# A CONCEPTUAL AND OPERATIONAL DEFINITION OF STEM FOR IOWA COMMUNITY COLLEGES

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#### Abstract

Over the past three decades, educators, employers, workforce analysts and elected officials have stated great concern over the decline in student performance and workforce supply in science, technology, engineering and math (STEM). While the term has produced millions of dollars in grants, research and programming, the concept of STEM remains ambiguous. Our research into the technical definitions of state, federal, and national not-for-profit agencies reveal that an objective definition of STEM is largely illusive. In order to develop a definition of STEM for the Iowa Department of Education, we developed a comprehensive, conceptual definition of STEM that reflected the purpose and value of STEM stated in existing literature. We propose an integrated STEM model which stresses the role of science, technology, engineering, and mathematics have on each other. That concept is consistent with the interdependent advancement of science and technology. Following our conceptual definition, we developed an evaluating methodology for the selection of Codes of Instructional Practice (CIPs) for STEM at Iowa's community colleges. Our data revealed that the gender gap in STEM is applicable to Iowa. More positively, our data suggests that Iowa has a proportionate number of blacks and Hispanics enrolled in STEM, relative to Iowa's demographics. We found some programs drew high proportions of females, relative to total enrollment.

#### **1. Introduction**

As the United States approached the new millennium, America was quietly confronted with the looming issues surrounding the educational, economic and technological advancements of developing nations and growing concern regarding America's relative position as the center for innovation and intellectual capital in the next century. Over the past ten years, the United States has identified numerous areas for improvement to retain our innovative edge these programs fall under the conceptual umbrella of science, technology, engineering and math (STEM). However, to properly measure STEM programs, we need to the similarities and differences the technical definitions for reporting amongst the various institutional stakeholders.

We find that STEM has been defined differently by national organizations and across states. Some definitions seem to simply recapture math and science curriculum into STEM, while others cast a wider, more inclusive net. The Iowa Department of Education proposes an integrative STEM model which emphasizes the interplay between math, science, engineering, engineering technology, and technology. We find that females are less likely to participate in these programs at Iowa community colleges while minorities are proportionally represented.

Section 2 will give an overview on the need for STEM education; section 3 will review the disperse definitions of STEM across the United States; section 4 develops a conceptual model of STEM; section 5 demonstrates how the Iowa Department of Education translated the conceptual model into a list of STEM programs; section 6 analyzes the proportion of women and minorities majoring in STEM majors at Iowa community colleges; and section 7 concludes.

## 2. Challenges Confronting the United States

In reviewing the issues confronting America, we shall follow a logical progression along the "STEM Pipeline". The logic of the pipeline is that problems have a genesis that tends to build and magnify subsequent problems. In essence, inputs and activities are reflected in outputs, both positive and negative. For example, if American students are failing to achieve basic and proficient scores on math and science at the primary level, then it would logically follow that they will continue to fall behind at the secondary and post-secondary levels, as well. Further, without an advanced education, it is impossible to fill the demand for an educated STEM workforce. Each of these problems is interconnected and is being addressed by STEM initiatives. However, before we can discuss the solution (STEM), we must fully understand the problem from which it arose and how that influences our conceptual understanding of STEM.

Our challenges in math and science appear to originate at the primary and secondary level. The governing body of the National Science Foundation (NSF), the National Science Board (2007) found that the United States student achievement-levels in math and science are not competitive compared to their international peers. In 2003, the Program for International Student Assessment (PISA), an international test measuring STEM critical thinking skills, ranked U.S. students 19<sup>th</sup> out of 29 nations; placing U.S. students beneath countries like New Zealand, Hungary and the Slovak Republic. They further found that nearly 30 percent of U.S. college students required remedial math and sciences courses in their first year of college. Similar results were found by the 2003 International Mathematics and Science Study (TIMSS). According to Kuenzi (2008) American students, while outscoring the international average in math and science, still scored lower in composite scores than: Singapore, the United Kingdom, Netherlands, South Korea, Japan, Hungary, Hong Kong, Estonia, and Chinese Taipei.

Combined, it is evident that the average American student remains academically uncompetitive compared to their international peers in math and science and nearly one third of students are unprepared to accomplish post-secondary math and science coursework. Given the disproportionate access to financial and physical resources of American students compared to their international peers, the shortcoming are even more confounding.

If we take a step back and analyze how American students are performing according to our own benchmarks, we find similar shortcomings. According to Kuenzi (2008) many American students are not even at basic levels, much less proficient in math skills. According to the National Assessment of Educational Progress (NAEP) the percentages of fourth grade students' at basic or proficient levels in math have increased between 1990 and 2005, the same cannot be said for their 8<sup>th</sup> and 12<sup>th</sup> grade counterparts. While proficiency in math skills among 8<sup>th</sup> graders has increased, basic skill levels have remained unchanged over the same time period. Twelfth grade tests results have actually declined since 1990, with fewer students scoring as either proficient or basic in their math skills. In addition, they found anywhere from 10 to 35 percent of all American students score under the basic skill-level in math. In 2005, nearly a third of all students tested below basic skill levels in math. In essence, a significant portion of American students are failing to achieve the standards set by American educators, much less remain competitive with their international peers.

If form follows function, then we have to question the manner in which students are Not surprisingly, studies have shown that a significant number of being taught. American math and science teachers are not qualified in the areas they teach. According to the Governor's Association (2007) wage disparities between the public education and private sector have contributed to the overall issue of attrition and the disparity of qualified math and science teachers in urban schools in comparison on suburban schools. This has resulted in a profession where teacher qualifications pose an obstacle to meaningful STEM advancement. One cannot reasonably expect students to learn advanced math and science knowledge and skills from educators who do not feel themselves equipped to teach those subjects. The Governor's Association states that "40 percent of U.S. middle-school physical science teachers teach out of their field, about 20 percent of middle-school biology teachers teach outside of their field," further, "eighth grade American math and science teachers were less likely to specialize (i.e., have either an undergraduate major or master's degree) in their STEM subject areas than their counterparts in other countries" and "that only one-quarter of sixth through eighth grade out-of-field math teachers felt, by their own assessment, well prepared to teach a basic set of arithmetic topics." (pg. 9).

Quantitatively, the actual number of science and math teachers is much lower than the levels needed. The Business-Higher Education Forum (2007), states "that the United States will need more than 280,000 new mathematics and science teachers by 2015 (pg. 9). Schools with high minority and high-poverty students are anticipated to have the greatest need. Students in these schools are significantly more likely to have math teachers that neither majored nor minored in the subject. Additionally, retention of

qualified teachers within the profession remains a serious and persistent issue. The forum found that "approximately half of all teachers leave within five years of entering the profession" (pg 10); further, math teachers possess the highest turnover rate amongst K-12 teaching professionals with science teachers holding second place (pg. 15). Retention rates are even lower in lower-income districts, where the rate of attrition is half again higher than higher-income areas (pg. 10). Further issues exasperate the problems in K-12 math and science, including: more than a third of America's teachers will have retired between 2007 and 2010, replacement of these teaching professionals remains the lowest of all teaching sub-fields, and anticipated growth in the of the American students over the next two decades increasing the demand for math and science teachers (pg. 14)

Research into the use and quality of secondary science labs reveal a number of issues. The Ewing Marion Kauffman Foundation (2007) reported "science labs in the Kansas City Region do not meet national standards and much work needs to be done to bring the science labs up to the national standards" (pg. 5). In their survey of 170 schools within the Greater Kansas City region, the Foundation found that safety standards were not being upheld in the majority of school science labs; that the majority of science labs were not large enough to allow for productive learning; equipment in many science labs were often unused, antiquated or broken; science class sizes were too large and exceeded recommended student-teacher ratios; most students received less than 2/3<sup>rd</sup>'s the recommended science lab time, per week; science labs were "rarely incorporated into the overall science curriculum" (pg. 6); and that there were no guidelines or policies within school districts on the proper use of science labs for science teachers. They further conclude that while studies of science labs are not common, studies conducted by the

National Research Council and the University of Texas found similar problems to those in Kansas City.

The Kauffman Foundation further contends that students and parents are not motivated to promote the changes necessary to enact meaningful STEM reform. They explained that employers within the Kansas City region expressed great concerned about the math and science skills of their younger employees. Many felt that their skills were not rigorous enough to meet the innovative needs of their business. The Foundation further found that parents and students in the region did not reflect similar concerns. They suggested that while both parents and students believed science and math are important to society, the students did not feel that either subject was necessary for their personal success. Further, parents did not feel that improvement in math and science education was a priority within their area. This disconnect between parents, students, and employers is troubling for it reveals that those with the greatest voice in local education (local parents and residential taxpayers) are not motivated to address the mounting issues regarding STEM. While we cannot generalize that the situation within Kansas City region is universal for the entire nation, public and academic sentiment would suggest that the issues confronting Kansas City are typical for many communities within the United States. (Kadlec & Friedman, 2007)

At the post-secondary level, studies have exhibited a general growth in STEM bachelor's degrees but have also shown a steep decline in master's and doctoral STEM degrees and demonstrated a loss of the highest-performing students in the STEM pipeline. According to the U.S. Government Accountability Office (2005) there has been an overall increase in the number of students entering STEM fields, although these

increases are in specific subfields of STEM; whereas there has been a considerable decline in other subfields. Overall growth in STEM enrollment across all non-associate, postsecondary degree programs was 20.74% between 1995-1996 and 2003-2004 Academic years. When accounting for population growth between 1995 and 2003, the assertion of STEM enrollment growth is proven accurate. According the U.S. Census Bureau's historical national population estimates (2000) and national and state population estimates (2005), roughly 1.04 percent of Americans enrolled in a STEM major in 1995 while 1.19 percent enrolled in 2003. While overall STEM graduates may have increased, a specific breakdown reveals declines in many STEM-associated subfields at the master and doctoral levels. Between 1995 and 2003, they found declines in STEM Master's degree graduates in the following subfields: biological/agricultural science by 41 percent; Earth, atmospheric, and ocean sciences by 8 percent; Engineering by 11 percent; physical sciences by 14 percent; and Technology by 44 percent. Similar results were found in Doctoral graduates in the following subfields: biological/agricultural science by 53 percent; Earth, atmospheric, and ocean sciences by 29 percent; Engineering by 18 percent; Math and computer sciences by 14%; physical sciences by 15 percent; and Technology by 74 percent. These percentages suggest a significant decline in students graduating with STEM doctoral degrees (GAO, 2005, pg. 24). These results are mirrored by Lowell, Salzman, Bernstein, & Henderson (2009), stating:

"It appears that the 1990's marked a turning point in longer-term trends for the best students either in high school or college. The top quintile SAT/ACT and GPA performers appear to have been dropping out of the STEM pipeline at a substantial rate, and this declines seems to have come on quite suddenly in the mid-to-late 1990's" (pg. iii).

Both findings suggest that America's best and brightest, those whom we count on for innovation and revolutionary ideas, are not demonstrating an interest in STEM and are instead moving into other subfields.

These findings are further demonstrated in the "STEM Pipeline" meaning "of those who become involved in STEM programs, how many are continuing STEM studies at the postsecondary level, persisting with their studies, achieving a degree and entering the STEM workforce?" According to Chen & Weko (2009) the quantitative-correlative support for STEM program effectiveness in equity may be questionable as their research found that the established indicators and correlations for student success were similar for successful movement through the STEM Pipeline. They found that "in general, the percentage of students entering STEM fields was higher among male students, younger and dependent students, Asian/Pacific Islander students, foreign students or those who spoke a language other than English as a child, and students with more advantaged family background characteristics and strong academic preparation than among counterparts who did not have these characteristics." (pg. 17). They further found that students with these characteristics were more likely to persist in a STEM major and acquire their degree, completing the pipeline. They also found that nearly 47 percent of all STEM entrants either switched to a non-STEM area of study or failed to acquire a degree (pg. 18).

This trend is not reflected internationally. As the United States is facing a decline in STEM talent, the rest of the world is surging ahead. Friedman (2005) states:

"that of the 2.8 million first university degrees (what we call bachelor's degrees) in science and engineering granted worldwide in 2003, 1.2 million were earned by Asian students and Asian universities, 830,000 were granted in Europe, and 400,000 in the United States. In engineering specifically, universities in Asian countries now produce eight times as many bachelor's degrees as the United States" (pg. 257)

This is particularly relevant to our economy as performance in high school math and science correlates to higher wage earnings later in life. According to Joensen & Nielson (2009) found that students who take higher-level math courses had an average wage 25-30% higher than students that did not. While Joensen & Nielsen acknowledge that the students who pursue higher-level math tend to have similar demographic characteristics, they do conclude that there is "a positive causal impact on math and earnings" (pg. 198). Past research supports conclusions from the previous studies. If there is a definite correlation between wages and skills in math and science, it is certainly in the interest of all to encourage higher performance in these areas. From a financial perspective, growth would be intimately tied to a skilled labor force in these areas.

As the number of advanced STEM graduates has declined, concern about America's supply of workers for the STEM workforce have grown. Over the past 60 years, the United States has shifted from an industrial economy, requiring skills in routine, manual tasks to an information, service-based economy driven by technology that requires non-routine, interactive tasks and skills. It is estimated that by 2014, 75 percent of the fastest growing occupations will require significant training in math and science (State Educational Technology Directors Association, 2008). According to Butz, Kelly,

Adamson, Bloom, Fossum & Gross (2004) "The implications of a shortage of skills critical to U.S. growth, competitiveness, and security are serious, probably more so now than in recent decades, as are the implications of continuing low entry of female and minority students into many STEM fields" (pg. 10).

The issue of gender and racial inequity continue to plague the STEM workforce. According to the public-private partnership BEST, Building Engineering & Science Talent (2008), in 1999 "despite decades of effort to broaden its base, the U.S. science and engineering workforce remains about 75 percent male and 80 percent white. Women, African Americans, Hispanics, Native Americans and persons of disabilities – the "underrepresented majority" that makes up *two-thirds* of the entire U.S. workforce – *account for only 25 percent of the technical workforce*" (pg. 2). In failing to create a diverse STEM workforce, the United States limits itself to the ideas promoted from a homogenous workforce and a homogenous work culture that may be less apt to conceive of revolutionary ideas.

In the end and as we first discussed, the backdrop for America's focus on STEM is the emergence of a new, world economy that is not necessarily dominated by the United States, but rather centered around developing nations competing for global human, organizational and financial capital; specifically the world's major population centers, China and India. The urgency surrounding STEM was addressed by Thomas Friedman in his popular book *The World Is Flat*. In his writing, Friedman (2005) quotes the president of the American Association for the Advancement of Science, Shirley Ann Jackson; she effectively summarizes America's anxiety about our place in the emerging world economy: "The U.S. is still the leading engine for innovation in the world. It has the best graduate programs, the best scientific infrastructure, and the capital markets to exploit it. But there is a quiet crisis in U.S. science and technology that we have to wake up to. The U.S. today is in a truly global environment, and those competitor countries are not only wide awake, they are running a marathon while we are running sprints. If left unchecked, this could challenge our preeminence and capacity to innovate." (pg. 253)

The mounting problems related to STEM are evident in the largest economy in the United States, the State of California. According to Offenstein & Shulock (2009) California, the world's eighth largest economy<sup>3</sup>, owes much of its growth to its higherthan-average number of STEM occupations. While the state has enjoyed higher numbers of entrepreneurs, venture capital investment, independent patents and broadband deployment; they have conversely suffered from low use of technology within schools, education amongst immigrants, and has one of the lowest rates of bachelor degrees conferred amongst states with "new" economies (pg. 3). The California Secretary of Labor found that nearly half of all STEM occupations are anticipated to have shortages in the coming years. California is expected to average 46,100 STEM job openings between now and 2016; more than half of these openings will require at least a bachelor's degree (pg. 7). However, the growth in STEM degrees granted is not anticipated to meet the growing need for STEM workers. Furthermore, the current fiscal problems plaguing the State of California are expected to negatively impact the capacity of California's public universities and community colleges to produce STEM graduates. STEM degrees

<sup>&</sup>lt;sup>3</sup> Imputed based on World Bank (2009) estimates of country GDP and Bureau of Economic Analysis (2009) state estimates.

typically require intensive lab work and technical equipment that is more expensive than the inputs required for non-STEM majors. As budgets are reduced for education at the state-level, it is highly likely STEM inputs will be reduced, further exasperating the STEM problems in California. Not only this, but as the job outlook within the state diminishes, the likelihood of students enrolling in STEM and subsequently seeking employment will decline, as well; further exasperating California's attempt to bounce back from the current recession.

## 3. The Undefined Solution to Defined Problems: STEM

While our assessment of science and math appear overly pessimistic and critical, it is necessary for us to understand the problem so that we can sufficiently move towards a solution. The solution to all of the aforementioned problems has been identified as STEM by a variety of sources. With this proposal, money has followed. Between the grants of the National Science Foundation and the U.S. Department of Education, over \$480 million dollars were spent on STEM, in 2006, alone (National Science Board, 2007).

So what is STEM? Simply, STEM is an acronym for science, technology, engineering and math. However, such a definition does not properly address what STEM is, precisely. Grammar offers little insight. Given the varying uses in both technical literature and mainstream conversation, it is impossible to identify whether STEM would be considered a noun or a noun modifier. Is it just STEM or is it STEM education? Some might call this semantics, but the fact remains that if STEM is an important focus of the American education system, we should be able to linguistically fence the word. Failing a

linguistic attempt of a definition, we are forced to examine STEM from a conceptual approach.

The conceptual views of STEM are quite diverse. Many believe that STEM is any one of the disciplines within the acronym, science, technology, engineering and math or conjunction of the four subfields. Others contend that it is an entirely new discipline that integrates knowledge and skills from other education studies. Some assert that STEM is transdisciplinary and multi-faceted (National Science Teachers Association, 2009). This leaves us without even a conceptual consensus of STEM.

Much of the confusion regarding STEM can attributed to its evolving use and growing popularity. The most recent developments and variations of STEM are difficult to organize, and the history of STEM is not often referenced in peer-reviewed journals or publications; however, we have been able to assemble a history of STEM, chronicling major developments.

Policy discussion regarding science, technology, engineering and math has been prevalent since the earliest days of the Cold War. This focus for educational excellence in the name of national defense appears to have been the early motivator for investment in what would have then been considered STEM-related programs.

According to Sanders (2009), STEM's predecessor, SMET originated in the 1990's within NSF to encompass the understanding of science, math, engineering and technology, but remained largely unknown to the greater public.

The origin of the STEM acronym was explained to us in an electronic communication by Neeraj P. Gorkhaly, Research Associate at the Committee for Science, Engineering and Public Policy; he stated that when Rita Colwell became the Director of the National Science Foundation in 2003, she re-arranged SMET into STEM, a more attractive acronym. This change was symbolically reflected when the former *Journal of SMET Education* changed their title to *Journal of STEM Education* in their volume 4, issue 3 publication. The journal stated "Please note that we have renamed the journal (from the Journal of SMET Education) to reflect a change in usage by the National Science Foundation, which has adopted the term "STEM" to emphasize that the focus needs to be on science, technology, engineering and math." (Raju & Sankar, 2003, pg. 2)

According to Sanders (2009) even after the 2003 change from SMET to STEM, many in the academic and administrative world were unfamiliar with the concept. The concept was popularized by Friedman (2005), which discussed the issue of an ascending and technologically-skilled India and China and the threat they pose to American preeminence in the math and science; keys to our status as an economic superpower. His book generated public discussion and galvanized institutional interest and government engagement on STEM issues which was only enhanced by the National Science Board's 2007 publication of *Rising above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. Funding shortly followed, and as Sander's (2009) coined, "STEMmania" has ensued. This has left us with an almost completely decentralized understanding of STEM, largely leaving local agencies to assume the initiative. STEM has functionally become a series of different public initiatives to address a series social problems deemed solvable by more comprehensive achievement and promotion of science, technology, engineering and math.

Approaches in implementing STEM vary greatly. Some agencies are taking a comprehensive, multi-institutional approach to devising their STEM programs.

(Minnesota Department of Education, 2006). Meanwhile, other institutions do not possess the resources to generate STEM programming or have very limited resources or a specific purpose which extends to only a limited aspect of STEM. Casual surveying suggests that STEM programming is largely created and managed by primary, secondary and post-secondary institutions in most states. However, some state, federal and not-forprofit agencies have devised STEM definitions that can track the graduation and enrollment data of education institutions.

One of the major issues confronting STEM is data reporting and longitudinal tracking. The National Center for Education Statistics (2009) has focused on undergraduate student progress through the STEM pipeline in an attempt to understand the demographics of students entering STEM majors, the retention of students in STEM majors and the successful completion of those students in STEM majors. To date, their research results support the findings of other agencies cited earlier in our discussion.

STEM has also been recognized as an educational pathway to achieve the goal of a new green economy, connecting environmental concerns and problem-solving with science, technology, engineering and math (Arnett, Kozlowski, Peach & Valera, 2009). According to White & Walsh (2008), "New energy technologies will depend on a workforce that is prepared and trained to build and implement them. But the skilled workers for these industries will not emerge from a vacuum." (page 9) This has resulted in some Workforce Development agencies becoming involved in STEM definitions and tracking.

Another facet of STEM concerns the issue social equity as we discussed earlier. Given the repeated statistical evidence that the typical STEM major is fairly homogenous, a number of initiatives have focused on creating a more diverse STEM population. Organizations like the STEM Equity Pipeline have been leaders in program and resource development to draw women and minorities into STEM fields.

The federal government has dedicated funding necessary to address many of these issues. In their 2006 report the GAO (2006) stated that \$2.8 billion was appropriated in fiscal year 2004 for over 200 STEM programs. Most of these programs were in the form of financial aid for students or institutional grants to support infrastructure at colleges and universities. They further note that approximately half of these organizations have been or will be evaluated but the nature of that evaluation was not provided. They also acknowledged a limited degree of coordination between programs. While much of this data is now outdated and reflect trends between the mid-nineties and 2006, the data suggests that STEM initiatives have had mixed results or have not been evaluated for effectiveness. Of the results available during this period, employment in math and science related industries increased, but minimal change in technology and engineering was recorded. Demographically, there has been an increase in female enrollment and a subsequent decrease in male enrollment. However, minorities saw little change and males continue to represent the majority of overall STEM majors. The report further states that while STEM jobs have increased from 7.2 million to 8.9 million between 1994 and 2003, the majority of these jobs were in the computer sciences field, which strongly correlate to the growth in personal computer and internet use and do not necessarily reflect overall increases in engineering and technology. The report concludes that teacher performance and quality in STEM studies at the K-12 level continues to be problematic for generating interest and skills in all students. Regarding women and minorities, the report suggests that mentors and role models are needed to attract students to these fields.

Even with these results, we must question the external validity of these results. Did STEM programming result in the demonstrated, positive changes or were other confounding variables responsible? We can only answer this question through evaluation using the experimental method and this requires data measurement, analysis and reporting using consistent, solid technical definitions based on a stated, conceptual understanding.

#### 4. Defining STEM in Iowa

During the 2009 legislative session, the Iowa State Legislature required the Iowa Department of Education and State of Iowa Board of Regents to report the proportion of women and minorities participating in STEM-related activities(Iowa Code Ch. 261E, § 3J). While the legislature mandated reporting, they did not provide a precise definition of STEM. In order to best comply with this mandate; we conducted academic research and institutional surveying of surrounding Midwestern states, national institutions and nonprofits in an attempt to discover the popular understanding of STEM.

The first phase of our research involved a review of the existing body of literature on STEM programs and STEM education. This review informed our understanding of the history and purpose of STEM initiatives. Much of this information was presented in the prior sections of this paper.

The second phase of our research involved collecting the technical definitions of STEM from various institutions that publish quantitative data. Iowa uses the

Certification of Instructional Programs (CIPs) codes for its data tracking and reporting. CIP codes are a taxonomic scheme created in 1980, by the National Center for Education Statistics. CIP codes are useful for applying objective designations of educational subjects and quantifying them for data tracking, reporting and analysis (National Center for Education Statistics, 2000). For the sake of applicability, we were primarily interested in programs utilizing (CIPs) codes.

To collect institutional definitions and gain a broad understanding of state, regional, and national definitions of STEM; definitions were collected from available, published sources from these institutions. In the event definitions were not easily assessable, the Iowa Department of Education conducted informal, electronic surveys of those organizations. Table 1 shows the following agencies and institutions were reviewed or contacted.

Table 1Agencies compared by the Iowa Department of Education

Regional Agencies	Federal Agencies	National Not-for –Profits
<ul> <li>Iowa Public Universities Board of Regents</li> <li>Iowa Department of Workforce Development</li> <li>Iowa Community Colleges</li> <li>Minnesota Department of Educa- tion</li> <li>Minnesota Office of Higher Edu- cation</li> <li>Minnesota State Colleges and Universities</li> <li>Wisconsin Department of Educa- tion</li> <li>Wisconsin Department of Public Instruction</li> <li>Wisconsin Department of Work- force Development</li> <li>Wisconsin Technical College System</li> <li>University of Wisconsin System</li> <li>Illinois Board of Education</li> <li>Missouri Department of Higher Education</li> <li>Ewing Marion Kauffman Foun- dation</li> <li>Kansas Academy of Math and Science</li> <li>Kansas Department of Education</li> <li>Nebraska Department of Educa- tion</li> <li>South Dakota Department of Education</li> <li>North Dakota University System</li> <li>North Dakota State University</li> </ul>	<ul> <li>National Science Foundation (NSF)</li> <li>National Center for Education Statistics (NCES)</li> <li>Committee on Science, Engineer- ing, and Public Policy (COSEPUP)</li> </ul>	<ul> <li>STEM Equity Pipeline</li> <li>STEM Education Coalition</li> </ul>

Note: Not all agencies had a technical definition of STEM. See Appendix A for a list of programs by agency.

A great deal of information regarding STEM was provided by many of these sources. However, among the institutions that either had published or responded to our surveys, ten were viewed as having the technical definitions of STEM that were desired for our comparative analysis.

The 11 institutions selected for our comparative analysis were: The National Science Foundation; Iowa Board of Regents; STEM Equity Pipeline; Iowa Community Colleges; Iowa Workforce Development; National Center for Education Statistics; Minnesota Department of Education; University of Wisconsin System; Missouri Department of Higher Education and Minnesota State Colleges and Universities.<sup>4</sup>

When all STEM CIPs from the selected institutions were compared amongst each other, it was concluded that there was only a limited degree of consensus amongst institutions as to what defines STEM. Of the 1,848 CIPs found in the 2000 CIP Guidebook, 897 of them were considered to be STEM by at least one institution. Of the 50 two-digit CIP groups, 30 groups were considered STEM by at least one institution. Varying degrees of consensus were found amongst either individual CIP codes or groups but no two institutions had identical, overall definitions of STEM. However, the greatest degree of consensus centered on the following CIP groups: 1.00 Agriculture, 11.00 Computer and Information Sciences, 14.00 Engineering, 15.00 Engineering Technology and Technicians, 26.00 Biological and Biomedical Sciences, 27.00 Mathematics and Statistics, and 40.00 Physical Sciences. Consistency on individual CIPs was less evident as some institutions chose to include entire CIP groups in their definitions, others chose to include whole CIP sub-groups and others chose to select only individual CIPs amongst CIP groups and/or subgroups.

In discovering the lack of consensus amongst external institutions, we chose to develop our own methodology for creating a definition of STEM.

Our first objective was to create a conceptual understanding of STEM. While we originally approached the concept from the "sum of the four fields" perspective, a number of statements within the literature and conversations with professionals led us to

<sup>&</sup>lt;sup>4</sup> A list of CIPs for each agency is available in Appendix A.

consider STEM as being something other than a series of categories or subjects, but rather as a living process that incorporates history, evolution, innovation and change.

Philosophers in the area of science and technology have best articulated the interplay of science and technology. Namely, science and technology depend on each other with support from engineering and the tools of mathematics to progress. In the last century, research within science and research within technology have become practically indistinguishable. Science and technology both depend on mathematics as the formal language to discuss each discipline. Engineering wraps these concepts into implementation. We argue that the interdependent progress of science and technology needs to be emphasized in the definition of STEM.

Scientists often refer to replicable experiments as the defining characteristic of science. While important, a more important facet is of falsification. Generally, empiricism is crucial to the epistemological advancement within science. Specifically, Popper's (1959) formulation of falsification, though controversial in some areas of education, suggests the reason science is successful is the ability to discard inaccurate theories and retain those that have withstood significant testing.

Scientists use mathematics to express their findings and communicate to other scientists. Mathematical formulations assists replicability since it provides people with a precise expectation in the laboratory. Those formulations can also be used to make deductions on deeper, unobserved aspects of science, such as the exploration of the Higgs boson. Today it may be difficult for students to distinguish mathematics and science. Yet, the experiments of Michael Faraday and the formulations of James Maxwell provide an example distinguishing science and mathematics. Faraday, a scientist with little formal training, was able to suggest physical relationships, notably between electricity and magnetism, through raw experimentation. However, it left some to be desired since he was not able to express it in formal mathematics as commonly done in the early 19th century. James Maxwell, trained in mathematics, formulated many of Faraday's most important experiments through four questions, known as the Maxwell Equations.

A scientist's principal concern is empirical fact, which is derived through method and testing. Engineers must consider pragmatic issues related to scientific discovery. Namely, when science is translated into technology, the engineer must consider the functional requirements related to the device's operation. Engineering bring science into operations through processes that are different than the scientific process. First, the device(s) are conceptualized by drafting a conceptual sketch or computer model, such as CAD. Then the device(s) are tested by manufacturing a prototype.

Franssen, Lokhorst, van de Poel (2009) contend the manufacturing process is not considered as "design", but the process "is often reflected in the functional requirements of a device." For our purposes, we ultimately rejected many manufacturing-specific programs as STEM for this reason. However, we consider the maintenance of the manufacturing process as STEM. Individuals who service equipment designed by engineers are equipped with complimentary training to the engineers themselves. Community colleges tend to serve this area of the workforce—the occupations which fix devices created by engineers. For instance, HVAC occupations must know the scientific principles which funnel air efficiently around a structure. We refer to this component of engineering as engineering technology whose principal focus is to maintain and operate technology created by engineers. Our final obstacle is to define the technology component of STEM. Technology can be interpreted widely. Modern technology must meet four criteria, it is: scientifically derived, contain a concrete component to count as technology (e.g., circuit board); must enter into some set of praxes which humans can use; a relation between the technologies and the humans who use, design, make, or modify the technologies in question (Ihde, 1993). In addition, we focus on technology that can be manipulated to advance and test science, math, and engineering. This last component narrows technology to that which is specific to STEM and not the generally used modern technology in the current economy.

Therefore, out conceptual model of STEM, shown in figure 1, has four components: science; math; engineering; engineering technology; and technology. We focus on the overlapping components of science, technology, engineering, and mathematics which reinforce each other. Thus, we do not consider some mathematical-based disciplines, such as actuarial science, as STEM. For example, actuaries do not practice mathematics to compliment science or to advance engineering.

This model fits within the history of science. Early science was able to exist independently from modern technology. However, science—with the use of mathematics—led some to design technology, which was in turn used to advance science. Presently, science could not advance without using technology that was created from earlier scientific discoveries. Quite simply, it's hard to imagine any science in the last century that could exist without the availability of electricity. Figure 2 shows a specific example of how Faraday's experimentation and Maxwell's formulation led to advancements in engineering and technology which led to further advancements in modern computing. We also gave pause to the following statements provided in the National Academy of Sciences (2007) report *Rising above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future.* "Our economy depends on the knowledge that fuels the growth of business and plants the seeds of new industries, which in turn provides rewarding employment for commensurately educated workers" (National Academy of Sciences, 2007, pg 37); and:

"The visible products of research, however, are made possible by a large enterprise mostly hidden from public view—fundamental and applied research, an intensively trained workforce, and a national infrastructure that provides risk capital to support the nation's science and engineering innovation enterprise. All that activity, and its sustaining public support, fuels the steady flow of knowledge and provides the mechanism for converting information into the products and services that create jobs and improve the quality of modern life. Maintaining that vast and complex enterprise during an age of competition and globalization is challenging, but it is essential to the future of the United States." (National Academy of Sciences, 2007, pg 42-43)

Given these statements, we surmised that if the inputs of STEM are funding and knowledge and its long-term outputs are economic growth and prosperity, then it is more appropriate to view STEM as a process, not a subject.

The final synthesis for developing our conceptual understanding of STEM was inspired by Minnesota Department of Education STEM Specialist, Dr. Joel Donna. In his work, Donna (2009) discussed the idea of "integrative STEM." While integrative STEM in not a new idea, we found that Dr. Donna's examination of the intricate and inexorable relationships between science, technology, engineering and math helped ground our idea of STEM as a process. Our conceptual understanding of STEM, based on these ideas is thus revealed in Figure 1.

Figure 1. Conceptual model of STEM as an integrative process.



To understand how our conceptual model weaves these ideas together, we used the concept of electromagnetism and its evolution as demonstrated in Figure 2.

**Conceptual STEM Model:** Applications to Electromagnatism Science/Math Magnetic Read/ Write (1940s) Science: Faraday's Laws (1820s) Math: Maxwell's Equations (1860s) Engineering: Engineering: Technology Technology: Magnetic Core Power plants & Random Access Commercial Memory (1950s) Transmission Lines Memory Electricity Engineering Tech. Transmission Line Installation/Main. Engineering Tech. Memory

Figure 2. Conceptual STEM model applications to electromagnetism.

"Enormous economic gains can be traced to research in harnessing electricity, which grew out of basic research (such as that conducted by Michael Faraday and James Maxwell) and applied research (such as that by Thomas Edison and George Westinghouse). Furthermore, today's semiconductor integrated circuits can be traced to the development of transistors and integrated circuits, which began with basic research into the structure of the atom and the development of quantum

Manufacturing

mechanics by Paul Dirac, Wolfgang Pauli, Werner Heisenberg, and Erwin Schrodinger and was realized through the applied research of Robert Noyce and Jack Kilby. In virtually all those examples, the original researchers did not—or could not—foresee the consequences of the work they were performing, let alone its economic implications. The fundamental research typically was driven by the desire to answer a specific question about nature or about an application of technology. The greatest influence of such work often is removed from its genesis, but the genius of the US research enterprise has been its ability to afford its best minds the opportunity to pursue fundamental questions" (National Academy of Sciences, 2007, pg 51)

### **5.** Consideration and Methodology

Having developed our conceptual definition of STEM, we then moved towards creating a technical definition of STEM capable of yielding quantitative data. We first discussed the new STEM model and the importance of interconnectivity and the flow between science, technology, engineering and math.

Most important to our methodology was the pursuit objectivity. As opposed to evaluating CIPs at face value against our preconceived biases, including/excluding CIPs for funding purposes, or using a word within the CIP program title, we chose to use the six-digit CIP to locate the descriptive narrative within the *CIP Definition Guidebook* and assessed those CIPs based on the stated wording in contrast to our conceptual STEM model. CIPs included in our definition were chosen because they were involved in testing, designing, creating and maintaining technology and using it to advance human knowledge. Of course, some degree of subjectivity will be present in our selection as some CIPs were not always evident in how they would operate within our STEM model. However, we felt our methodology based on the objective narratives best limits the opportunity of arbitrary inclusion of certain CIPs within STEM or attempts to discredit our definitions using slippery-slope assertions.

As we stated, a certain degree of ambiguity was present for a number of CIPs due to the short narratives provided within the CIP guidebook and our lack of exposure to those programs. For CIPs that were questionably STEM, we utilized our database of consensus among technical STEM definitions by other entities. This was valuable as it gave us a barometer for understanding what other institutions regard as STEM and how many of them regard certain CIPs as STEM. While we are not required to follow a specific standard, nor duplicate the understanding of STEM by another institution, this gave us an idea of where our conclusions fell within the definition continuum. Further, we were able to articulate the reasons for our deviation from other institutions in our definition and justify specific CIPs for inclusion. While this was not a significant determinate in how we selected CIPs for STEM, it was useful in indicating which CIPs deserved greater attention and focus as we considered the meaning of the each CIPs stated definition within the guidebook.

In our discussions we had contention regarding agriculture, nursing, and logistics. With Agriculture and Nursing, the ability of these subjects to fit into the STEM model was questioned. Ultimately we chose to include certain Agriculture programs like Biotechnology as it is the foundation for bridging inorganic technology and organic manipulation. On the other hand, we chose to exclude Nursing (51.1601) on the grounds that while nurses are a critical aspect of healthcare infrastructure, they primarily use technology to identify already understood health issues and tend to be less involved in design, creation and maintenance of technology. We anticipate controversy to arise from this decision as there appears to be a divide over Nursing amongst our institutions. Four of the ten institutions in our study included Nursing: Iowa Board of Regents, STEM Equity Pipeline, Iowa Workforce Development and the Minnesota Department of Education. Those that chose not to include nursing were: the National Science Foundation, the National Center for Educational Statistics, the University of Wisconsin System, the Missouri Department of Higher Education and Minnesota State Colleges and Universities. Given the divide on Nursing and our confidence in our methodology, we felt the exclusion of Nursing was justified.

With Logistics, we questioned the use of science and mathematics with the precise definition of engineering. In particular, we discussed whether processes that utilized math were essentially technology or merely management tool. Further, we needed to determine whether technology needed to be tangible. Ultimately, we concluded that while technology in STEM need not necessarily be tangible, it most often is and that we are generally averse to including management principles in STEM unless they clearly fall within the STEM model. Further, while 5 of our 10 institutions included Business Management, Marketing, and Related Support Sciences (CIP Group 52.00) within their definitions of STEM, of the 94 six-digit CIPs within this group only 12 CIPs were considered by any institution and only two codes being considered STEM by more than one institution, 52.1304 Actuarial Science was regarded as STEM by four institutions and 52.1201, Management Information Systems was considered STEM by two institutions.

So while roughly half our institutions considered at least one CIP from Business Management in their definition of STEM, no institution regarded the entire group as STEM and a super-minority of those CIPs were considered STEM by those institutions. Further, no institution regarded Logistics (52.0203) as STEM. Given these considerations, logistics was not included.

In reviewing the implications of our conclusions on STEM we compared our selections with another entity in Iowa, the Board of Regents. In this we found a considerable amount of agreement between our definitions and the Board of Regents.

The vast majority of CIPs offered by Iowa's community colleges are not recognized as STEM by either the Board of Regents or the Committee. Of the 231 CIPs offered by Iowa's community colleges 162 were not recognized by either the Committee or the Regents. Of the 69 remaining CIPs, 48 are considered STEM by the Committee but are not offered by Iowa's State Universities. Since they do not offer these programs, we can conclude that variation between the purposes of an institution will yield reasonable differences in STEM definition.

Of the 21 remaining CIPs, 9 are considered to be STEM by the Committee and the Board of Regents. Taken together, there is agreement on 219 or 94.8 percent of all CIPs offered by Iowa's Community Colleges.

The following were considered STEM by Board of Regents but were excluded from our definitions: Agriculture, Environmental Studies, Natural Resources Management, Nursing, E Agribusiness, Arboriculture, Mortuary Science, Dental Hygiene, Radiologic Technology, Human Services/Disability Studies, Logistics, and Construction Management. Each of these CIPs were questioned and excluded for different reasons. Some were excluded by the fact that they were more focused on business management than on science or engineering. Others were excluded because the use of the word "science" within the CIP title but their use was not reflective of our understanding of the scientific process. Others still were excluded because while they superficially would be considered STEM, we could not rationally justify their inclusion using our understanding of STEM as a process.

### 6. Results

Based results produced by our methodology, using a conceptual STEM model, we found that the commonly referred to gender gap in STEM enrollment is applicable and significant for Iowa's community colleges. The Iowa Department of Education maintains the Community College MIS, which contains enrollment and outcomes information for all community college students in Iowa.

According to 2007-08 enrollment data, roughly 84.05% of all STEM majors were male while only 15.82% were female. This is nearly a 6:1 ratio of male-to-female enrollment in STEM majors. That proportion is significantly different from the 1:1.45 male-to-female ratio in Iowa community colleges (Iowa Department of Education, 2009).

To understand the breakdown of ethnic demographics, one needs to understand the current ethnic make-up of Iowa community colleges. Whites comprise 89% of enrollment in Iowa community colleges, while 3.6% are black, 2.2% are Hispanic, and persons of Asian descent comprise 1.8 percent (Iowa Department of Education, 2009). In relation to STEM enrollments, we found that whites make up roughly 83.83%, black

persons 3.66% and Latino or Hispanics 2.84%. This suggests that black and Hispanic/Latino students are proportionately reflected in STEM programs.

For the state of Iowa, we can infer that the gender gap between male and female enrollment at post-secondary, community college institutions remains significant. However, there are positive indicators for racial equity in proportional enrollment amongst white, black and Latino or Hispanic persons in STEM programs. Further analysis suggests that certain programs have gender concentrations that favor women over men. Given the overwhelming proportion of males to STEM, it is understandable that the majority of programs are dominated by men. Interestingly, females outnumber males in Animal Production Technology and Dental Laboratory Technology nearly 4:1. Females also represent a majority of Biotechnology students. Understanding the attraction of females to these specific programs may assist in formulating initiatives to address gender equity issues in other STEM programs.

In respect to ethnicity, the proportion of whites over other ethnicities in the general population makes extrapolating meaningful inferences difficult within our dataset. In reviewing the data, we found that the programs with higher general enrollment have higher proportion of minority students. Programs with low enrollment frequently have a handful of minority students and many have none. To what degree this is simply a reflection of Iowa's general demographics and overrepresentation of males in STEM programs or a function of racial inequity is difficult to ascertain within this study.

Table 2

Totals between Iowa Community College STEM programs by Student Gender and Ethnicity by Program Enrollment

		Gende		Race/Ethnicity								
(TD) Deceminitien	Mala	Famala	Thebassian	American	<b>4</b> al an	Disale	Hispanic/	W.L.: 4.0	Not Descrided	Thelemann	Program	
CIP Description	71.20	28.70	UIKIIOWII	maran	Asian	JIACK	2 20/	72 70/	11.20/	Unknown	251	
11010302 INFORMATION TECHNOLOGY	/1.5%	28.7%	-	- 1 10/	4.4%	1.10/	5.2%	15.1%	2.20	-	251	
11090102 COMPUTER STSTEMS NET WORKING & TELECOM. TECHNO.	66.9%	11.1%	-	1.1%	1.1%	1.1%	1.9%	92.7%	2.2%	-	5/1	
11100302 COMPUTER AND INFORMATION SYSTEMS SECURITY TECHN	68.5%	31.5%	-	-	-	-	1.9%	96.3%	1.9%	-	54	
14030102 BIOPROCESSING ENGINEERING ETHANOL TECHNOLOGY	94.1%	5.9%	-	-	-	-	5.9%	94.1%	-	-	17	
15000002 ENGINEERING TECHNOLOGY 15020202 ELECTRONICS ENGINEERING TECHNOLOGY	91.4%	8.6%	-	- 0.4%	-	-	5.7% 2.8%	94.3% 81.4%	- 7 20/	- 1994	35 540	
15051202 MANUEA CTURING TECHNOLOGY	91.170	6.7%	-	0.470	2.0%	4.970	3.870	01.470	6 70/	0.1870	J49 45	
15130602 MECHANICAL DRAFTING/CAD/CADD TECHNOLOGY	93.370 87 7%	10.7%	1.6%	2.270	-	1 306	3 1%	91.1%	10.7%	-	45 383	
26120102 BIOTECHNOLOGY	41.0%	59.0%	-	-	1.6%	8.2%	-	80.3%	9.8%	_	61	
11020202 COMPUTER PROGRAM SPECI APPLICA TECHNOLOGY	76.0%	24.0%	-	1.0%	2.6%	6.2%	3.1%	77.1%	10.0%	_	807	
11100402 WEB/MULTIMEDIA MANAGEMENT AND WEBMASTER TECHNOLOGY	50.0%	50.0%	_	-	-	-	-	100.0%	-	_	8	
11109902 COMPLITER AND INFORMATION SYSTEMS TECHNOLOGY	80.2%	19.8%	_	1.0%	1.7%	4.8%	2 7%	77.8%	11.9%		202	
1/380112 CLOBAL IMAGING SYSTEMS TECHNOLOGY	85 /1%	1/ 6%		1.070	1.770	4.070	2.770	97.6%	2 40%		293	
15010102 ADCHITECTURAL ENCINEERING TECHNOLOGY	82 204	14.070	-	6 70/	-	-	16 70/	60.0%	2.470	-	41	
15000102 ARCHITECTURAL ENGINEERING TECHNOLOGY	03.370 95.604	10.770	-	0.770	-	2 90/	0.8%	96.404	0.1%	-	50	
15020402 LASED AND OPTICAL TECHNOLOGY	02.10/	14.470 6.00/	-	-	-	2 40/	0.870	02.10/	9.170 2.40/	-	152	
15050402 LASER AND OPTICAL TECHNOLOGY	95.1%	0.9%	-	-	-	5.4%	-	95.1%	5.4%	-	29	
15030502 TELECOMMUNICATIONS TECHNOLOGY	87.8%	12.2%	-	9.8%	-	-	-	73.2%	17.1%	-	41	
15040102 BIOMEDICAL TECHNOLOGY	100.0%	-	-	-	-	-	50.0%	50.0%	-	-	2	
15040502 ROBOTICS TECHNOLOGY	91.9%	8.1%	-	-	-	-	5.4%	94.6%	-	-	37	
15050312 SUSTAINABLE ENERGY SYSTEMS TECHNOLOGY	100.0%	-	-	-	-	-	-	100.0%	-	-	12	
15050602 WATER QUALITY, WASTEWATER TREATMENT TECHNOLOGY	82.1%	17.9%	-	-	-	7.7%	2.6%	74.4%	15.4%	-	39	
15050702 ENVIRONMENTAL ENGINEERING TECHNOLOGY	70.3%	29.7%	-	1.6%	1.6%	4.7%	1.6%	84.4%	6.3%	-	64	
15110300 HYDRAULICS AND FLUID POWER	-	-	-	-	-	-	-	-	-	-	0	
15130110 DRAFTING AND DESIGN ASSISTANT	/5.0%	25.0%	-	-	12.5%	-	-	87.5%	-	-	8	
15130302 ARCHITECTURAL DRAFTING/CAD/CADD TECHNOLOGY	82.0%	18.0%	-	0.6%	1.7%	1.2%	2.3%	88.7%	5.5%	-	344	
15130401 CIVIL DRAFTING/CAD/CADD TECHNICIAN	82.4%	17.6%	-	-	5.9%	-	-	94.1%	-	-	17	
41010102 BIOLOGICAL LABORATORY TECHNOLOGY 41020102 CHEMICAL TECHNOLOGY	70.9%	19.2%	3.8%	- 20/	-	-	- 2 20/	100.0%	-	-	26	
41050102 CHEMICAL IECHNOLOGY 46020201 ELECTRICAL TECHNICIAN	15.5%	20.7%	-	3.3% 2.40/	-	1.20/	3.3%	95.5%	-	-	50	
40030201 ELECTRICAL LECHNICIAN 46020201 UNE WORKER TECHNICIAN	94.0%	0.0%	-	2.4%	-	1.2%	4.8%	81.0%	10.7%	-	84 103	
47010502 INDUSTRIAL FLECTRONICS TECHNOLOGY	96.0%	4.0%	-	0.3%	1.0%	3.7%	4 7%	84.6%	5 7%	-	298	
47020101 HEATING/AC/VENTILATION/REFRIG, MAINTEN, TECHNI.	100.0%	-	-	2.8%	1.9%	5.6%	7.4%	73.1%	9.3%	-	108	
47030301 INDUSTRIAL FOUIPMENT MAINTENANCE TECHNICIAN	96.6%	3.4%	-	-	2.3%	4.5%	2.3%	85.2%	5.7%	-	88	
47040402 MUSICAL INSTRUMENT FABRICATION & REPAIR TECHNOLOGY	71.4%	28.6%	-	-	-	-	-	71.4%	28.6%	-	21	
48050101 MACHINE TOOL TECHNICIAN	100.0%	-	-	-	-	-	-	100.0%	_	-	12	
48050602 PRECISION SHEET METAL TECHNOLOGY	75.0%	25.0%	-	_	_	_	-	100.0%	_	_	4	
48050702 TOOL AND DIE TECHNOLOGY	97.1%	2 9%		1.5%	1.5%	3 7%	2 9%	79.4%	11.0%	_	136	
11100102 SYSTEMS A DMINISTRATION TECHNOLOGY	90.2%	9.8%	-	0.6%	1.2%	3.5%		89.0%	5.8%	_	173	
	20.270	2.070		0.070	1.270	51570		0,10,10	5.670		175	
01000002 AGRICULTURAL SCIENCE TECHNOLOGY	85.7%	14.3%	-	-	2.0%	-	-	95.9%	2.0%	-	49	
52200102 CONSTRUCTION MANAGEMENT	100.0%	-	-	-	-	-	-	100.0%	-	-	1	
01020412 AGRICULTURAL POWER TECHNOLOGY (J.D.)	97.0%	3.0%	-	-	-	-	-	92.4%	7.6%	-	66	
01030202 ANIMAL PRODUCTION TECHNOLOGY	22.6%	77.4%	-	-	-	3.2%	3.2%	90.3%	3.2%	-	62	
46050312 GAS UTILITY TECHNOLOGY	100.0%	-	-	-	-	-	4.5%	86.4%	9.1%	-	22	
47010302 COMMUNICATIONS SYSTEMS TECHNOLOGY	93.8%	6.3%	-	-	-	6.3%	-	90.6%	3.1%	-	32	
48070301 CABINETMAKING AND MILLWORKING TECHNICIAN	90.5%	9.5%	-	-	4.8%	9.5%	9.5%	42.9%	33.3%	-	21	
51060302 DENTAL LABORATORY TECHNOLOGY	18.5%	81.5%	-	-	-	14.8%	3.7%	51.9%	29.6%	-	27	
Total	4,230	796	7	41	80	184	143	4,179	405	1	5033	
Percent	84.05%	15.82%	0.14%	0.81%	1.59%	3.66%	2.84%	83.03%	8.05%	0.02%	100%	

However, there are a number of concerns to be acknowledged in moving towards national standards. First, such a move would be controversial as STEM may be a source of major funding for many valuable programs that could be excluded from revised definitions. Further, one of the major underpinnings of STEM initiatives is innovation and creativity. Would national standards suppress or dissuade innovative programming from occurring? Is this an acceptable risk in pursuit of cross-applicability and program accountability? Another issue to be addressed is the STEM pipeline and to what degree the different stakeholders (K-12, community colleges, universities, workforce development agencies, not-for-profit local, state, regional and national partners, federal agencies, education professionals, administrators, and funding bodies) have inherently different missions and contributions regarding STEM that would warrant differing definitions of STEM and how or if these issues can be reasonably reconciled. Such concerns would need to be addressed and brought before stakeholders in order to find the most productive method for developing a more meaningful and effective STEM definition.

There are opportunities to address these issues in the future. First, any number of entities can assume the role of speaker to generate a grass-roots dialog regarding STEM programming and STEM conceptual and technical definitions. Second, the process of updating the CIP 2000 guidebook is underway and will soon be updated for 2010. Entities that track and report data on STEM will may need to revise their collection and reporting system to reflect those changes. Since this will need to be done by the majority of STEM stakeholders, this event could act as a catalyst for institutions to adopt or make changes to their own definitions of STEM.

Clearly defining STEM—both conceptually and programmatically through CIPs can enhance the evaluation of STEM programming. In particular, state longitudinal data systems implements through recent Institute for Education Sciences grants and mandated by the American Recovery and Reinvestment Act (State Fiscal Stabilization Fund Program, 2009) and Race to the Top (Overview Information; Race to the Top Fund; Notice Inviting Applications for New Awards for Fiscal Year (FY) 2010, 2009) have equipped states to study long-term outcomes of STEM curriculum. For example, Iowa has spent nearly \$3 million on implement Project Lead The Way, a hands-on STEM curriculum in middle and high schools. The Iowa Department of Education has launched an evaluation which will measure whether PLTW casually increases participation in STEM majors in postsecondary institutions (Schenk, Rethwisch, Laanan, Chapman, Starobin, and Zhang, 2009). The evaluation will measure the likelihood of participating in the aforementioned CIPs after participating in PLTW.

Regardless of the position of a STEM stakeholder concerning technical definitions; it is our desire to encourage discussion regarding the purpose and definition of STEM within the United States. If we can promote discussion amongst the numerous and diverse entities that are involved in STEM, we can foster a culture of cooperation amongst STEM entities. Hopefully, with a culture of cooperation amongst STEM stakeholders, we can begin to see more significant progress in addressing the various problems that persist within the STEM pipeline; ultimately resulting in more positive economic and socially equitable outcomes for students, workers, educators and businesses within the United States.

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#### Specialized Area of Study

#### Appendix A: Comparison of CIPs by Institution and State

Specialized Area of Study	CIP						Entity					
		N ational Science	lowa Board of	lowa Community	S TEM	Lowa Workforce	N ational C enter For	M innesota D enartment of	U niversity of W isconsin	<b>M</b> issouri <b>D</b> enartment of	M innesota	Community College
		Foundation	R egents	C olleges	P ipeline	D evelopment	E ducational	E ducation	S ystem	H igher	C olleges and	I ntegrative
		STEM	STEM	STEM	STEM	STEM	S tatistics STEM	STEM	STEM	E ducation METS	U niversities STEM	S TEM
						Yes;						
- Anriculture General	-	Tes	v res	tes	v res	v	Tes	res; crosswaiked	Tes	res V	res V	X
Agricultural Business and Management, General	01.0000		^		x	^		x		x	x	
Agribusiness/Agricultural Business Operations	01.0102				х			х		х	х	
Agricultural Economics	01.0103				х			х		х	х	
Farm/Farm and Ranch Management or Agricultureal Studies	01.0104		х		x			x		x	x	
Agricultural/Farm Supplies Retailing and Wholesaling	01.0105		v		x	v		x		x	x	
Agricultural Business and Management. Other	01.0100		^		x	^		x		x	x	
Agricultural Mechanization, General or Agriculture Systems Technology	01.0201		х		x			x		x	x	
Agricultural Power Machinery Operation	01.0204				х			х		х	х	x
Agricultural Mechanics & Equipment/Machine Technology	01.0205				х			х		х	х	
Agricultural Mechanization, Other	01.0299				x			x		x	X	
Agricultural Production Operations, General Animal/Livestock Husbandry and Production	01.0301				x	x		x		x	x	×
Aquaculture	01.0303				x	~		x		x	x	
Crop Production	01.0304				х	х		х		х	х	
Dairy Husbandry and Production	01.0306				x			x		x	x	
Horse Husbandry/Equine Science and Management	01.0307				x			x		x	x	
Agricultural Production Operations, Other	01.0399				х			х		х	х	
Agricultural and Food Products Processing	01.0401				х			х		х	х	
Dog/Pet/Animal Grooming	01.0504				x			x		x	x	
Animai Training Fouestrian/Fouine Studies	01.0505				x			x		x	x	
Taxidermy/Taxidermist	01.0508				x			x		x	x	
Agricultural and Domestic Animal Services, Other	01.0599				х			х		х	х	
Applied Horticulture/Horticultural Operations, General	01.0601				х			х		х	х	
Ornamental Horticulture	01.0603				x			x		x	x	
Greenhouse Operations and Management	01.0604				x			x		x	x	
Plant Nursery Operations and Management	01.0605				x			x		x	x	
Turf and Turfgrass Management	01.0607				x			x		x	x	
Floriculture/Floristry Operations and Management	01.0608				х			х		х	х	
Applied Horticulture/Horicultural Business Services, Other	01.0699				х			х		х	х	
International Agriculture or Global Resources	01.0701		x		x			x		x	x	
Agricultural and Extension Education Services or Agriculture Education Studies	01.0801		x		x			x		x	x	
Agricultural Public Services. Other	01.0899				x			x		x	x	
Animal Sciences	01.0901	х	х		х	х		х	х	х	х	
Agricultural Animal Breeding	01.0902				х	х		х	х	х	х	
Animal Health	01.0903				х			х	х	х	х	
Animal Nutrition	01.0904		v		x	X		x	x	x	x	
Livestork Management	01.0906		^		x	^		x	x	x	x	
Poultry Science	01.0907				x			x	x	x	x	
Animal Sciences, Other	01.0999				х			х	х	х	х	
Food Science or Culinary Science	01.1001	х	х		х	х		х	х	х	х	
Food Technology and Processing	01.1002	x			x			x	x	x	X	
Poor Science and Technology, Other	01.1099	~			Ŷ	v		×	× ×	Ŷ	×	
Agronomy or Agronomy and Crop Science	01.1101		х		x	x		x	x	x	x	
Horticulture or Horticultural Science	01.1103		х		х	х		х	х	х	х	
Agricultural and Horticultural Plant Breeding	01.1104				х	х		х	х	х	х	
Plant Protection and Integrated Pest Management or Pest Management, Plant Health Protection	01.1105		х		x	x		х	x	x	x	
Range Science and Management Seed Science or Plant Sciences, Other	01.1106		v		x	x		x	x	x	x	
Soil Science and Aeronomy. General	01.1201	х	~		x	x		x	x	x	x	
Soil Chemistry and Physics	01.1202	х			х	х		х	х	х	х	
Soil Microbiology	01.1203	х			х	х		х	х	х	х	
Soil Sciences, Other	01.1299	х			х			х	х	х	х	
Agriculture, Agriculture Operations and Related Sciences, Other or Sustainable Agriculture	01.9999	x	х		×	v		х	x	×	х	
Environmental Studies	03.0101	x	x		x	x			x	x		
Environmental Science	03.0104	x	x		x	x			x	x		
Environmental Technology	03.0104		х									
Natural Resources Conservation and Research, Other or Biorenewable Resources and Technology	03.0199		х		х				х	х		
Natural Resources Management and Ecology	03.0201	x	х		x				х	x		
Natural Resource Economics Water, Wetlands, and Marine Resources Management	03.0204	x			x	x			x	x		
Land Use Planning and Management/Development	03.0205	x			x	x			x	x		
Natural Resources Management and Policy, Other	03.0299	х			х	х			х	х		
Fishing and Fisheries Sciences and Management	03.0301	х			х				х	х		
Forestry, General	03.0501	x			x	X			X	x		
Forest Management /Expect Recourses Management	03.0502	x	x		×	×			×	×		
Urban Forestry	03.0508	x			x	x			x	x		
Wood Science and Wood Products/Pulp and Paper Technology	03.0509	х			х				х	х		
Forest Resources Production and Management	03.0510	х			х	х			х	х		
Forest Technology/Technician	03.0511	х			х	х			х	х		
Forestry, Other Wildlands Science and Management	03.0599	x			×	х			x	×		
Natural Resources and Conservation. Other or Water Resources	03.9999	x	х		x	х			x	x		
Architecture (BArch, BA/BS, MArch, MA/MS, PhD)	04.0201	x			x	x						
Environmental Design/Architecture	04.0401				х	х						1
Interior Architecture	04.0501				х							1
Landscape Architecture (BS, BSLA, BLA, MSLA, MLA, PhD) Architectural History and Criticism, Ganeral	04.0601				X	v						
Architectural Technology/Technician	04,0901				x x	x						1
Architecture and Related Services, Other	04.9999				x	x						1
Health Communication	09.0905				х							1
COMMUNICATIONS TECHNOLOGIES/TECHNICIANS AND SUPPORT SERVICES.	10							х		х		1
Communications Technology Occupations	10.0000							x		v		1
Communications Technology/Technician.	10.01							x		×		1
Audiovisual Communications Technologies/Technicians.	10.02							x		x		1
Photographic and Film/Video Technology/Technician and Assistant.	10.0201							х		х		1
Radio and Television Broadcasting Technology/Technician.	10.0202							х		х		
Recording Arts Technology/Technician.	10.0203							x		×		
	10.0233							~		~		

Specialized Area of Study	CIP						Entity					
		N ational Science	l owa B oard of	lowa Community	S TEM	lowa Workforce	N ational	M innesota	U niversity of W isconsin	M issouri Department of	M innesota	Community
		Foundation	Regents	C olleges	P ipeline	D evelopment	E ducational	E ducation	S ystem	H igher	C olleges and	I ntegrative
							S tatistics			E ducation	<b>U</b> niversities	\$ TEM
Graphic Communications.	10.03							х		х		
Graphic Communications, General.	10.0301							х		х		
Printing Management.	10.0302							х		х		
Prepress/Desktop Publishing and Digital Imaging Design.	10.0303							х		х		
Animation, Interactive Technology, Video Graphics and Special Effects.	10.0304							х		х		
Graphic and Printing Equipment Operator, General Production.	10.0305							х		х		
Platemaker/Imager.	10.0306							х		х		
Printing Press Operator.	10.0307							х		х		
Computer Typography and Composition Equipment Operator.	10.0308							x		x		
Graphic Communications, Other.	10.0399							х		х		
Communications Technologies/Technicians and Support Services, Other.	10.99							х		х		
Communications Technologies/Technicians and Support Services, Other.	10.9999							х		х		
Computer and Information Sciences, General	11.0101	х	х		х	х	х	х	х	х	x	
Artificial Intelligence and Robotics	11.0102				х	х	х	х	х	х	x	
Information Technology or Human Computer Interaction	11.0103		х		х	х	х	х	х	х	х	х
Informatics.	11.0104							х	х	х	х	
Computer and Information Sciences, Other or Computer Information Systems	11.0199		х		х			х	х	х	х	
Computer Programming/Programmer, General	11.0201				х	х	х	х	х	х	x	
Computer Programming, Specific Applications	11.0202				х	х	х	х	х	х	х	х
Computer Programming, Vendor/Product Certification	11.0203				х	х	х	х	х	х	х	
Computer Programming, Other	11.0299				х			х	х	х	x	
Data Processing and Data Processing Technology/Technician	11.0301				х	х	х	х	х	х	х	
Information Science/Studies	11.0401	Х	х		х	х	х	х	х	х	х	
Computer Systems Analysis/Analyst	11.0501				х	х	х	х	х	х	х	
Data Entry/Microcomputer Applications.	11.06							х	х	х	х	
Data Entry/Microcomputer Applications, General.	11.0601							х	х	х	х	
Word Processing.	11.0602							х	х	х	х	
Data Entry/Microcomputer Applications, Other.	11.0699							х	х	х	х	
Computer Science, Computer Science Education	11.0701	х	х		х	х	х	х	х	х	x	
Web Page, Digital/Multimedia & Information Resources Design	11.0801				х	х	х	х	х	х	x	
Data Modeling/Warehousing and Database Administration	11.0802				х	х	х	х	х	х	x	
Computer Graphics.	11.0803					х	х	х	х	х	х	
Modeling, Virtual Environments and Simulation.	11.0804							х	х	х	х	
Computer Software and Media Applications, Other	11.0899				х			х	х	х	x	
Computer Systems Networking and Telecommunications or Networking & System Administration	11.0901		х		х	х	х	х	х	х	х	х
System Administration/Administrator	11.1001				х	х	х	х	х	х	х	х
System, Networking, and LAN/WAN Management/Manager	11.1002				х	х	х	х	х	х	х	
Computer and Information Systems Security or Information Assurance	11.1003		х		х	х	х	х	х	х	х	x
Web/Multimedia Management and Webmaster	11.1004				х	х	х	х	х	х	х	x
Information Technology Project Management.	11.1005							х	х	х	х	
Computer Support Specialist	11 1006							x	×	×	×	
Computer /Information Technology Services Administration & Management. Other	11.1099				х			x	x	x	x	x
Computer and Information Sciences & Support Services. Other	11.9999				x	x		x	x	x	x	
Funeral Services & Mortuary Science	12 0301		x									
Full-calinal Assessment Research Statistics	13.0604		x									
	13 1301		x									
Industrial Technology, Technology, Education	13,1309		x							×		
Mathematics Teacher Education	13,1311		х							×		
Science Teacher Education	13.1316		x							x		
Technical Teacher Education	13,1319		x							x		
Trade and Industrial Teacher Education	13.132									x		
Computer Teacher Education	13 1321									x		
Rinkov Teacher Education	13 1322									x		
Chemistry Teacher Education	13 1323									x		
Division Tracher Education	13 1329									x		
Suchalay Teacher Education	13 1335									x		
Computer Applications in Education	13,9999		x							~		
Forineering General	14.0101	x	x	x	x		x		×	×	x	
Aerosnace. Aeronautical and Astronautical Engineering	14.0201	x	x		x		x		x	x	x	
Arricultureal/Riological Engineering and Rioengineering	14 0301	x	x		x		x		x	x	×	×
renewards boogdal before than a boot and boot an	14.030102	~	~	x	~		~		~	~	~	
	14.030102	x		~	x		x		×	×	×	
Riomedical/Medical Engineering	14.0501	x	x		x		x		x	x	×	
Ceramic Sciences and Expineting	14.0501	x	x		x		x		x	x	×	
Chamical Engineering	14.0701	v	Y		x		~		Ŷ	Ŷ	Ŷ	
Circle Instruction Circle Circ	14.0901	v	Ŷ		x	×	v		×	Ŷ	×	
Centerhineang	14.0802	~	~		x	X	x		x	x	x	
Structural Engineering	14.0803	x			x		x		x	x	x	
Transportation and Hiphway Engineering	14.0804				x	x	x		x	x	x	
Water Resources Fingineering	14.0805	×			x	x	x		x	x	x	
Guil Engineering. Other	14.0899	~			x	x	~		x	x	x	
Computer Engineering, General	14.0901	х	х		x	x	х		x	x	x	
Computer Hardware Engineering	14.0902				х		х		х	х	x	
Computer Software Engineering	14.0903		х		х	х	х		х	х	x	
Computer Engineering, Other	14.0999				х				х	х	x	
Electrical, Electronics and Communications Engineering	14.1001	х	х		х	х	х		х	х	х	
Engineering Mechanics	14.1101	х			х		х		х	х	x	
Engineering Physics or Applied Physics/Engineering	14.1201	х	х		х		х		х	х	x	
Engineering Science	14.1301	х	х		х		х		х	х	x	
Environmental/Environmental Health Engineering	14.1401	х			х		х		х	х	x	
Materials Engineering	14.1801	х	х		х		х		х	х	x	
Mechanical Engineering	14.1901	х	х		х	х	х		х	х	х	
Metallurgical Engineering	14.2001	х	х		х		х		х	х	х	
Mining and Mineral Engineering	14.2101	х			х		х		х	х	х	
Naval Architecture and Marine Engineering	14.2201	х			х		х		х	х	х	
Nuclear Engineering	14.2301	x			x		x		x	x	х	
Ocean Engineering	14.2401	x			x		x		x	x	х	
Petroleum Engineering	14.2501	x			x		x		x	x	х	
Systems Engineering	14.2701	x	х		x		x		x	x	х	
Textile Science and Engineering	14.2801	x			x		x		x	x	x	
Materials Science	14.3101	x			x		x		x	x	x	
Polymer/Plastics Engineering	14.3201	x			x		x		x	x	x	
Construction Engineering	14.3301		х		x		x		x	x	x	
Forest Engineering	14.3401				x		x		x	x	x	
Industrial Engineering	14.3501		х		x	х	x		x	x	x	
Manufacturing Engineering	14.3601				x		x		x	x	х	
Operations Research	14.3701	х					x		x	x	х	
Surveying Engineering	14.3801				х		x		x	x	x	x
Geological/Geophysical Engineering	14.3901				x		x		x	x	х	
Engineering, Other or Engineering Applications	14.9999	х	х		х				х	х	х	
Engineering Technology, General or Engineering or Industrial/Engineering Technology	15		х	х	х		х	х	х	х	х	
ENGINEERING TECHNOLOGY	15.000002			х								x

Specialized	<b>∆rea</b>	of	Study	,

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	IP	

Specialized Area of Study	CIP						Entity					
		N ational S cience	lowa Board of	Lowa Community	S TEM	lowa Workforce	N ational Center For	M innesota D enartment of	U niversity of W isconsin	M issouri D enartment of	M innesota S tate	Community College
		Foundation	R egents	<b>C</b> olleges	P ipeline	D evelopment	E ducational	E ducation	<b>S</b> ystem	H igher	C olleges and	I ntegrative
							S tatistics			E ducation	<b>U</b> niversities	\$ TEM
ENGINEERING - CAREER ACADEMY	15.001			х								
Architectural Engineering Technology/Technician	15.0101				х		х	х	х	х	х	x
Civil Engineering Technology/Technician	15.0201				х	Х	х	х	х	х	х	×
Electrical, Electronics and Communications Engineering Technology	15.0303		х		x	Х	X	x	X	x	x	×
Laser and Optical Technology/Technician	15.0304				x	v	x	x	x	x	X	×
Telecommunications Technology/Technician	15.0305		v		~	×	~	×	Ŷ	Ŷ	×	×
Electrical & Electronic Engineering Technologies/Technicians, Other of Electrical and Electronic Technology	15.0399		~		Ŷ	Χ.	v	× v	Ŷ	Ŷ	× ×	×
Electromechanical Technology/Felentromechanical Engineering Technology	15.0401		x		×		x	x	x	x	x	Â
Instrumentation Technology/Technician	15.0404		~		x		x	x	x	x	x	
Robotics Technology/Technician	15.0405				x		x	×	x	x	x	×
Electromechanical & Instrumentation and Maintenance Technologies/Technicians. Other	15.0499				x			x	x	x	x	
Heating, Air Conditioning & Refrigeration Technology/Technician (ACH/ACR/ACHR/HRAC/HVAC/	15.0501				х		х	х	х	х	х	
Energy Management and Systems Technology/Technician	15.0503				х		х	х	х	х	х	x
Solar Energy Technology/Technician	15.0505				х		х	х	х	х	х	
Water Quality & Wastewater Treatment Management & Recycling Technology/Technician	15.0506				х		х	х	х	х	х	x
Environmental Engineering Technology/Environmental Technology	15.0507				х		х	х	х	х	х	x
Hazardous Materials Management & Waste Technology/Technician	15.0508				х		х	х	х	х	х	
Environmental Control Technologies/Technicians, Other	15.0599				х			х	х	х	х	
Plastics Engineering Technology/Technician	15.0607				х		х	х	х	х	х	
Metallurgical Technology/Technician	15.0611				х		х	х	х	х	х	
Industrial Technology	15.0612		х		х		х	х	х	х	х	
Manufacturing Technology	15.0613		х		х		х	х	х	х	х	x
Industrial Production Technologies/Technicians, Other	15.0699				х	Х		х	х	х	х	
Occupational Safety and Health Technology/Technician	15.0701				х	Х	х	х	х	х	х	
Quality Control Technology/Technician	15.0702				х		х	х	х	х	х	
Industrial Safety Technology/Technician	15.0703				х	х	х	х	х	х	х	
Hazardous Materials Information Systems Technology/Technician	15.0704				х		х	х	х	х	х	
Quality Control and Safety Technologies/Technicians, Other	15.0799				x	Х		x	X	x	x	
Aeronautical/Aerospace Engineering Technology/Technician	15.0801				x		X	x	X	x	X	
Automotive Engineering Technology Technician	15.0803				x		x	x	x	x	x	
Mechanical Engineering/Mechanical Technology/Technician	15.0805				x		х	x	X	x	x	
Mechanical Engineering Related Technologies/Technicians, Other	15.0899				x			x	X	x	x	
Mining Technology/Technician	15.0901				x		x	x	x	x	x	
Petroleum Technology/Technician	15.0903				x		x	x	X	x	X	
Mining and Petroleum Technologies/Technicians, Other	15.0999				x			x	X	x	X	
Construction Engineering Technology/Technician	15.1001				x	X	x	x	x	x	X	
Accounting and Computer Science	15.1041				v	X	v	x	x	x	X	
surveying recimiology/surveying	15.1102				×	~	<u>,</u>	~	~	÷	~	
Hydraulics and Huid Power Technology Technician	15.1103				x		x	x	x	x	X	*
Engineering-Related Lectinologies, Other	15.1199				~	v	~	×	×	÷	×	
Computer Tachnology/Computer Sustains Tachnology	15 1201				Ŷ	×	Ŷ	x	x	Ŷ	Ŷ	
Computer reaching of the formation of th	15 1202				x	x	x	x	x	x	x	
Computer Failurate Technology Technician	15 1205				x	x	x	x	x	x	x	
Computer Forineer rearroogy, rechnicians Other	15 1299				x	x	~	x	x	x	×	
Compared anglescong reconsisting of the second	15.1301				x	x	x	x	x	x	x	×
CAD/CADD Drafting and/or Design Technology/Technician	15.1302				x	x	x	×	x	x	x	
Architectural Drafting and Architectural CAD/CADD	15.1303				х	х	х	х	х	х	x	x
Civil Drafting and Civil Engineering CAD/CADD	15.1304				х	х	х	х	х	х	х	x
Electrical/Electronics Drafting & Electrical/Electronics CAD/CADD	15.1305				х		х	х	х	х	х	
Mechanical Drafting and Mechanical Drafting CAD/CADD or Industrial Technology: Machine Design and Drafting Technology	15.1306		х		х	х	х	х	х	х	х	x
Drafting/Design Engineering Technologies/Technicians, Other	15.1399				х			х	х	х	х	
Nuclear Engineering Technology/Technician	15.1401				х		х	х	х	х	х	
Engineering/Industrial Management or Engineering Related or Engineering Related/PLTW (15.1500/15.1501)	15.1501			х	х	Х	х	х	х	х	х	
Engineering Technologies/Technicians, Other	15.9999		х	х	х			х	х	х	х	
Foods, Nutrition, and Wellness Studies, General or Nutrition and Food Science	19.0501	х	х		х	Х						
Human Nutrition or Food Science and Human Nutrition	19.0504	х	х		х	Х						
Foodservice Systems Administration/Management	19.0505	х			х	Х						
Foods, Nutrition, and Related Services, Other	19.0599	Х			х							
Home Furnishings and Equipment Installers	19.0605				х							
Apparel and Textiles, General	19.0901				x							
Apparel and Textile Manufacture	19.0902				х							
Textile Science	19.0904				x							
Apparel and Textiles, Other	19.0999				х							
lechnology Education/industrial Arts.	21.0101	v	v		v		v		v	x	v	
	26.0101	×	~		~		, v		×	Ŷ	×	
Biochemistry	26.0102	×	Ŷ		~		Ŷ		×	÷	×	
Biocherinschy	26.0202	Ŷ	Ŷ		Ŷ		Ŷ		Ŷ	Ŷ	Ŷ	
Judgingsita Malerular Biology	26.0203	x	x		x		x		x	x	x	
Molecular Biochemistry	26.0205				x		x		x	x	x	
Molecular Biophysics	26.0206				х		х		х	х	х	
Structural Biology	26.0207				х		х		х	х	х	
Photobiology	26.0208				х		х		х	х	х	
Radiation Biology/Radiobiology	26.0209		х		х		х		х	х	х	
Biochemistry, Biophysics and Molecular Biology	26.021		х		х		х		х	х	х	
Biochemistry, Biophysics and Molecular Biology, Other or Biochemistry and Biophysics	26.0299		х		х				х	х	х	
Botany/Plant Biology	26.0301	х	х		х		х		х	х	х	
Plant Pathology/Phytopathology	26.0305	х	х		х		х		х	х	х	
Plant Physiology	26.0307	х	х		х		х		х	х	х	
Plant Molecular Biology	26.0308				х		х					
Botany/Plant Biology, Other	26.0399				х				х	х	х	
Cell/Cellular Biology and Histology	26.0401	Х			х		х		х	х	х	
Anatomy	26.0403	х			х		х		х	х	х	
Developmental Biology and Embryology	26.0404	х			х		х		х	х	х	
Neuroanatomy	26.0405	х			х		х		х	х	х	
Cell/Cellular and Molecular Biology	26.0406	х			х		х		х	х	х	
Cell Biology and Anatomy or Anatomy and Cell Biology	26.0407	x	x		х		х		X	X	x	
worecular Celluar and Developmental Biology	26.0499	x	x						X	X	x	
Microbiology	26.0502	x	х		X		x		X	X	x	
weucal wicropology and Bacteriology	26.0503	X			X 		x		X	X	x	
Virulugy	26.0504	x			X		x		X	X	x	
n anarcology Myrology	20.0505	~			×		v		~	×	v	
Immunology	20.0300	v	v		v		Ŷ		v	× v	v	
Microbiological Sciences and Immunology. Other	20.0307	~	~		^		^		×	×	v	
Zoology/Animal Biology	20.0399	v	v		v		¥		x	×	Ŷ	
Entomology	26.0701	v	v		v		Ŷ		x	×	Ŷ	
Animal Physiology (New)	26.0707	x	^		x		x		x	x	x	
Animal Behavior and Ethology	26.0708	~			x		x		x	x	x	1
Wildlife Biology New	26.0709				x		x		x	x	x	1
Zoology/Animal Biology, Other	26.0799				х				х	х	х	
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Specialized	i Area	of	Study

specialized Area of Study	CIP						Entity					
		N ational	Lowa	Iowa	S TEM	lowa	N ational	<b>M</b> innesota	U niversity of	M issouri	<b>M</b> innesota	<b>C</b> ommunity
		S cience F oundation	B oara of R egents	C ommunity C olleges	E quity P ipeline	<b>W</b> orkforce <b>D</b> evelopment	E ducational	D epartment of E ducation	<b>S</b> ystem	D epartment of H igher	S tate C olleges and	C ollege I ntegrative
							S tatistics			E ducation	<b>U</b> niversities	S TEM
Genetics, General (New)	26.0801	х	х		х		х		х	х	х	
Molecular Genetics	26.0802				X				x	x	x	
Microbial and Eukaryotic Genetics	26.0803	v			×		x		x	x	x	
Plant Genetics (New)	26.0804	x			x		x		x	x	x	
Iuman/Medical Genetics or Public Health Genetics	26.0806	х	х		х		х		х	х	х	
Senetics, Other	26.0899				х				х	х	х	
Physiology, General (New)	26.0901	х	х		х		х		х	х	х	
Molecular Physiology	26.0902	x			Х		x		х	x	x	
iell Physiology	26.0903	x			X		x		x	x	x	
ndocrinology Reproductive Biology	26.0904	x			x		x		x	x	x	
Veurobiology and Neurophysiology or Neuroscience	26.0906	x	х		x		x		x	x	x	
Cardiovascular Science	26.0907	х			х		х		х	х	х	
xercise Physiology	26.0908	х			х		х		х	х	х	
/ision Science/Physiological Optics	26.0909	х			х		х		х	х	х	
Pathology/Experimental Pathology	26.091	X			x		x		X	x	x	
Jncology and Cancer Biology	26.0911	х			х		х		X	x	x	
nysiology, Pathology, and Related Sciences, Other.	26.0999	x	x		×		x		x	×	Ŷ	
Molecular Pharmacology	26.1002	A	~		x		x		x	x	x	
Veuropharmacology	26.1003				х		х		х	х	х	
Toxicology	26.1004	х	х		х		х		х	х	х	
Volecular Toxicology	26.1005				х		х		х	х	х	
invironmental Toxicology	26.1006				х		х		х	х	х	
Pharmacology and Toxicology	26.1007				x		х		X	X	x	
/harmacology and Toxicology, Other	26.1099	v			×		~		x	x	x	
Rinstatistics	26.1101	x	x		×		Ŷ		x	x	Ŷ	
Bioinformatics or Bioinformatics and Computational Biology	26.1103		x		x	х	x		x	x	x	
Biomathematics and Bioinformatics, Other	26.1199				х	х			х	х	х	
Siotechnology	26.1201	х	х		х		х		х	х	х	x
Cology	26.1301	х			х		х		х	х	х	
Varine Biology and Biological Oceanography	26.1302	х			х		х		х	х	х	
volutionary Biology	26.1303	х			X		x		X	X	x	
Aquatic Biology/Limnology	26.1304				×		x		x	x	x	
Ponulation Biology	26.1305				×		Ŷ		x	x	Ŷ	
Conservation Biology	26.1307				x		x		x	x	x	
systematic Biology/Biological Systematics	26.1308				х		х		х	х	х	
pidemiology	26.1309	х	х		х		х		х	х	х	
cology, Evolution and Organismal Biology	26.1399		х		х				х	х	х	
Molecular Medicine.	26.1401								х	х	х	
Siological and Biomedical Sciences, Other or Immunobiology	26.9999	X	x		X				X	X	x	
Mathematics	27.0101	х	х		x		x		X	x	x	
Ageora and Number Theory	27.0102				×		Ŷ		x	×	Ŷ	
Seometry/Geometric Analysis	27.0104				x		x		x	x	x	
Topology and Foundations	27.0105				х		х		х	х	х	
Mathematics, Other	27.0199				х				х	х	х	
Applied Mathmatics	27.0301	х	х		х		х		х	х	х	
Computational Mathmatics	27.0303		x		x		х		X	x	x	
Applied Mathematics, Other or Industrial Mathematics	27.0399	v	x		x		v		X	x	x	
Idustics, General Mathematical Statistics and Probability	27.0501	x	^		×		Ŷ		x	×	Ŷ	
Vath: Statistics & Acturarial Science or Statistics. Other	27.0599	x	x		x		~		x	x	x	
Mathematics and Statistics, Other	27.9999	x			x				x	x	x	
Military Science	28.0301		х									
Vilitary Technologies.	29.0101						х			х		
Biological and Physical Sciences	30.0101	х	х		х							
systems Science and Theory	30.0601	X			X							
	30.0801	× ×			Ŷ							
Secontology	30 1101	~			×							
listoric Preservation and Conservation	30.1201				x							
Cultural Resource Management and Policy Analysis	30.1202				х							
listoric Preservation and Conservation, Other	30.1299				х							
Medieval and Renaissance Studies	30.1301				х							
cience, Technology and Society	30.1501				x							
senavioral Sciences	30.1701				×							
Nutritional Sciences or Dietetics. Nutritional Sciences	30.1901	х	х		x	х						
nternational/Global Studies	30.2001				х							
Holocaust and Related Studies	30.2101				х							
Ancient Studies/Civilization	30.2201				х							
Classical, Ancient Mediterranean, and Near Eastern/Asian Studies and Archaeology	30.2202				х							
Veuroscience	30.2401	х	х		x				х	х	х	
ognitive science Aulti-/laterdisciplinary Studies, Other or Select Occupations	30.2501			×	×							
AUITINTERDISCIPIINARY OCCUPATIONS	30.999902			x	^							
MULTIINTERDISCIPLINARY TECHNICAL STUDIES	30.999912			x								
Parks, Recreation and Leisure Studies	31.0101				х							
Parks, Recreation and Leisure Facilities Management	31.0301				х							
ixercise Science	31.0501		х									
kinesiology and Exercise Science	31.0505		x									
Jiel dilu Exercise Darks: Derreation: Leisure and Eitness Studies: Other	31.0599		х		v							
arks, neo cauon, Leisure anu riuress suures, uurer Physical Sciences	31.3339 40.0101				X X		×		x	x	×	
Astronomy	40.0201	х	х		x		x		x	x	x	
Astrophysics	40.0202	x	.,		x		x		x	x	x	
Planetary Astronomy and Science	40.0203	х			х		х		х	х	х	
Astronomy and Astrophysics, Other.	40.0299								х	х	х	
Atmospheric Sciences and Meteorology, General or Geological and Atmospheric Sciences	40.0401		х		х		х		х	х	х	
Atmospheric Chemistry and Climatology	40.0402				х		X		x	x	X	
Autrospheric Physics and Dynamics	40.0403		v		X		×		X	x	×	
vinceorology Stmosnheric Sciences and Meteorology. Other	40.0404		x		×		x		×	×	×	
Themistry	40,0501	x	×		x	×	×		x	x	x	
analytical Chemistry	40.0502	.,			x	x	x		x	x	x	
norganic Chemistry	40.0503				х	х	х		х	х	х	
Organic Chemistry	40.0504				х	х	х		х	х	х	
Physical and Theoretical Chemistry	40.0506				х	x	X		x	x	X	
wymer chemistry	40.0507	х			Х	х	х		х	х	х	I

Specialized	Area	of	Study

Specialized Area of Study	CIP						Entity		
		N ational S cience	l owa B oard of	l owa C ommunity	S TEM E quity	lowa Workforce	N ational C enter For	M innesota D epartment of	U niversity W isconsir
		F oundation	<b>R</b> egents	<b>C</b> olleges	<b>P</b> ipeline	D evelopment	E ducational S tatistics	E ducation	<b>S</b> ystem
Chemical Physics	40.0508				х	х	х		х
Chemistry, Other	40.0599		х		х	х			х
Geology/Earth Sciences, General Geochemistry	40.0601	x	х		X		x		X
Geophysics and Seismology	40.0603	x			x		x		x
Paleontology	40.0604	х			х		х		х
Hydrology and Water Resources Science	40.0605	x			x		х		x
Geochemistry and Petrology Oceanography. Chemical and Physical	40.0606	x			x		х		x
Earth Science, Geology - (Air Quality, Etc.)	40.0699	х	х						х
Physics	40.0801	х	х		х		х		х
Atomic/Molecular Physics or Nanoscience and Nanotechnology (Regents) Elementary Particle Physics	40.0802		х		X		x		x
Plasma and High-Temperature Physics	40.0805				x		x		x
Nuclear Physics	40.0806				х		х		х
Optics/Optical Sciences	40.0807	х			х		х		x
Solid State and Low-Temperature Physics Acoustics	40.0808	x			x		x		x
Theoretical and Mathematical Physics	40.081	~			x		x		x
Physics, Other or Applied Physics	40.0899		х		х				х
Physical Science, Other	40.9999	х		v	х				х
Biology Technician/Biotechnology Laboratory Technician	41.0101			^	х	х	x		
BIOLOGICAL LABORATORY TECHNOLOGY	41.010102			х					
Industrial Radiologic Technology/Technician	41.0204				х		x		
Nuclear/Nuclear Power Technology/Technician	41.0205				x		х		
Chemical Technology/Technician	41.0301				x	х	х		
Physical Science Technologies/Technicians, Other	41.0399				х	х			
Science Technologies/Technicians, Other	41.9999				х	х			
Psychology, General Clinical Psychology	42.0101				x	x			
Cognitive Psychology and Psycholinguistics	42.0301				x	x			
Community Psychology.	42.0401								
Comparative Psychology	42.0501				х				
Counseiing Psychology Developmental Psychology	42.0601					x			
Experimental Psychology	42.0801				х				
Industrial and Organizational Psychology	42.0901				х				
Personality Psychology	42.1001				X				
Social Psychology	42.1101				x				
School Psychology	42.1701				х	х			
Educational Psychology	42.1801				х				
Psychometrics and Quantitative Psychology Clinical Child Psychology	42.1901				x	v			
Environmental Psychology	42.2101				x	~			
Geropsychology	42.2201				х				
Health/Medical Psychology	42.2301				х				
Psychopharmacology Family Psychology	42.2401 42.2501				x				
Forensic Psychology	42.2601				x				
Psychology, Other	42.9999				х				
Anthropology	45.0201				X				
Anthropology	45.0202				x				
Archeology	45.0301				х				
Demography and Population Studies	45.0501				х				
Economics, General	45.0601				x	x			
Econometrics and Quantitative Economics	45.0602				x	x			
Development Economics and International Development	45.0604				х				
International Economics	45.0605				х	х			
Economics, Other Geography	45.0699 45.0701				X				
Cartography	45.0701				x				
CARTOGRAPHY TECHNOLOGY	45.070202			х					
Geography, Other N	45.0799				х				
Canadian Government and Politics Construction Trades, General	45.1003				x			x	
Mason/Masonry	46.0101				х			х	
Carpentry/Carpenter	46.0201				х			х	
Electrical & Power Transmission Installation/Installer, General	46.0301				X			x	
Lineworker	46.0302				x			x	
Electrical and Power Transmission Installers, Other	46.0399				х			х	
Building/Property Maintenance and Management	46.0401				х			х	
Concrete Finishing/Concrete Finisher Building/Home/Construction Inspection/Inspector	46.0402				x			x	
Drywall Installation/Drywaller	46.0404				x			x	
Glazier	46.0406				х			х	
Painting/Painter and Wall Coverer	46.0408				х			х	
Kööter Metal Building Assembly/Assembler	46.041				x			x	
Building/Construction Site Management/Manager	46.0412				x			x	
Carpet, Floor, and Tile Worker.	46.0413							х	
Insulator. Building Construction Technology	46.0414							x	
Building/Construction Finishing, Management, & Inspection, Other	40.0415 46.0499				x			x x	
Pipefitting/Pipefitter and Sprinkler Fitter	46.0502				x			x	
Plumbing Technology/Plumber	46.0503				х			х	
Well Drilling/Driller	46.0504				x			x	
Plumbing and Related Water Supply Services, Other	46.0599				x X			x	
Construction Trades, Other	46.9999				x			x	
Mechanics and Repairers, General	47.0000				х				
Electrical/Electronics Equipment Installation & Repair, General	47.0101				x				
Communications System Technology	47.0102				~				
Computer Installation and Repair Technology/Technician	47.0104				х				
Industrial Electronics Technology/Technician	47.0105				х				
Appliance Installation and Repair Technology/Technician	47.0106				x				
Security system installation, repair, & inspection rectificition	47.011				х				

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Specialized Area of Study	CIP						Entity					
		N ational S cience	l owa B oard of	l owa C ommunity	S TEM E quity	l owa W orkforce	N ational C enter For	M innesota D epartment of	U niversity of W isconsin	M issouri D epartment of	M innesota S tate	Community College
		F oundation	R egents	<b>C</b> olleges	P ipeline	D evelopment	E ducational S tatistics	E ducation	<b>S</b> ystem	H igher E ducation	C olleges and U niversities	I ntegrative S TEM
Electrical/Electronics Maintenance & Repair Technology, Other	47.0199				х							
Heating, Air Conditioning, Ventilation & Refrigeration Maintenance Technology/Technician	47.0201				х							x
Heavy Equipment Maintenance Technology/Technician Industrial Mechanics and Maintenance Technology	47.0302				x							x
Heavy/Industrial Equipment Maintenance Technologies, Other	47.0399				x							
Gunsmithing/Gunsmith	47.0402				х							
Locksmithing and Safe Repair Musical Instrument Exhibition and Repair	47.0403				X							v
Wuscar inscriment Fabrication and Repair Watchmaking and Jewelrymaking	47.0404				x							Â
Parts & Warehousing Operations & Maintenance Technology/Technician	47.0409				х							
Precision Systems Maintenance and Repair Technologies, Other	47.0499				х							
Autobody/Collision and Repair Technology/Technician Automobile/Automotive Mechanics Technology/Technician	47.0603				x			x				
Diesel Mechanics Technology/Technician	47.0605				x			x				
Small Engine Mechanics and Repair Technology/Technician	47.0606				х			х				
Airframe Mechanics & Aircraft Maintenance Technology/Technician	47.0607				х			x				
Aircraft Powerplant Technology/Technician Avionics Maintenance Technology/Technician	47.0608				x			x				
Bicycle Mechanics and Repair Technology/Technician	47.061				x			x				
Motorcycle Maintenance and Repair Technology/Technician	47.0611				х			х				
Vehicle Emissions Inspection & Maintenance Technology/Technician	47.0612				X			x				
Alternative Fuel Vehicle Technology/Technician	47.0613				x			x				
Engine Machinist	47.0615				x			x				
Marine Maintenance/Fitter & Ship Repair Technology/Technician	47.0616				х			х				
Vehicle Maintenance and Repair Technologies, Other.	47.0699				X			x				
Mechanic and Repair Technologies/Technicians, Uther Precision Production Trades. General	47.9999				x			x				
Upholstery/Upholsterer	48.0303				х			х				
Shoe, Boot and Leather Repair	48.0304				х			х				
Leatherworking and Upholstery, Other	48.0399				X			x				,
Machine Tool Technology/Machinist Machine Shon Technology/Assistant	48.0501				x			x				×
Sheet Metal Technology/Sheetworking	48.0506				x			x				x
Tool and Die Technology/Technician	48.0507				х			х				×
Welding Technology/Welder	48.0508				Х			x				
Ironworking/ironworker Computer Numerically Controlled (CNC) Machinist Technology/CNC Machinist.	48.0509 48.0510				х			x				
Metal Fabricator.	48.0511							x				
Precision Metal Working, Other	48.0599				х			х				
Woodworking, General	48.0701				х			x				
Furniture Design and Manutacturing Cabinetmaking and Millwork/Millwright	48.0702				x			x				×
Woodworking, Other	48.0799				x			x				
Boilermaking/Boilermaker	48.0801				х			х				
Precision Production, Other	48.9999				X			x				
Aeronautics/Aviation/Aerospace science & Technology, General Airline/Commercial/Professional Pilot and Flight Crew	49.0101				x			x				
Aviation/Airway Management and Operations	49.0104				x			x				
Air Traffic Controller	49.0105				х			х				
Airline Flight Attendant	49.0106				X			x				
Air Transportation, Other	49.0108				x			x				
Construction/Heavy Equipment/Earthmoving Equipment Operation	49.0202				х			х				
Truck and Bus Driver/Commercial Vehicle Operation	49.0205				х			х				
Mobil Crane Operation/Operator Elagging and Traffic Control	49.0206				х			x				
Railroad and Railway Transportation.	49.0208							x				
Ground Transportation, Other	49.0299				х			х				
Commercial Fishing	49.0303				х			x				
Diver, Professional and Instructor Marine Science/Merchant Marine Officer	49.0304				x			x				
Marine Transportation, Other	49.0399				x			x				
Transportation and Materials Moving, Other	49.9999				х			х				
Health Services/Allied Health/Health Sciences, General.	51.0000							x				
Health and Weilness, General. Chiropractic (DC) or Pre-Chiropractic	51.0001		×		x			x				
Communication Disorders, General	51.0201				x	х		x				
Audiology/Audiologist and Hearing Sciences	51.0202				х			х				
Speech-Language Pathology/Pathologist	51.0203				X	x		x				
Communication Disorders Sciences and Services, Other	51.0204				x	x		x				
Dentistry	51.0401		х		х	х		х				l
Dental Clinical Sciences, General (MS, PhD) or Operative Dentistry	51.0501		х		х			х				
Advanced General Dentistry (Cert, MS, PhD)	51.0502		v		X	х		x				
Dental Public Health	51.0503		x		x	х		x				
Dental Materials (MS, PhD)	51.0505				х			х				
Endodontics/Endodontology (Cert, MS, PhD)	51.0506				х			х				
Oral and Maxillofacial Surgery Orthodoptics	51.0507		x		x			x				
Pediatric Dentistry/Pedodontics (Cert, MS, PhD)	51.0509		~		x	х		x				
Periodontics/Periodontology (Cert, MS, PhD)	51.051				х			х				
Prosthodontics/Prosthodontology (Cert, MS, PhD)	51.0511				X			х				
Advanced/Graduate Dentistry and Oral Sciences, Other or Oral Science Dental Assisting/Assistant	51.0599 51.0601		х		x			x				
Dental Hygiene/Hygienist or Oral Health Science	51.0602		х		x	х		x				l
Dental Laboratory Technology/Technician	51.0603				х			х				×
Dental Services and Allied Professions, Other	51.0699				x			x				l
nearus nearus care Auministration/Management Hospital & Health Care Facilities Administration/Management	51.0701				x x			x x				l
Health Unit Coordinator/Ward Clerk	51.0703				x			x				l
Health Unit Manager/Ward Supervisor	51.0704				х			х				l
Medical Office Management/Administration	51.0705				x			x				l
reards and inaconymedical Records Administration/Administrator Health Information/Medical Records Technology/Technician	51.0705 51.0707				x x	x		x x				l
Medical Transcription/Transcriptionist	51.0708				x			x				l
Medical Office Computer Specialist/Assistant	51.0709				х	х		х				l
Medical Office Assistant/Specialist	51.071				x			x				l
Medical Reception/Receptionist	51.0712				x			x				l
Medical Insurance Coding Specialist/Coder	51.0713				x	х		x				
Medical Insurance Specialist/Medical Biller	51.0714				х			х				I

#### Specialized Area of Study

CIP

Specialized Area of Study	CIP						Entity					
		S cience	B oard of	Community	E quity	W orkforce	C enter For	D epartment of	W isconsin	D epartment of	S tate	C ollege
		Foundation	<b>R</b> egents	C olleges	P ipeline	D evelopment	E ducational S tatistics	E ducation	S ystem	H igher F ducation	C olleges and	I ntegrative
Haalth/Madical Claims Evaminer	51 0715				×		Statistics	×		Lucation	Universities	3 1 2 1 1
Medical Administrative/Executive Assistant & Medical Secretary	51.0715				x			x				
Medical Staff Services Technology/Technician	51.0717				x			x				
Health and Medical Administrative Services, Other	51.0799				х			х				
Medical/Clinical Assistant	51.0801				х			х				
Clinical/Medical Laboratory Assistant	51.0802				x	х		X				
Occupational Therapist Assistant	51.0803				x	v		X				
Pharmacy Technician/Assistant	51.0805				×	^		x				
Veterinary/Animal Health Technology/Technician & Veterinary Assistant	51.0808				x	х		x				
Anesthesiologist Assistant	51.0809				х			х				
Emergency Care Attendant (EMT Ambulance)	51.081				х	х		х				
Pathology/Pathologist Assistant	51.0811				х	х		х				
Respiratory Therapy Technician/Assistant	51.0812				х			х				
Chiropractic Assistant/Technician	51.0813				x	v		X				
Annea Health and Medical Assisting Services, Other	51.0899				×	^		x				
Electrocardiograph Technology/Technician	51.0902				x			x				
Electroneurodiagnostic/Electroencephalographic Technology/Technologist	51.0903				х			х				
Emergency Medical Technology/Technician (EMT Paramedic)	51.0904				х	х		х				
Nuclear Medicine Technology	51.0905		х		х			Х				
Perfusion Technology/Perfusionist	51.0906				х			х				
Medical Radiologic Technology/Science - Radiation Therapist	51.0907				X	X		X				
Respiratory Care Therapy/Therapist	51.0908				×	× v		× ×				
Diagnostic Medical Sonography/Sonographer & Ultrasound Technician	51.090				x	~		x				
Radiation Sciences, Radiologic Technology or Radiologic Technology/Science - Radiographer	51.0911		х		х	х		х				
Physican Assistant	51.0912		х		х	х		х				
Athletic Training	51.0913		х		х			Х				
Gene/Genetic Therapy	51.0914				X			X				
Cardiopulmonary Technology/Technologist	51.0915				x			X				
Aduation Protection/ Health Physics Technician	51.0910				×	v		× ×				
Blood Bank Technology Specialist	51.1001				x	x		x				
Cryotechnology/Cryotechnologist	51.1002		х		х	х		х				
Hematology Technology/Technician	51.1003				х	х		х				
Clinical/Medical Laboratory Technician	51.1004				х	х		Х				
Clincial Laboratory Science/Medical Technology/Technologist	51.1005		х		х	х		х				
Ophthalmic Laboratory Technology/Technician	51.1006				x			X				
Histologic Technology/Histotechnologist	51.1007				x	x		x				
Phlebotomy/Phlebotomist	51 1008				x	x		x				
Cytogenetics/Clenetics/Clinical Genetics Technology/Technologist	51.1005				x	x		x				
Renal/Dialysis Technologist/Technician	51.1011				х	х		х				
Clinical/Medical Laboratory Science & Allied Professions, Other	51.1099				х	х		х				
Pre-Dentistry Studies	51.1101		х					х				
Pre-Med/Pre-Medical Studies	51.1102		х					х				
Pre-Pharmacy Studies	51.1103		x					X				
Pre-Professional: Veterinary Pre-Professional: Nursing	51.1104		x					x				
Professional Health Programs	51.1199		x					x				
Medicine	51.1201		х		х	х		х				
Medical Scientist (MS, PhD) or Pathology	51.1401		х		х		х	х				
Substance Abuse/Addiction Counseling.	51.1501							х				
Psychiatric/Mental Health Services Technician	51.1502				X			X				
Clinical/Medical Social Work	51.1503				x			x				
Marriage and Family Therapy/Counseling.	51.1505							x				
Clinical Pastoral Counseling/Patient Counseling.	51.1506							х				
Psychoanalysis and Psychotherapy	51.1507					х		х				
Mental Health Counseling/Counselor.	51.1508							х				
Genetic Counseling/Counselor	51.1509				х			X				
Mental and Social Health Services and Allied Professions, Uther.	51.1599		v		v	v		X				
Nursing Administration (MSN_MS_PhD)	51 1602		^		x	x		x				
Adult Health Nurse/Nursing	51.1603				x	x		x				
Nurse Anesthetist	51.1604				х	х		х				
Family Practice Nurse/Nurse Practitioner	51.1605				х	х		х				
Maternal/Child Health and Neonatal Nurse/Nursing	51.1606				х	х		х				
Nurse Midwite/Nursing Midwitery	51.1607		v		x	x		x				
Pediatric Nurse/Nursing	51.1609		^		x	x		x				
Psychiatric/Mental Health Nurse/Nursing	51.161				x	x		x				
Public Health/Community Nurse/Nursing	51.1611				х	х		х				
Perioperative/Operating Room and Surgical Nurse/Nursing	51.1612				х	х		х				
Licensed Practical /Vocational Nurse Training (LPN, LVN, Cert, Dipl, AAS)	51.1613				х	х		х				
Nurse/Nursing Assistant/Aide and Patient Care Assistant	51.1614				x			X				
Clinical Nurse Specialist	51.1616		х		x	x		x				
Occupational and Environmental Health Nursing	51.1618				x	x		x				
Nursing, Other	51.1699				x	x		x				
Pre-Professional: Optometry	51.1701		х		х			х				
Opticianry/Ophthalmic Dispensing Optician	51.1801				х	х		х				
Optomeric Technician/Assistant	51.1802				х			х				
Opthalmic Technician/Technologist	51.1803				x			X				
opininamine a opiometric support services a Ameu Professions, Other Osteonathic Medicine/Osteonathy (DO)	51.1899 51.1901				X V	У		x				1
Pharmacy	51.2001		х		x	x		x				1
Pharmacy Administration & Pharmacy Policy & Regulatory Affairs (MS, PhD)	51.2002				х	х						
Pharmaceutics	51.2003		х		х	х		х				1
Med & Nat Prod Chemistry	51.2004		х		х	х		х				
Natural Products Chemistry & Pharmacognosy (MS, PhD)	51.2005				X	x		x				
Clinical and industrial Drug Development (MS, PhD) Pharmacheropomics (Dharmaceutical Economics (MS, PhD)	51.2006				X	×		x				
Clincical and Administrative Pharmacy	51.2008		х		x	x		x				
Industrial & Physical Pharmacy & Cosmetic Sciences (MS, PhD)	51.2009				x	x		x				1
Pharmacy (Other)	51.2099		х		х	х		х				1
Pre-Professional: Podiatry	51.2101		х		х			х				1
Public Health General	51.2201		X		X			x				1
Environmental, Occupation, and Agricultural Health	51.2202		х		X ,,	х		x				1
nearun meana Physics Occupational Health and Industrial Hygiene	51.2205				X V	У		x				1
Public Health Education and Promotion	51.2207				x	~		x				

#### Specialized Area of Study

Specialized Area of Study	CIP						Entity					-
		N ational S cience	l owa B oard of	l owa C ommunity	S TEM E quity	lowa Workforce	N ational C enter For	M innesota D epartment of	U niversity of W isconsin	M issouri D epartment of	M innesota S tate	Community College
		Foundation	R egents	C olleges	P ipeline	D evelopment	E ducational S tatistics	E ducation	<b>S</b> ystem	H igher E ducation	C olleges and U niversities	I ntegrative S TEM
Community and Behavioral Health	51.2208		х		х			х				
Maternal and Child Health	51.2209				х			х				
International Public Health/International Health	51.221		v		X			X				
Public Health, Other	51.2299		^		x			x				
Art Therapy/Therapist	51.2301				х			х				
Dance Therapy/Therapist	51.2302				X			x				
Occupational Therapy/Therapist	51.2305				x	х		x				
Orthotist/Prosthetist	51.2307				х			х				
Physical Therapy and Rehab Science	51.2308		х		х	х		х				
Therapeutic Recreation/Recreational Therapy Vocational Rehabilitation Counseling/Counselor	51.2309 51.231				x			x				
Kinesiotherapy/Kinesiotherapist	51.231				x	х		x				
Assistive/Augmentative Technology & Rehabiliation Engineering	51.2312				х			х				
Rehabilition Studies, Cardiac Rehabilitation	51.2399		x		X	v		X				
Veterinary Medicine Veterinary Sciences/Veterinary Clinical Sciences, General (Cert, MS, PhD)	51.2401		^		x	x		x				
Veterinary Anatomy	51.2502		х		х	х		х				
Vet Physiology and Pharmacology	51.2503		x		х	x		х				
Veterinary Microbiology and Preventative Medicine	51.2504		x		x	x		x				
Veterinary Toxicology & Pharmacology (Cert, MS, PhD)	51.2506				x	x		x				
Large Animal/Food Animal & Equine Surgery & Medicine (Cert, MS, PhD)	51.2507				х	х		х				
Small/Companion Animal Surgery & Medicine (Cert, MS, PhD)	51.2508				X	x		X				
Veterinary Preventative Medicine Epidemiology and Public Health (Cert, MS, PhD)	51.2505				x	x		x				
Veterinary Infectious Diseases (Cert, MS, PhD)	51.2511				х	х		х				
Veterinary Clinical Science, Veterinary Diagnostics, and Production Animal Medicine	51.2599		х		X	х		x				
Health Aide/Home Attendant	51.2601				x			x				
Medication Aide	51.2603				x			x				
Health Aides/Attendants/Orderlies, Other	51.2699				х			х				
Medical Illustration/Medical Illustrator or Biological/Pre-Medical Illustration	51.2703		х		X	v		X				
Medical Informatics Medical Illustration and Informatics. Other	51.2706				x	x		x				
Dietetics/Dietitian (RD)	51.3101		х		х	х		х				
Clinical Nutrition/Nutritionist	51.3102				х	х		х				
Dietetic Technician (DTR)	51.3103				X			x				
Dietetics and Clinical Nutrition Services, Other	51.3104				x	х		x				
Bioethics/Medical Ethics	51.3201				х			х				
Acupuncture	51.3301				х	x		x				
Traditional Chinese/Asian Medicine & Chinese Herbology Naturonathic Medicine/Naturonathy (ND)	51.3302 51.3303				x	x		x				
Homeopathic Medicine/Homeopathy	51.3304				x	x		x				
Ayurvedic Medicine/Ayurveda	51.3305				х	х		х				
Alternative & Complementary Medicine & Medical Systems, Other	51.3399				х	x		х				
Direct Entry Midwitery (LM, CPM) Alternative & Complementary Medical Support Services. Other	51.3401 51.3499				x	х		x				
Massage Therapy/Therapeutic Massage	51.3501				x			x				
Asian Bodywork Therapy	51.3502				х			х				
Somatic Bodywork	51.3503				X			x				
Movement Therapy and Movement Education	51.3601				x			x				
Yoga Teacher Training/Yoga Therapy	51.3602				х			х				
Hypnotherapy/Hypnotherapist	51.3603				х			x				
Movement & Mind-Body Therapies & Education, Other Aromatherapy	51.3699 51.3701				x	x		x				
Herbalism/Herbalist	51.3701				x	x		x				
Polarity Therapy	51.3703				х			х				
Reiki	51.3704				х			x				
Energy and Biologically Based Therapies, Other	51.3799		x		x	x		x				
E-commerce/Electronic Commerce	52.0208					x						
Transportation/Transportation Management	52.0209				х							
Parts, Warehousing, & Inventory Management Operations	52.0409				X							
Business and Managerial Economics	52.0601				^	х						
Management Information Systems, General	52.1201	х				х						
Management Information Systems and Services, Other	52.1299	v				х						
Actuarial Science	52.1301	x	x			х	x					
Marketing Research	52.1402					х						
Vehicle & Vehicle Parts & Accessories Marketing Operations	52.1907				х							
Construction Management History, General	52.2001 54.0101				X							x
American History (United States)	54.0102				x							
European History	54.0103				х							
History and Philosophy of Science and Technology	54.0104				х							
Public/Applied History and Archival Administration Asian History	54.0105 54.0106				x							
Canadian History	54.0107				x							
History, Other	54.0199				х							
Dental/Oral Surgery Specialty - (Residency Program)	60.0101				X	v						
Dental Public Health Specialty - (Residency Program) Endodontics Speciality - (Residency Program)	60.0102				x	x						
Oral Pathology Specialty - (Residency Program)	60.0104				x							
Orthodontics Specialty - (Residency Program)	60.0105				х							
Pedodontics Specialty - (Residency Program) Periodontics Specialty - (Residency Program)	60.0106				x	х						
Prosthodontics Specialty - (Residency Program)	60.0107				x							
Dental Residency Program, Other	60.0199				х							
Aerospace Medicine – (Residency Program)	60.0201				х	x						
Allergies and Immunology – (Kesidency Program) Anesthesiology – (Residency Program)	60.0202				x	х						
Blood Banking - (Residency Program)	60.0203				x	х						
Cardiology - (Residency Program)	60.0205				х							
Chemical Pathology - (Residency Program)	60.0206				x	x						
Child Psychiatry - (Residency Program) Child Psychiatry - (Residency Program)	60.0207 60.0208				x x	x						
Colon and Rectal Surgery - (Residency Program)	60.0209				x							
Critical Care Anesthesiology-(Residency Program)	60.021				х							1

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Specialized Area of Study	CIP						Entity					
		N ational	lowa Roard of	Lowa	S TEM	lowa Workforco	N ational	M innesota	U niversity of	M issouri	M innesota	Community
		Foundation	R egents	C olleges	P ipeline	D evelopment	E ducational	E ducation	S ystem	H igher	C olleges and	I ntegrative
							S tatistics			E ducation	<b>U</b> niversities	S TEM
Critical Care Medicine - (Residency Program)	60.0211				х							1
Critical Care Surgery - (Residency Program)	60.0212				х							
Dermatology - (Residency Program)	60.0213				х	х						
Dermatopathology - (Residency Program)	60.0214				х	х						
Diagnostic Radiology - (Residency Program)	60.0215				х	х						
Emergency Medicine - (Residency Program)	60.0216				х	х						
Endocrinology and Metabolism - (Residency Program)	60.0217				х	х						
Family Medicine - (Residency Program)	60.0218				х	х						
Forensic Pathology - (Residency Program)	60.0219				х	х						
Gastroenterology - (Residency Program)	60.022				х	х						
General Surgery - (Residency Program)	60.0221				х							
Geriatric Medicine - (Residency Program)	60.0222				x							
Hand Surgery - (Residency Program)	60.0223				x							
Hematology - (Kesidency Program)	60.0224				x	×						
Hematological Pathology - (Residency Program)	60.0225				x	X						
Immunopatriology - (Residency Program)	60.0226				Ŷ	Χ.						
Interculous Disease - (Residency Program)	60.0227				Ŷ							
Internal Medicine - (Residency Program)	60.0228				Ŷ	v						
Laboratory mentioner (nestonerity Frigram)	60.0225				Ŷ	×						
Musculosketeta Oncology - (residence Forgram)	60.023				Ŷ	^						
Neohrangar - Emission Medicine - (nesidenti y Foglam) Neohrangar - (Residenci Program)	60.0231				x	x						
Neurological Surgery (Neurosurgery - (Residency Program)	60.0232				x	~						
Neurology - (Revidency Program)	60.0233				x	x						
Neuropathology (Residency Program)	60.0235				x	x						
Nuclear Medicine - (Residency Program)	60.0236				x	x						
Nuclear Radiology - (Residency Program)	60.0237				x	x						
Obstetrics and Gynecology - (Residency Program)	60.0238				x							
Occupational Medicine - (Residency Program)	60.0239				х	х						
Oncology - (Residency Program)	60.024				х	х						
Ophthalmology - (Residency Program)	60.0241				х	х						
Orthopedics/Orthopedic Surgery - (Residency Program)	60.0242				х							
Otolaryngology - (Residency Program)	60.0243				х	х						
Pathology - (Residency Program)	60.0244				х	х						
Pediatric Cardiology - (Residency Program)	60.0245				х							
Pediatric Endocrinology - (Residency Program)	60.0246				х							
Pediatric Hemato-Oncology - (Residency Program)	60.0247				х							
Pediatric Nephrology -(Residency Program)	60.0248				х							
Pediatric Orthopedics - (Residency Program)	60.0249				х							
Pediatrics Surgery- (Residency Program)	60.025				х							
Pediatrics - (Residency Program)	60.0251				х							
Physical and Rehabilitation Medicine - (Residency Program)	60.0252				х	х						
Plastic Surgery - (Residency Program)	60.0253				х							
Preventive Medicine - (Residency Program)	60.0254				х	х						
Psychiatry - (Residency Program)	60.0255				х							
Public Health Medicine - (Residency Program)	60.0256				х	х						
Pulmonary Disease - (Residency Program)	60.0257				х	х						
Radiation Oncology - (Residency Program)	60.0258				х	х						
Radioisotopic Pathology - (Residency Program)	60.0259				х	Х						
Rheumatology – (Residency Program)	60.026				x	x						
Sports Medicine – (Residency Program)	60.0261				x	х						
Thoracic Surgery - (Residency Program)	60.0262				x							
Urology - (Kesidency Program)	60.0263				x	x						
Vascular Surgery - (residency Program)	60.0264				Ŷ							
Adult Reconstructive Orthopedics (Orthopedic surgery) (Residency Program)	60.0265				Ŷ	v						
Cind ved ology - (Residency Frogram)	60.0200				Ŷ	Ŷ						
Cycopartiology - (nesidency in ogram) Geriatric Medicina (Interna) Medicina) - (Becidency Program)	60.0267				Ŷ	v						
Generic webshere (Residency Frequency Frequency Frequency Partiatric Unalized and Partiatric Unalized	60.0269				x	x						
Physical Medical and Rehabilitation/Psychiatry - (Residency Program)	60.0205				x	x						
Arthonedic Surgery of the Spine - (Residence Program)	60.027				x	x						
Medical Residence Programs. Other	60.0299				x	x						
Veterinary Anesthesiology – (Residency Program)	60.0301				x	x						
Veterinary Dentistry - (Residency Program)	60.0302				x	x						
Veterinary Dermatology - (Residency Program)	60.0303				x	x						
Veterinary Emergency and Critical Care Medicine - (Residency Program)	60.0304				x	x						
Veterinary Internal Medicine – (Residency Program)	60.0305				х	х						
Laboratory Animal Medicine - (Residency Program)	60.0306				х	х						1
Veterinary Microbiology - (Residency Program)	60.0307				х	х						1
Veterinary Nutrition - (Residency Program)	60.0308				х	х						1
Veterinary Ophthalmology – (Residency Program)	60.0309				х	х						1
Veterinary Pathology - (Residency Program)	60.031				х	х						1
Veterinary Practice - (Residency Program)	60.0311				х	х						1
Veterinary Preventive Medicine – (Residency Program)	60.0312				х	х						1
Veterinary Radiology - (Residency Program)	60.0313				х	х						1
Veterinary Surgery - (Residency Program)	60.0314				х	х						1
Theriogenology – (Residency Program)	60.0315				х	х						1
Veterinary Toxicology - (Residency Program)	60.0316				х	х						1
Zoological Medicine- (Residency Program	60.0317				х	х						1
Veterinary Residency Programs, Other	60.0399				х	х						L