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# SMARTER PATHWAYS

Strengthening New Hampshire's STEM Pipeline



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The New Hampshire Charitable Foundation is the largest provider of publicly available scholarships in New Hampshire, awarding \$5 million each year to the most promising students with the greatest need. In 2012, amid changing workforce needs and rising student debt, the Foundation brought together business and education leaders to ask ‘how can we increase the impact of our scholarships, and better prepare our students and our state for the workforce of tomorrow?’

The consensus was clear — increase support for science, technology, engineering and math, or STEM fields; and support alternative pathways to the workforce, including certificates and two-year degrees. The Foundation launched its Smarter Pathways initiative, and made a commitment to increase STEM scholarships to \$500,000 per year for the next three years. We exceeded that goal in 2013 with awards totaling \$695,000 to nearly 300 STEM students.

There are many ongoing efforts to develop STEM talent in New Hampshire, with programs and partners all across the state. Leaders in business and education, however, highlighted the need to inventory and align these efforts, and build a common understanding of the assets and gaps in our STEM talent pipeline. The Foundation, with the support from its donors, brought in Education First, national consultants on education policy and practice, to do a comprehensive analysis and make recommendations to strengthen our STEM talent pipeline. An advisory committee of top business and education leaders (listed on page 3 of this report) guided this study, and they have endorsed the recommendations for action.

This study comes at a time when New Hampshire’s workforce is changing. For many years our economy has been fueled by in-migration and a large population of baby-boomers. Recent demographic shifts have changed this picture. With in-migration dramatically reduced, and baby boomers heading

toward retirement, New Hampshire will need every one of its young people to have the opportunity to become active and contributing members of our workforce and our communities. Investing in our own is an economic as well as a social imperative, and will require access to quality education and opportunity to prepare for jobs of future. This study of New Hampshire’s STEM talent pipeline is part of the Foundation’s commitment to New Hampshire’s youth, our economic future, and the well-being of our communities. We look forward to working with the advisors of this study and many others to advance the recommendations set forth in this report.

Richard Ober  
President and CEO  
New Hampshire Charitable Foundation

## STEM Pipeline Study Advisory Committee

Robert Baines, Administrator, STEAM Ahead NH  
Virginia Barry, Commissioner, NH Department of Education  
Fred Bramante, President, National Center for Competency-Based Learning  
Judith Burrows, Director of Student Aid, NH Charitable Foundation  
Molly Connors, Policy Advisor, Office of the Governor  
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Bruce DeMay, Director, Economic & Labor Market Information Bureau  
Ross Gittell, Chancellor, Community College System of NH  
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Jeremy Hitchcock, Chief Executive Officer and Chairman, Dyn  
Molly Kelly, NH State Senator, Chair, Senate Education Committee and Governor's Advanced Manufacturing Education Advisory Council  
Frederick Kocher, Co-Chair, NH Coalition for Business & Education  
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Stephen Reno, Executive Director, Leadership NH  
Jim Roche, President, Business and Industry Association  
Jeffrey Rose, Commissioner, NH Department of Resources and Economic Development  
Pamela Walsh, Chief of Staff, Office of the Governor  
Val Zanchuck, President, Graphicast

## Acknowledgments

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This study was conducted and written by Education First.



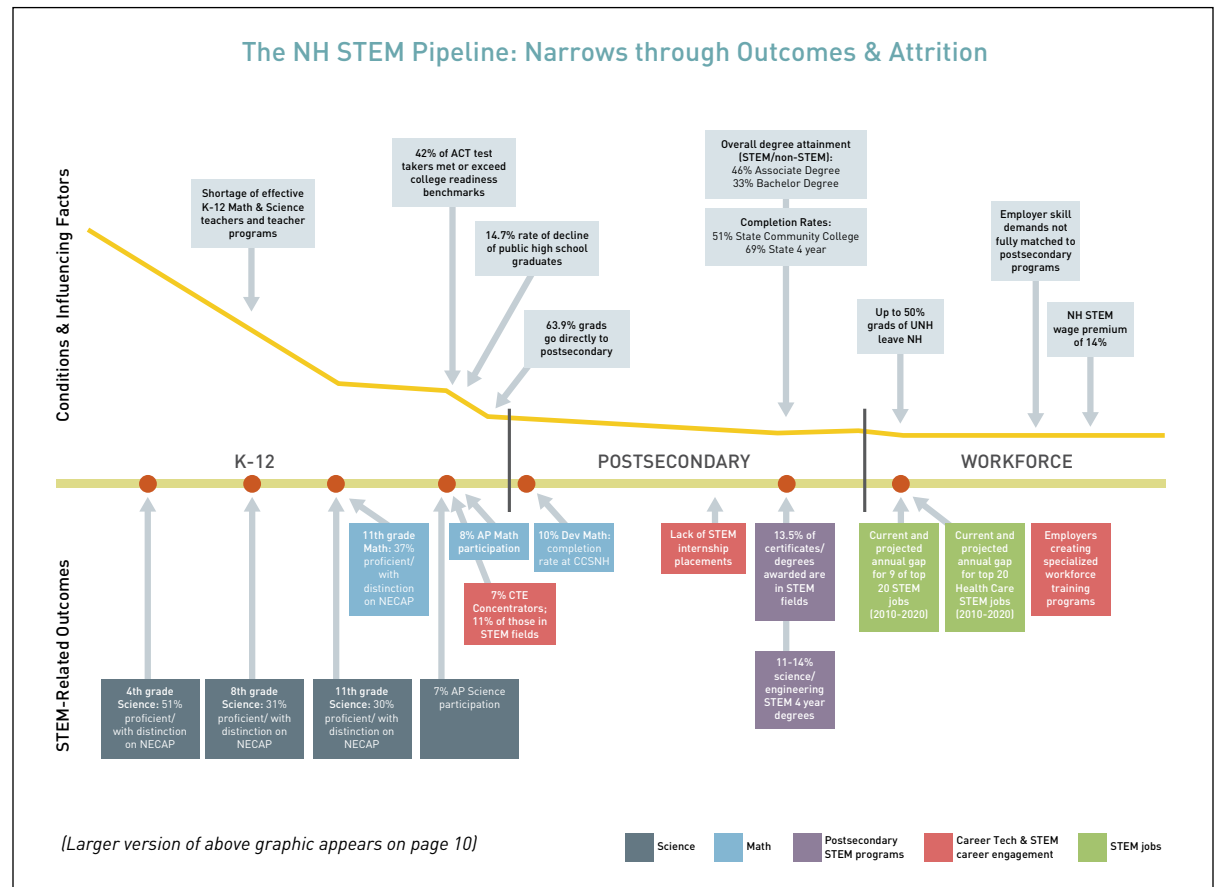
Education First is a national education policy and strategic consulting firm striving to improve public education by helping leaders to innovate, think bigger and achieve more on behalf of students. <http://www.education-first.com>, PO Box 22871, Seattle, WA 98122-0871.

# New Hampshire STEM Pipeline Study

## Executive Summary

New Hampshire outranks many states in educational achievement measures, but the state's STEM talent pipeline narrows early and relentlessly. New Hampshire's K12 science and math achievement is not strong enough to supply future workforce demand. In both math and science, proficiency drops dramatically in the early grades. In science, only 51 percent of students are proficient or better in the 4th grade, dropping to 31 percent by 8th grade. In math, proficiency plummets from 68 percent to 37 percent between grades 8 and 11, as shown in graphic to the right. Couple this with a demographic shift that suggests a decrease in the number of high school graduates over the next ten years, and it becomes essential to strengthen STEM achievement for all students to broaden the K12 pipeline. Support for teacher preparation will be critical, because New Hampshire is producing only half of the K12 math and science teachers needed and teacher preparation programs do not fare well in national quality ratings.

Workforce demand is strong for STEM skills and jobs, particularly in computer systems, engineering and advanced manufacturing, but the supply of potential candidates is barely keeping pace. Additionally, there appears to be misalignment in the candidates currently produced by New Hampshire institutions for high-demand STEM jobs. A recent labor market analysis concluded that simply increasing graduates in STEM-related fields will not be enough without better aligning educational programs to occupations in demand.



Despite these challenges, there is good news. The state boasts a robust portfolio of STEM programs with more than seven hundred STEM efforts in place throughout New Hampshire (detailed in the NH STEM Assets Database created as part of this report). Top state leaders from business and industry, government, education and nonprofits have committed to building STEM talent and aligning it to business needs in New Hampshire. The time is right

to join forces to strategically advance STEM talent in New Hampshire.

The highest leverage actions the state can take are outlined in the recommendations that follow. The business and education leaders on the advisory committee for this study have unanimously endorsed these recommendations to improve New Hampshire's STEM Talent Pipeline.

# NH STEM Highest Impact Recommendations

1

## **Formalize a statewide STEM Leadership Coalition and create a focused action plan, with agreed-upon goals, progress monitoring and accountability**

- Coalition would advocate and coordinate a focused action plan, including recommendations 2 - 7
- Incorporate existing higher education goal to double the number of STEM graduates
- The NH Coalition on Business and Education and the Governor's STEM Education Task Force are positioned to address this recommendation

2

## **Increase expectations and accountability through Common Core State Standards (CCSS), Next Generation Science Standards (NGSS) and high school graduation requirements**

- Current graduation requirements seriously lag other states
- Strongly encourage full implementation of the Common Core and Next Generation Science Standards
- Determine what specific math students need for graduation and to earn postsecondary STEM credentials
- Encourage school districts to accomplish this preparation through competency-based means
- This recommendation will be referred to Governor Hassan's new STEM Education Task Force for consideration

3

## **Strengthen math and science teacher preparation programs, accountability and public reporting, and streamline alternative licensure process**

- Public higher education has primary responsibility for training New Hampshire teachers and must better prepare candidates
- Consider highly effective program models such as UTeach in the program refinement process
- Build upon the work in place by streamlining alternative teacher licensure process
- Clearly identify the depth of math knowledge needed by teacher candidates for subjects they will teach
- The Commissioner of Education and the Chancellor of the University System are best positioned to address this recommendation

## NH STEM Highest Impact Recommendations

4

**Increase the number of STEM industry pathways with a purpose that provide seamless course work and advising from high school through two- and four-year STEM degrees.**

- Continue and expand establishment of STEM-focused Career & Technical Education programs that earn significant early college credit and have partnerships with 2 and 4 year institutions
- Establish early-college high school models in concert with community colleges across the state
- Partnership with Lumina Foundation will bring together New Hampshire partners to address this

5

**Redesign developmental math and gateway courses to increase outcomes and align STEM credentials/degrees with specific industry needs (both technical and soft skill)**

- Identify the right math for the job path, for developmental math and first-year math for STEM majors.
- Incorporate communication and other skills that employers value within STEM programs
- Include a focus in computer science and engineering programs to meet employer demand
- The chancellors of the public higher education systems are well positioned to address this

## NH STEM Highest Impact Recommendations

6

### **Increase industry partnerships with K12 and postsecondary education to expose students to career opportunities and strengthen connection between learning and the real world**

- Encourage school/employer partnerships, like the NH Scholars and Junior Achievement programs
- Challenge employers to provide research and internships in STEM industries and projects
- Provide opportunities for teachers to experience STEM work environments and projects
- Employers and educators are best positioned to advance this work

7

### **Work to change the value proposition and culture of STEM in NH**

- Publicly illustrate the value of STEM learning and its ties to industry/careers and the economy
- Showcase STEM learning and accomplishments at the local and state levels , and during the NH primary
- Beginning in elementary grades, link STEM careers directly to pathways and postsecondary majors, to encourage students and parents to choose the schools, courses and pathways early
- Employers, educators, government, and media and community partners will all need to advance this collectively



## New Hampshire STEM Pipeline Study

### Introduction

*States across the country are grappling with a mismatch between the rapid growth of science, technology, engineering and math (STEM) related jobs and the supply of qualified candidates to fill those jobs.*

New Hampshire is no different. In fact, the state faces the convergence of three factors that are sure to aggravate an already sizeable STEM talent challenge: growing STEM workforce demand, shrinking pool of qualified, highly capable STEM workers and expanding workforce options for STEM degree holders. By 2018, the state is expected to demand more than 40,000 STEM jobs with more than half of those being in computer occupations.<sup>1</sup> Yet, current projections show shortages in a number of computer-related professionals including analysts, systems managers and software developers.<sup>2</sup> Echoing the data, New Hampshire-based advanced manufacturing and information technology employers are decrying the lack of qualified candidates to fill their open positions, even for jobs with wages over 25 percent higher than average. Increasingly, employers also value STEM skills in non-STEM jobs. Hence, through increased competition for critical thinkers and problem solvers

in the workplace, many STEM-degree holders are lured outside of the STEM professions.<sup>3</sup>

But the talent challenge doesn't begin when students hit the workforce. It begins much earlier than that. In her recent State of the State address, Governor Maggie Hassan said that, "For New Hampshire to lead the way in building a workforce that is prepared for the high-tech jobs of today and tomorrow, our schools need to provide an even more rigorous STEM education that our businesses believe in, our educators believe in, and our students and families believe in ... We need to reach our students at a young age and help them understand that they can stay in New Hampshire, find jobs here that are interesting and exciting, and build careers that will allow them to support their families and climb the ladder of opportunity."<sup>4</sup>

In the increasingly STEM-focused national and international economies, the economic strength of New Hampshire depends upon the talent and skills of its people. But what steps must New Hampshire take to win the STEM talent race? Who needs to be involved at what parts of the K12 through workforce pipeline? And what tough choices can make the difference for

residents of New Hampshire to learn, live and work in their home state?

The New Hampshire Charitable Foundation asked Education First to address these questions through the New Hampshire STEM Talent Pipeline Study. This report summarizes the work of the study and what we learned, and offers tailored recommendations for next steps to grow STEM talent in New Hampshire.

### Study Overview

In fall 2013, the New Hampshire Charitable Foundation commissioned Education First to study New Hampshire's STEM talent pipeline to inform and align statewide STEM efforts and facilitate collective action to advance STEM outcomes. The Foundation convened an advisory committee of top business and education leaders to guide the study.

Education First gathered and analyzed STEM-related achievement data, information on STEM-related programs and stakeholder input to:

- Map major STEM achievement and assets across the state along the K12-postsecondary-workforce continuum;



- Identify strengths and gaps in STEM talent and alignment to workforce needs; and
- Develop recommendations to inform collaborative statewide action to advance the STEM talent pipeline.

This report includes the study’s major findings and recommendations. In addition, Education First developed a set of tools to support New Hampshire’s work at the regional and state levels, and track progress on STEM achievement:

- **New Hampshire STEM Talent Pipeline Analysis & Recommendations (PowerPoint)**  
Provides additional details and findings that support the recommendations in this report and promote important dialogue and understanding.
- **New Hampshire STEM Assets Database (Excel)**  
Identifies and catalogues over 700 STEM programs in the state, illustrates concentration of programs within regions and allows sorting by geography, program type, ages served and more.

## New Hampshire’s STEM Pipeline

New Hampshire outranks many states in educational achievement measures, but the state’s STEM talent pipeline narrows early and relentlessly. Students are falling off the track toward STEM careers at key points within and beyond K12. New Hampshire must address multiple weaknesses along the STEM pipeline to be among the top producers of STEM talent.

Just as professional sports leagues don’t leave talent development to chance — with little league, minor league and scouts to identify prospects — STEM talent development can’t occur only at the end of the pipeline. To drive economic prosperity in the state and provide students the opportunity to develop STEM skills, their talent must be nurtured both in and out of school over the course of their education.

New Hampshire’s K12 science and math achievement on the New England Common Assessment Program (NECAP) is not strong enough to supply the numbers of students necessary in the pipeline to satisfy future workforce demand. Proficiency drops dramatically in the early grades. In science, only 51 percent of students are proficient or better in the 4th grade, dropping to 31 percent by 8th grade. In math, proficiency plummets from 68 percent to 37 percent between grades 8 and 11.<sup>5</sup>

Only a limited number of students are engaging in early college credit in STEM disciplines (such as AP and Running Start) which is important for fueling student interest and efficient mastery of STEM skills in K12 and postsecondary education.<sup>6</sup> And, New Hampshire is one of a handful of states expecting a decrease in the number of high school graduates over the next ten years. These demographics make it essential to strengthen STEM achievement for all students in the K12 pipeline.

# The NH STEM Pipeline: Narrows through Outcomes & Attrition

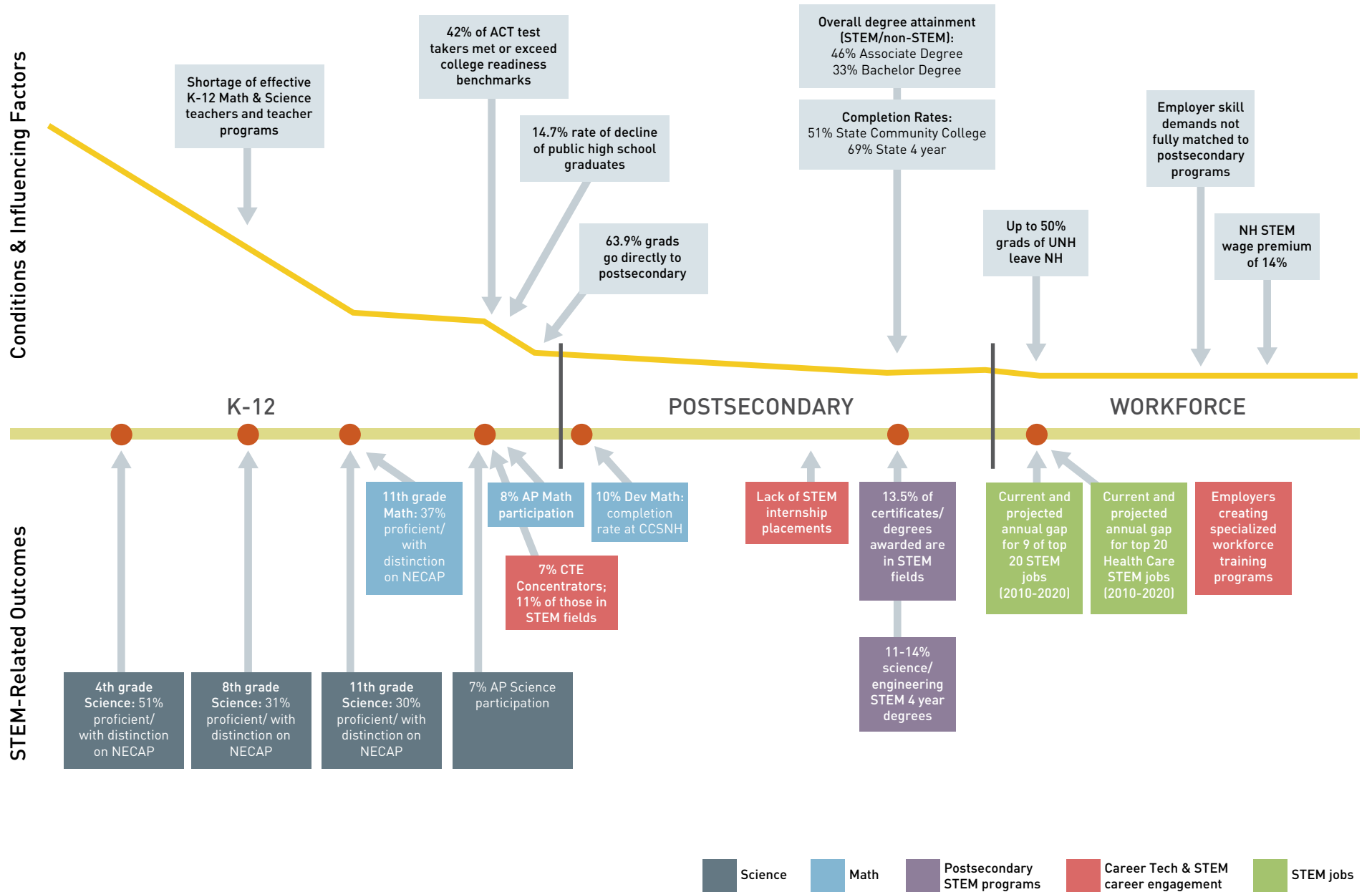


Figure 1

But the K12 challenges don't stop there. New Hampshire is producing only half of the K12 math and science teachers needed to fill current openings, contributing to the statewide shortage of effective STEM teachers<sup>7</sup>. In addition, the state's teacher preparation programs — with the University System of New Hampshire system carrying the greatest load for preparing the state's teachers — do not fare well in national quality ratings. New Hampshire teacher preparation programs trail neighboring states' programs in candidate selectivity and content preparation (except for elementary math), and all programs in the state failed measures of providing high quality student teaching experiences.<sup>8</sup>

At the postsecondary level, students in developmental math and 'gateway' math courses (initial college math courses, such as statistics or calculus, required for specific programs of study) often struggle to succeed and attrition numbers for these students are estimated to be very high<sup>9</sup>. Additional study of campus level data is necessary to fully quantify this challenge, but nationally only ten percent of students who are placed in developmental math courses ever earn a credential. New Hampshire's Community College System is tuned into this challenge and is actively working to chart a path forward. A similar effort to explore gateway course completion and attrition must be undertaken at the university level. The public postsecondary system

has already committed to doubling the number of STEM graduates in the state. Identifying how to solve the STEM attrition challenge early in the student postsecondary journey is critical to accomplishing and building upon this goal over time.

Workforce demand is strong for STEM skills and jobs, particularly in computer systems (networking, programming, software development) and engineering (electrical, mechanical, industrial), but the supply of potential candidates is barely keeping pace. The percentage of degrees conferred in science and engineering is lower in New Hampshire compared to regional neighbors and the majority of states.<sup>10</sup> And while dialogue between postsecondary institutions and employers has increased in recent years and there are many STEM education and training programs, there appears to be misalignment in the quantity and readiness of candidates produced by New Hampshire institutions for in-demand STEM jobs. This is especially evident in advanced manufacturing, where New Hampshire industry leaders have taken it upon themselves to design entry-level training programs because they can't find individuals with strong basic math and statistical analysis skills. A recent labor market analysis concluded that increasing graduates in STEM-related programs will not be enough without better aligning educational programs to occupations in demand.<sup>12</sup>

To exacerbate matters, up to 50 percent of college graduates leave New Hampshire for opportunities out-of-state.<sup>13</sup> As a result, employers are challenged to find New Hampshire talent to meet job requirements and to identify candidates with the right complement of skills, experience and approach to fit individual company cultures. Companies are hiring nationally and internationally for the highest level STEM positions, and are likely to continue to do so.

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*New Hampshire industry leaders in advanced manufacturing have taken it upon themselves to design entry-level training programs because they can't find individuals with strong basic math and statistical analysis skills.*

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Despite these challenges, there is good news. The state boasts a robust portfolio of STEM programs with more than seven hundred school and postsecondary, grassroots and entrepreneurial STEM efforts in place throughout New Hampshire (as detailed in the NH STEM Assets Database). It is difficult to judge the

impact each program has on student achievement, as most programs lack evaluation or impact data. But there is no doubt there is a significant commitment to nurturing STEM skill and interest throughout New Hampshire. As yet largely uncoordinated, the opportunity exists to bring programs together within regions and statewide to align their efforts and intentionally collaborate to move the needle on STEM achievement. The NH STEM Assets Database provides a tool to further explore and document what is working, determine where evaluation and outcome data is necessary to inform additional decision making, and shine a light on programs that are having an impact.

Top state leaders from business and industry, government, education and nonprofits have committed to building STEM talent in New Hampshire. The number of STEM programs across the state and the commitment of New Hampshire educators is impressive. The need for a strong workforce with strong STEM skills, interest and credentials at multiple levels is evident, particularly in specific industries. The time is right to build on these factors to embrace a culture of science, technology, engineering and math and join forces to strategically advance STEM talent in New Hampshire.

## Recommendations to Strengthen the NH STEM Talent Pipeline

Strong STEM pipelines require fostering student achievement in STEM disciplines, interest in STEM fields and focused programs and pathways aligned to industry and employer needs. They require high expectations (standards) coupled with engaging and challenging real-world curriculum and aligned assessments; course sequences and pathways that guide students from one level of STEM learning to the next; a strong supply of effective STEM educators throughout K12; early and ongoing exposure to STEM career options; certificate and degree programs aligned to employer needs; and, collaboration between business, education and government to make real world learning work for students both inside and beyond classrooms. Strong STEM pipelines also require laser-like focus on outcomes with specific measurable goals, a willingness to be data-driven when making decisions about what strategies to embrace or abandon, and the ability to coordinate efforts across systems statewide.

New Hampshire has a solid platform upon which to build. Achieving results, however, will require leadership, alignment, policy change, program redesign and accountability. There are a number of

groups working to improve the STEM talent pipeline already. Some are particularly well-positioned to address specific recommendations and are noted below. Local school districts and postsecondary institutions will also be key to advancing the recommendations. Collectively with students and parents, New Hampshire can both create a STEM culture and significantly advance STEM talent in the state.

## 1

## Formalize a statewide STEM Leadership Coalition and create a focused action plan, with agreed upon goals, progress monitoring and accountability

A STEM Leadership Coalition would advocate for and coordinate a focused action plan (including Recommendations 2-7) that identifies specific STEM talent development goals, uses concrete metrics to measure progress, prioritizes initiatives for alignment and investment, brings stakeholders into the process to support the work and reports regularly on New Hampshire's STEM talent effort.

In New Hampshire the organization should include significant business leadership and multi-sector representation to focus and align efforts to address the state's STEM needs. New Hampshire's Coalition for Business and Education is well positioned to advance this recommendation. The Governor's new STEM Task Force and Advanced Manufacturing Education Advisory Council will be important partners in this work.

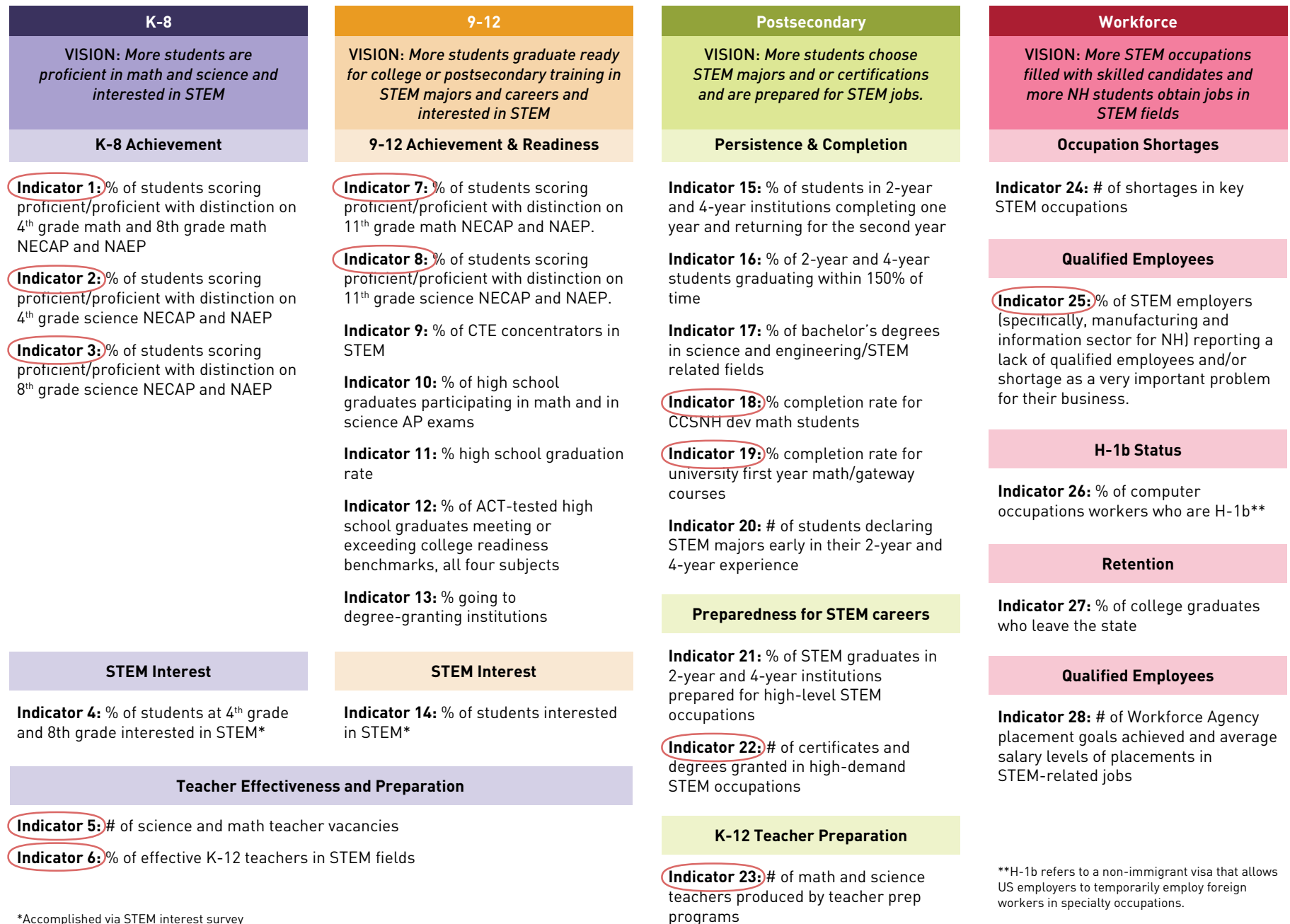
Committing to specific STEM talent development goals across the STEM pipeline — including

incorporating the existing higher education goal of doubling the number of STEM graduates in the state — is a critical first step. The STEM Leadership Coalition must also hold leaders accountable for following through on those goals through a data-driven structure to track progress and outcomes. Identifying key indicators that align to the priority goals, tracking those indicators regularly and publicly reporting on them over time will provide accountability for results. Without this type of approach, STEM efforts across the state will continue to be mostly uncoordinated and result in minimal impact.

On the following page are Key Indicators for the entire New Hampshire STEM talent pipeline (see figure 2, page 13). For beginning this work in New Hampshire, Education First recommends using twelve Power Indicators" (circled on figure 2) to focus energy and attention on priority areas. For how New Hampshire currently stacks up on all the data indicators, see the [NH STEM Talent Pipeline Analysis](#).

In addition to committing to goals and a corresponding monitoring process, the state might also commit to a collaborative structure that harnesses the commitments of interested organizations to accomplish the work. Embracing a collective action model could be an important, sustainable approach for New Hampshire. Centered on a strong backbone organization that plays the role of convener and action plan manager, each partner organization contributes high value expertise, time and/or funds to assure success of the overall effort.<sup>14</sup> This model assures that no one organization carries the full weight of accomplishing the goal alone, but leaders use collective impact — each being accountable for executing a key portion of the work such that collectively they reach the goal.

# New Hampshire STEM Talent Pipeline: Key Indicators



\*\*H-1b refers to a non-immigrant visa that allows US employers to temporarily employ foreign workers in specialty occupations.

\*Accomplished via STEM interest survey

Figure 2

## 2

## Increase expectations and accountability through Common Core State Standards (CCSS), Next Generation Science Standards (NGSS) and high school graduation requirements

The K12 system is outperforming the minimum graduation requirements in New Hampshire. With only a two-year math requirement for high school graduation, for example, one would expect achievement to be lower than it is. While math and science requirements seriously lag other states, New Hampshire fares well on achievement in math compared to other states. But not well enough to develop STEM talent in the numbers the state needs.

New Hampshire's graduation requirements need to be updated, and all students should benefit from them. As a first step, the state should strongly encourage full implementation of Common Core State Standards (CCSS) in math and English Language Arts and the Next Generation Science Standards (NGSS) in all school districts. Both sets of standards require real-world learning experiences in the classroom and an inquiry-based instructional approach tailor-made for STEM student development. NGSS includes engineering, process and content standards with a focus on technology and an increased emphasis on active lab experience and real-world problem solving.

Both CCSS and NGSS encourage applied problem solving in the classroom, which can be further reinforced by bringing in quality programs such as

FIRST Robotics. Identifying which programs achieve real outcomes and bringing these into the school day is a high-value strategy for student engagement. It is also a mechanism to engage STEM industry professionals and volunteers to support teachers in encouraging authentic STEM learning. Strong Career and Technical Education (CTE) programs do this as well, and would benefit greatly from the increased rigor and expectations CCSS and NGSS provide.

In a local control state, adoption incentives can be developed, including the creation of STEM achievement stretch goals for districts and schools, recognition programs and competitive innovation funds (such as Ohio's Straight A Fund or the Massachusetts STEM Innovation Fund) to spur action.

New Hampshire should also require four years of math in high school for every student. The New Hampshire Department of Education can work with postsecondary institutions and STEM employers to determine specifically which math skills are needed to prepare students to succeed in the workforce and entry level postsecondary math courses (Algebra II, Trigonometry, Calculus, Statistics, etc.). The state should set a minimum expectation that students achieve these foundational skills, with practice occurring through the

end of high school so that students are positioned for success in postsecondary programs. New Hampshire should encourage school districts to accomplish these skills through the leading-edge, competency-based means the state has championed. The goal is to prepare students to meet and exceed expectations and to move seamlessly to and through early college credit experiences as they are prepared to do so.

In addition, the state should incorporate science achievement in the statewide accountability framework, just as math is now, so that schools pay greater attention to science success. This, combined with NGSS, will expose all students to science, technology and engineering as a core portion of their in school experience. Science achievement in K12 is a serious issue from the primary grades and beyond, and comparative national data indicates that New Hampshire has actually lost ground and lags behind other states on the time students spend on science in the classroom each week.<sup>15</sup>

This recommendation will be referred to the Governor's STEM Education Task Force for its consideration.

## 3

### Strengthen math and science teacher preparation programs, accountability and public reporting, and streamline alternative licensure process

New Hampshire must strengthen both the number and level of effectiveness of new STEM educators and hold preparation programs accountable for doing so.

The public higher education system has the primary responsibility for producing teachers for New Hampshire and must change its approach to better prepare candidates to meet new licensure requirements. Current data on preparation programs in New Hampshire indicate that they do not incorporate high value strategies for preparing STEM educators, do not produce the numbers of math and science teachers needed, and are not held accountable publicly for outcomes.<sup>16</sup>

Preparation institutions must determine if the depth of math and science content in their programs is sufficient to support teacher candidates in achieving new licensure requirements, and if data-based decision making and inquiry-based instructional methods are appropriately incorporated into the candidate experience. Institutions must revise their

programs to assure these and other leading edge topics valued by districts and cited in research as critical to effective teaching are present. As part of the revision process, the public higher education system should also strongly consider implementing or adapting effective program models from around the country, such as UTeach, a successful STEM teacher preparation program in 34 universities and 17 states. UTeach has some of the highest teacher retention and effectiveness rates in the country (as measured by student data), with nearly 80 percent of STEM teachers remaining in the classroom after five years.<sup>17</sup>

The state can further build upon its teacher licensure and evaluation/effectiveness work by streamlining the alternative licensure to accommodate individuals with deep content knowledge. In Texas in the last two years, they licensed more teachers through alternative routes than traditional ones. They continue to suffer a STEM teacher shortage, but are making up ground in their teacher corps by using this approach.

Assuring accountability for quality in teacher preparation, however, goes well beyond designing a model and should be measured by data on candidate performance in the classroom in the years following graduation. States like Louisiana, Ohio and others report teacher preparation program outcomes by using teacher evaluation data and student achievement/growth data for the years following graduation as a measure of program performance. Using this data, programs are ranked by performance with like programs (public, private and alternative). Data is shared with the programs and they are required to respond to it, with outcomes informing the state's policy making and investment decisions. In some cases this data is more publicly reported to provide transparent information to potential students and families. The Chancellor of the University System and the Commissioner of New Hampshire's Department of Education are best positioned to address this recommendation.



## 4

## Increase the number of STEM industry pathways that provide seamless course work and advising from high school through two- and four-year STEM degrees

In recent years, STEM-focused Career and Technical Education (CTE) programs and community colleges in New Hampshire have developed an increasing number of college credit partnerships that provide valuable pathways for high school students to achieve credit in and exposure to STEM fields, particularly in manufacturing. New models that take advantage of accelerated partnerships — such as Manchester’s STEAM Ahead — are also emerging. The state should continue and expand establishment of these programs that earn significant early college credit and have partnerships with both 2- and 4-year institutions.

In addition, other states have found success in establishing early college high school models in concert with community colleges and universities.

Such models provide seamless student advising from grades 9-16, some as early as grade 6. This model has been particularly effective in Ohio, North Carolina and Texas, where the Early College High School approach also has Early College STEM High Schools. Started in New York and now spreading to Illinois and Connecticut, the P-TECH (Pathways in Technology Early College High Schools, a partnership with IBM) model is designed to graduate students with no-cost two year STEM degrees and the ability to “go to the head of the line” when applying for jobs at IBM.<sup>18</sup> Blueprints for these schools and how their relationships with postsecondary institutions work are available from the North Carolina New Schools Project, Educate Texas and P-Tech and through Jobs

for the Future, an organization that is leading the way in supporting early college experiences.

This recommendation will be referred to the Governor’s STEM Education Task Force and the Advanced Manufacturing Education Advisory Council for their consideration. It also will be advanced by a partnership between the Lumina Foundation, the Charitable Foundation, employers, educators, and state partners.

## 5

## Redesign developmental math and gateway courses in postsecondary to increase outcomes, and fully align STEM credentials/degrees with specific industry needs (technical and soft skill)

As with many other states, New Hampshire's developmental math and math 'gateway' courses (first year math courses required for various STEM majors) do not boast high levels of student success. Passing initial required math courses — both for general education and for specific STEM programs — are significant attrition points for postsecondary STEM students.<sup>19</sup>

Part of this work should include identifying the right math courses that are essential for each STEM program of study (i.e., all STEM programs/jobs don't need algebra/calculus sequence, but may need statistics instead), evaluating the data on student performance in those courses and then identifying if that model or another makes the most sense.

A number of models around the country are providing just-in-time-support for embedded calculus for first year engineering courses, instead of requiring a calculus prerequisite. At Wright State University, they have experienced dramatic gains in student course completion and degree attainment as a result of their multi-year National Science Foundation funded

work, and the model is in place in more than twenty institutions across the country.

STEM employers are increasingly asking for greater incorporation of communication and other soft skills into postsecondary STEM programs to better prepare students for the workplace.<sup>20</sup> Working with employers to develop, prioritize and confirm course and program outcomes — what students should know and be able to do from a technical and soft skill perspective — as well as identifying mechanisms to gauge whether graduates actually possess those skills is important. Real work experience, often gained through working in teams, embedding communication and presentation expectations within course work and participating in internships and co-ops can be extremely valuable. Getting as specific as possible — what skills for what jobs in which industries — can inform program design, content and pedagogy.

One recently developed model that emphasizes both the technical and soft skills necessary for STEM success is from the National STEM Consortium, a group of ten community colleges in nine states funded through a

Department of Labor Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant. The Consortium has created one-year, industry-aligned STEM certificates that incorporate workplace communication and professional skills as well as math and technical skills, with dramatic results. Eighty percent of students earn credentials and are now integrating these programs into their two-year degree paths.<sup>21</sup> The programs are available for use by others through the Open Courseware Consortium and the STEM Bridge Course — designed to address professional work place as well as STEM readiness skills — is provided online as well.

For New Hampshire, focusing degree and credential work on computer science and electrical, mechanical, and industrial engineering design and increasing numbers of graduates is essential to meet employer demand. Work is already well underway in the state in advanced manufacturing. The University and Community College System Chancellors are well positioned to advance this recommendation.

## 6

## Increase industry partnerships within K12 and postsecondary education to expose students to career opportunities and strengthen the connection between learning and application of knowledge in the real world

As stated previously, CCSS and NGSS call for authentic, real world, inquiry-based learning in K12. New Hampshire should encourage school/employer partnerships that feature applied lessons showcasing STEM careers within K12 classrooms. The opportunity for significant business engagement has never been better; the challenge is to build upon what works while fundamentally rethinking how most schools and business are used to doing this work. NH Scholars, Junior Achievement and the recently endorsed 10,000 Mentors program are good examples of going beyond the surface to authentic student engagement and support.

Internships and co-ops provide important opportunities for students to gain experience in potential careers and for employers to get to know potential candidates. While many postsecondary STEM programs require internships or projects with employers, STEM students need more of these interactions throughout school.

Teachers also need more avenues to experience STEM work environments and projects to increase their own knowledge of the careers available to STEM-capable students.

New Hampshire should challenge employers, particularly the smaller ones that haven't participated in internships programs to date, to provide research and internship opportunities for STEM careers. For its part, New Hampshire should carefully consider what type of internship matching or clearinghouse might assist in scaling such work with small and mid-sized employers, and what supports (such as those 10,000 Mentors is developing for their program) might be needed to fully engage employers. Change the Equation is an excellent resource for identifying high value models and mechanisms for engaging STEM industries and professionals, and gauging the efficacy of such work.<sup>22</sup>

This work is most successfully done at the regional level. While there can be a state framework, the action happens at the schools and in the communities. Identifying and shining a light on strong regional work and models that are having an impact can inform scaling of programs to other schools and communities, as evidenced by the recent movement to create STEM Regional Hubs. And regional leaders — from all sectors — can be incredible spokespersons and advocates for the work at the state level as well.<sup>23</sup>

This recommendation will be referred to the NH Coalition for Business and Education and the Governor's Advanced Manufacturing Education Advisory Council, and the state's EPSCoR Committee, along with other business partners.

## 7

## Work to change the value proposition and culture of STEM in New Hampshire

Many students and families are not aware of the 21st century STEM careers that exist and the attractive compensation and benefits they offer. New Hampshire, led by its STEM industry employers, should continue to publicly illustrate the value of STEM learning and its ties to careers and the economy. Branding and public information campaigns, like that for Manufacturing Week, as well as showcasing and celebrating STEM learning experiences and accomplishments at both the local and state levels can help. But changing the culture of STEM requires deeper, ongoing engagement, not simply a media blitz.

For example, it is important to begin linking STEM career opportunities to student pathways and postsecondary majors as early as the elementary

grades, to encourage students and parents to consider engaging in STEM, courses early. Helping parents and teachers experience high quality STEM CTE programs and high tech work environments can make the difference between supporting or rejecting entire STEM industries as viable career options for their children.

Parents and teachers have the greatest influence on students. Arming them with the tools to help students connect the science, technology, engineering and math they are learning and how it matters in the real world can encourage pursuit of STEM interests and the intention to enter STEM programs and careers.

In middle and high school, school counselors are a critical resource in building this awareness. They

must have the knowledge, tools and incentives to effectively promote STEM options to their students. At the very least, understanding the course sequencing and competencies necessary for building STEM skills, identifying potential paths for students and families early on and being able to communicate about STEM careers is important for. This recommendation will need to be advanced collectively by employers, educators, government, foundations, media and community partners.

## Suggested Next Steps for New Hampshire

*New Hampshire is fortunate to have so many individuals and organizations motivated to advance STEM talent in the state.*

In terms of next steps moving forward, the STEM Pipeline Advisory Committee (members listed on page 3) has already endorsed the above recommendations, and invites others to pledge their support. While some of the details are likely to change and choices must be made for focus and implementation, endorsing the recommendations in the spirit in which they are written will provide a foundation to move ahead.

Second, making a final decision about who will take responsibility for driving the strategic action plan forward and serving as the backbone organization needs to happen quickly. Because there are so many different groups, organizations and individuals to coordinate with, it is important that someone take responsibility for that task. The time necessary to bring others to the table and authentically hear their perspectives, determine what role they can play and building out a strategic action plan cannot be underestimated. Experience at Education First tells us that having one organization responsible for this work and one person whose time is dedicated to this

task makes all the difference in how fast a joint effort can move. The New Hampshire Charitable Foundation has stepped forward to play a coordinating role in partnership with the Lumina Community Partnership for Attainment to work with employers and state partners to begin to advance this work.

These first two choices allow for a number of things to happen: focused work to get underway and appropriate resources to be dedicated or gathered. Whether staff for this work will be loaned from another organization, funded by a participating organization or grant funded, some basic questions are resolved:

- Who is leading?
- Who is participating?
- Who will accomplish the daily work?
- What outcomes are you working toward in what timeframe?
- What will it cost to do this for the next 3-6 months or beyond?

Through a regular meeting structure and ongoing strategic conversations among members that focuses on the progress of the work and outcomes, the STEM Leadership Coalition can support the advancement of STEM talent in ways that can outlive any one administration, executive or education leader.

## End Notes

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