclosed for your records is the signed Request for Approval form.

Please note that, where applicable, subjects must sign and must be given a copy of the Seton Hall University current stamped Letter of Solicitation or Consent Form before the subjects' participation. All data, as well as the investigator's copies of the signed Consent Forms, must be retained by the principal investigator for a period of at least three years following the termination of the project.

Should you wish to make changes to the IRB approved procedures, the following materials must be submitted for IRB review and be approved by the IRB prior to being instituted:

- Description of proposed revisions;
- *If applicable*, any new or revised materials, such as recruitment fliers, letters to subjects, or consent documents; and
- *If applicable*, updated letters of approval from cooperating institutions and IRBs.

At the present time, there is no need for further action on your part with the IRB.

In harmony with federal regulations, none of the investigators or research staff involved in the study took part in the final decision.

Sincerely,

Mary F. Ruzicka, Ph.D

Mary F. Ruzicka, Ph.D.
Professor
Director, Institutional Review Board
cc: Dr. Gerard Babo

Office of Institutional Review Board
Presidents Hall • 400 South Orange Avenue • South Orange, New Jersey [illegible] • Tel. [illegible] • Fax [illegible] • [illegible]

OSWEGO
STATE UNIVERSITY OF NEW YORK

Human Subjects Review

DATE: 6/26/12

TO: Mr. Tolga Hayali

FROM: Dr. David Bozak, Co-Chair, Human Subjects Committee

RE: An Examination on the Influence of NY Students' Demographic Factors and High School Academic Performance on Freshman Level Mathematics and Science Course Performance at SUNY Oswego

Your above titled research project has been evaluated and found to be exempt from review by the SUNY Oswego Institutional Review Board under the Code of Federal Regulations, Title 45, Part 46, Section 101.b.4.

Best wishes for a successful project.

Sincerely,

Dr. David Bozak
Co-Chair, Human Subjects Committee
414 Mahar Hall
State University of New York at Oswego
Oswego, NY 13126
david.bozak@oswego.edu

Oswego, NY 13126
www.oswego.edu

SETON HALL UNIVERSITY
COLLEGE OF EDUCATION AND HUMAN SERVICES
OFFICE OF GRADUATE STUDIES

APPROVAL FOR SUCCESSFUL DEFENSE

Doctoral Candidate, **Tolga Hayali,** has successfully defended and made the required modifications to the text of the doctoral dissertation for the **Ed.D.** during this **Summer Semester 2013.**

DISSERTATION COMMITTEE
(please sign and date beside your name)

Mentor:
Dr. Gerard Babo

Committee Member:
Dr. James Caulfield

Committee Member:
Dr. Yildiray Yildirim

Committee Member:
Dr. Fehmi Damkaci

The mentor and any other committee members who wish to review revisions will sign and date this document only when revisions have been completed. Please return this form to the Office of Graduate Studies, where it will be placed in the candidate's file and submit a copy with your final dissertation to be bound as page number two.

OSWEGO
STATE UNIVERSITY OF NEW YORK

INSTITUTIONAL RESEARCH AND ASSESSMENT

July 30, 2012

To Whom It May Concern:

This letter is intended to verify that the Data for Mr. Tolga Hayali's research "An Examination of the Influence of NY Students' Demographic Factors and High School Academic Performance on Freshman Level Mathematics and Science Course Performance" are drawn from SUNY Oswego's databases. All students' information are kept confidential, they are not shared with Mr. Tolga Hayali and are anonymous.

If you have any question, please feel free to contact me.

Sincerely,

Mehran Nojan

Dr. Mehran Nojan, Director
Institutional Research and Assessment
SUNY Oswego
315-312-2345
mehran.nojan@oswego.edu

MN/tc

Oswego, NY 13126
www.oswego.edu