



West Virginia Council on  
**STEM** Report  
November 2014

Phase I: Findings and  
Recommendations



Commissioned by  
Gov. Earl Ray Tomblin on April 11, 2014



# Acknowledgments

The following report is the product of many hours of research, collaboration, and dialogue by members of the WV Council on STEM. Established through Executive Order No. 3-14 on April 24, 2014, the Council was developed to enhance STEM education and experiences for West Virginia students. Chaired by Charles Patton, President and COO of Appalachian Power, the WV Council on STEM was comprised of twelve major STEM stakeholders in West Virginia. Serving as a steering committee, the Council networked with national and state STEM leaders, and engaged local and national STEM experts to identify successful models and strategies. Members of the Council included:



Name	Agency/Company
Keith Burdette	West Virginia Department of Commerce
Mike Carroll	Allied Logistics, Huntington, West Virginia
David Claudio	DuPont Corp., Belle, West Virginia
Arria Foster Hines	Allegheny Science & Technology, Bridgeport, West Virginia
Mike Green	West Virginia Board of Education
Mark Hall	Braskem Inc., Kenova, West Virginia
Paul Hill	West Virginia Higher Education Policy Commission
Millie Marshall	Toyota Motor Manufacturing West Virginia Inc., Buffalo
Stephen McCoy	Bombardier Inc., Bridgeport, West Virginia
Shawn Patterson	Columbia Pipeline Group, Charleston, West Virginia
Charles Patton (Chair)	Appalachian Power, Charleston, West Virginia
Dr. James Phares Dr. Michael Martirano	West Virginia Department of Education
James Skidmore	Community and Technical College System of West Virginia

The Council wishes to express its appreciation for the generous support from the Claude Worthington Benedum Foundation which enabled the convening of stakeholders and the development of this report.

In addition to above members, the Council sought the expertise and advice of a variety of professionals in the business, industry, technology, and innovation communities, as well as educators from public education, two-year and four-year institutions of higher education. These individuals served on the STEM Committee that investigated specific STEM strategies.



It is my sincere pleasure to present the following report on behalf of the WV Council on STEM. Having taken the charge seriously, the Council has thoroughly investigated effective STEM initiatives that have been implemented in other states. Considering the job outlook of West Virginia and the workforce development that will be required, the Council has made several strong recommendations to satisfy the objectives set forth by the Governor.

The importance of STEM education has been acknowledged for years. Today, the presence of technology in the workplace and the need for critical thinkers is pervasive; therefore, the adequate preparation of our labor force requires we develop curricula and programs to support this reality. I believe the Council has presented a template for raising West Virginia's awareness of the importance of STEM-related skills in today's workplace and facilitating the creation of regional partnerships that tap into the growing network of proven STEM-related programs.

I want to express my sincere appreciation to each member of the Council for their dedication, commitment and service to the Council. Your perspective and insight as leaders in West Virginia were essential to the development of this robust report. I also want to thank the numerous individuals who served on the STEM stakeholder committee for their advice and input to the Council.

On behalf of the Council, I want to thank Governor Tomblin for his vision in establishing the WV Council on STEM and for his ongoing leadership that continues to support education and workforce development as essential to our state's success.

Sincerely,

Charles Patton, Chair  
WV Council on STEM

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## Planning Framework



The WV Council on STEM convened five times during the seven month period between the issuance of the Governor's Executive Order in March 2014 and the presentation of the Council's Report to the Governor in November 2014. During the Council's meetings and under the leadership of the chair, Council members framed their research and decision-making around several key objectives:

### Meet the Goals and Timelines established by the Governor in the executive order

The Council was established to collaborate to achieve goals for STEM education and workforce planning. It was required to address its findings and recommendations around the following eight goals by December 1, 2014.

- Improve measurable STEM outcomes for students
- Improve STEM instruction in West Virginia Schools
- Increase public engagement in STEM efforts
- Engage with STEM-centric business partners
- Increase number of graduates with degrees in STEM fields
- Enhance STEM experience of post-secondary students

- Explore STEM advanced career sequence offered by Southern Regional Education Board
- Tailor secondary and post-secondary programs for energy, natural gas in petrochemical industry

### Review both formal and informal summaries of existing STEM programs and outcomes

The Council reviewed several reports highlighting data of West Virginia's existing student achievement in STEM areas as well as the various programs that support STEM education. This information was provided by the West Virginia Department of Education, West Virginia Community and Technical College System, the West Virginia Higher Education Policy Commission and other sources. These included, but were not limited to:

- The WV Science and Technology Strategic Plan
- Documents from the Consortium on Undergraduate Research and Engineering — (includes a list of K-12 programs).
- Current listing of STEM events for K-12
- Magazine for 8th graders on nanotechnology — sent to all 8th grade science classes in WV
- Videos about science in WV created through partnership with WV Public Broadcasting
- 2013 Higher Ed Report Card
- Other listings/summaries of current STEM initiatives across the state

### Study national trends, hear from national experts, and investigate effective practice of other state STEM initiatives

Council members received a summary of national perspectives of state STEM initiatives (Appendix B) that summarized the efforts of Iowa, Ohio, Massachusetts, Tennessee, Oregon, Washington and other states. In addition, the Council received presentations from Iowa's STEM Council's Executive Director Dr. Jeff Weld and Coordinator Jacci Linn, both of whom





were recommended by the Washington DC STEM Connector organization to provide a “national perspective” on state-led STEM efforts. The Council’s research examined some common elements in states’ STEM initiatives including:

- Executive orders or legislation to pursue STEM
- Timeline for establishing state STEM efforts
- Funding for STEM efforts
- Use of Regional STEM Network Hubs to promote STEM
- STEM Public Engagement efforts
- Scale up of K-12 STEM initiatives

## Convene West Virginia STEM experts, educators and STEM-related business and community organizations for input

During August 2014, a STEM Committee of nearly 100 business, education and community leaders from across the state met to examine ways to increase STEM education. The

committee convened at the new Advanced Technology Center in South Charleston at the request of the WV Council on STEM. Participants in the meeting heard from STEM experts David Burns (Battelle’s STEM Innovation Networks Director) and Wesley Hall (Director of Tennessee STEM Innovation Network) about successful strategies that are being deployed to develop a pipeline of students who are ready to work in our changing economy. They also provided feedback about how best to move West Virginia forward and increase STEM education. During September the STEM Committee reconvened via virtual webinar to review their feedback and finalize recommendations to the Council which included:

- Capitalizing on West Virginia assets supporting STEM education
- Executing a regional approach to enhance STEM inputs and outcomes
- Engaging the public in the need for STEM education

A full summary of the Committee’s Recommendations is available at: [http://www.educationalalliance.org/files/STEM Committee Recommendations1.pdf](http://www.educationalalliance.org/files/STEM%20Committee%20Recommendations1.pdf)

## Why STEM? Why Now?

According to the Bureau of Business and Economic Research (2014), employment in West Virginia is growing steadily. The natural resources and mining sector has been the largest contributor to statewide net job growth over the past few years, adding an estimated 2,300 workers since the second quarter of 2012. The state’s natural gas production has more than doubled in the past two years, drilling and extraction throughout the Marcellus and Utica Shale formations have provided increased paychecks for employees. Over 20,000 jobs have been projected for West Virginia as reported by the World Class Industrial Network report (WCIN, 2011). The report asserts that this level of Marcellus activity in West Virginia is anticipated to last for decades. **This increase in natural gas production requires a steady flow of workers who are skilled in Science, Technology, Engineering and Mathematics (STEM) in the Mountain State.** The West Virginia education system has the challenge of preparing the needed STEM-skilled workers to fill these positions (WCIN, 2011).

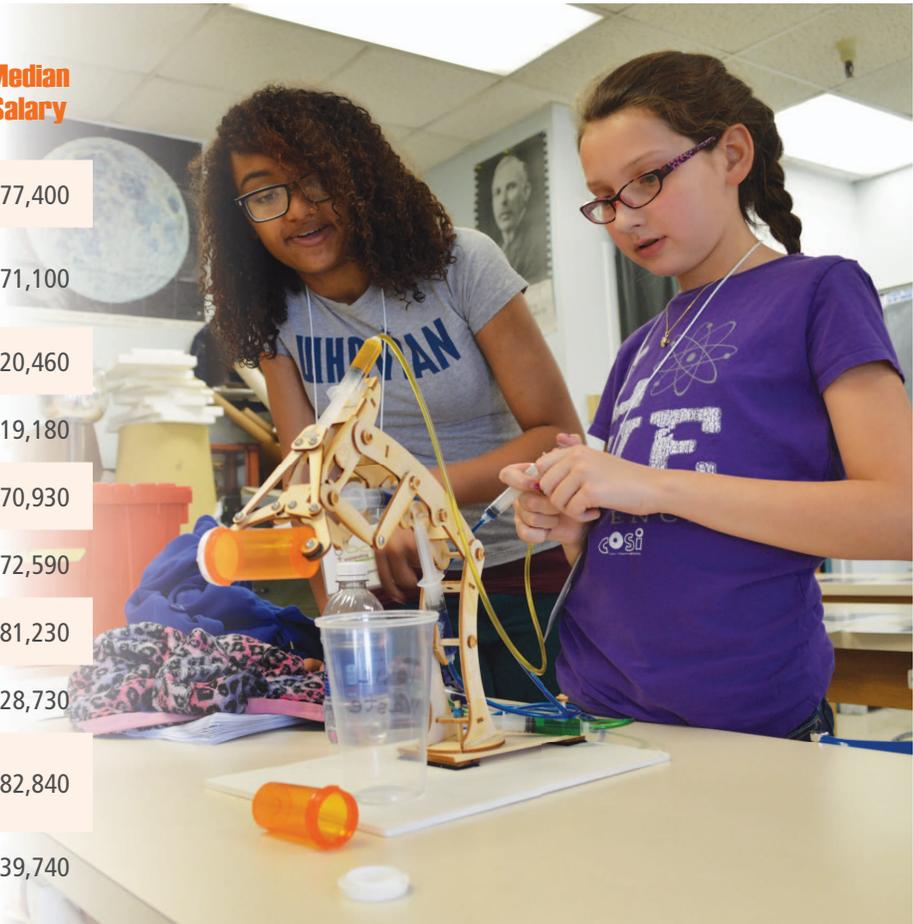
Beyond the energy sector, STEM-skilled workers are critical to building a strong economic foundation in a wide range of West Virginia industries. The Governor’s Executive Order emphasizes it is vital for robust manufacturing, enhanced productivity and

ingenuity, quality health care services, expanded technology and a healthy environment. For the last several years, state leaders have been working to **improve and diversify West Virginia’s economy — preparing students for careers in STEM is the key to achieving that goal.** With an increase in Marcellus shale drilling (Marcellus Coalition, 2014) as well as growing opportunities in manufacturing, health care and technology fields, we are now positioned to have thousands of opportunities for West Virginia families to find excellent jobs here in the Mountain State.

West Virginia, under Governor Tomblin’s leadership, is part of **a national movement to focus more intently on STEM education** for considerable reasons. **STEM related jobs are considered high wage and high skill.** Workers in STEM occupations use science and math to drive our state’s innovation and competitiveness by generating new ideas, new companies, and new industries. Increasingly, corporations are in need of employees that have problem solving skills rooted in a strong STEM foundation. In fact, according to the United States Department of Labor, 6 of the 10 fastest growing occupations through 2018 are in STEM related fields. *See table below.*



Fastest Growing Rank	Occupation	Median Salary
1	Biomedical Engineer	\$77,400
2	Networks Systems Analyst	\$71,100
3	Home Health Aide	\$20,460
4	Personal Care Aide	\$19,180
5	Financial Examiner	\$70,930
6	Medical Scientist	\$72,590
7	Physician Assistant	\$81,230
8	Skin Care Specialist	\$28,730
9	Biochemist/ Biophysicist	\$82,840
10	Athletic Trainer	\$39,740



Jobs in STEM fields not only are among the fastest growing occupations, but they have much higher average salaries than jobs from other sectors. This is true for occupations requiring post-secondary education. Occupations requiring a graduate or professional degree in a STEM field, such as researchers, physicians, dentists, pharmacists, and nurses are among the most lucrative. However, the trend continues at the baccalaureate level as well. According to a 2012 *Forbes.com* report of occupations requiring a bachelor's degree for entry-level employment, eight of the highest earning jobs require STEM skills, namely engineering. See table below.

Although the U.S. Bureau of Labor Statistics reports that manufacturing jobs will decrease nationally between 2012 and 2022, **West Virginia is expected to add manufacturing jobs** according to the *West Virginia Economic Outlook 2014*, "Going forward, our forecast calls for the state's manufacturing sector as a whole to post marginal increases in employment of 0.2 percent per year through the end of 2018." This includes positive gains in five of the ten manufacturing subcategories; wood products, plastics and rubber, transportation equipment, fabricated metals, and other durables. By comparison, West Virginia experienced negative growth in all ten subcategories between 2002 and 2012.



Fastest Growing Rank	Occupation	Starting Salary
1	Computer Engineer	\$70,400
2	Chemical Engineer	\$66,400
3	Computer Scientist	\$64,400
4	Aerospace Engineer	\$64,000
5	Mechanical Engineer	\$62,900
6	Electrical Engineer	\$62,300
7	Civil Engineer	\$57,600
8	Financial Advisor	\$57,300
9	Construction Scientist	\$56,600
10	Information Systems Analyst	\$56,100

Employment gains should also be realized in the state's energy sector due to new opportunities being brought about by clean coal/clean energy technologies, shale gas production, and ethane processing and manufacturing. According to the *West Virginia Economic Outlook 2014*, "Overall, the West Virginia Energy sector will continue to face considerable uncertainty in the near term. Coal mining is expected to remain a critical part of the state's employment and resource base into the foreseeable future, but is likely to face up and down cycles. Meanwhile, the state's natural gas industry is expected to provide strong growth over the next five years, cementing its place as a major player in West Virginia's energy mix."

Job projections for STEM related occupations not only are positive nationally, they are increasing in the State of West Virginia as well. **West Virginia is expected to add 25,000 STEM jobs by 2018.** These jobs will impact most sectors of our economy, and will continue to drive unemployment down in West Virginia, which is currently at its lowest point since early-2009 and is well below that national rate. According to the *West Virginia Economic Outlook 2014*, a report produced by the West Virginia University College of Business and Economics, "The state's unemployment is expected to continue to fall during the period, reaching a low of 4.5 percent by the end of 2018. However, this decline is attributable to not only job gains, but also to demographic trends, since a larger share of the state's workforce will be retiring and exiting the labor force." **Preparing a new generation of STEM-skilled workers to replace the growing number of retiring workers is a key component of the state's long-term economic stability.**

According to U.S. Census data, the only age group in West Virginia that is growing between 2010 and 2020 is the 60+ age group. The state's population is expected to decline by a rate of 0.1 percent annually through 2018 due primarily to the death rate surpassing the birth rate. Furthermore, the overall health of West Virginians continues to

decline. According to America's Health Rankings, West Virginia ranked poorly in 2012 across a number of health measures, including overall health, obesity and physical inactivity. Perhaps most concerning is a decline in its rank in overall health from 41st in 2011 to 47th in 2012. The combination of an aging population and poor overall health will require a need for additional health care workers. According to the *West Virginia Economic Outlook 2014*, "the West Virginia healthcare sector provided over 114 thousand jobs in 2012 while paying roughly \$4.42 billion in employee wages." **The highly STEM-related healthcare sector is forecast to grow steadily in West Virginia and add jobs at a rate of 2.3 percent annually for the next five years.**

The addition of 25,000 new STEM jobs into West Virginia's economy signals a time of great promise for our state. However, it signals a time of great responsibility for our state's P-20 educational system. *Change the Equation*, a STEM-related philanthropic and advocacy group composed of STEM



businesses and corporations that works to ensure that all students are STEM literate has issued a status report on each state. The report is called *Vital Signs*, and it gives a current picture of the State of West Virginia in terms of STEM. The report begins with “**Business leaders in West Virginia have sounded an alarm.** They cannot find the science, technology, engineering and mathematics (STEM) talent they need to stay competitive. Students’ lagging performance in K–12 is a critical reason why.”

Given the projection for 25,000 new STEM jobs by 2018, the critical question we must all ask is “Can West Virginia meet the growing need for STEM skills?” Research tells us the answer will depend on several factors:

- Increased early exposure to a solid foundation in math and science at elementary grade levels
- Continued hands-on engagement in science and engineering activities during the middle grades
- Increased numbers of students taking and passing rigorous STEM courses at the high school level that include both Career Technical Certifications and Advanced Placement or International Baccalaureate courses.
- Early and intense career counseling regarding community-technical college program opportunities
- Increased number of non-traditional students completing STEM-related 4 year degree programs

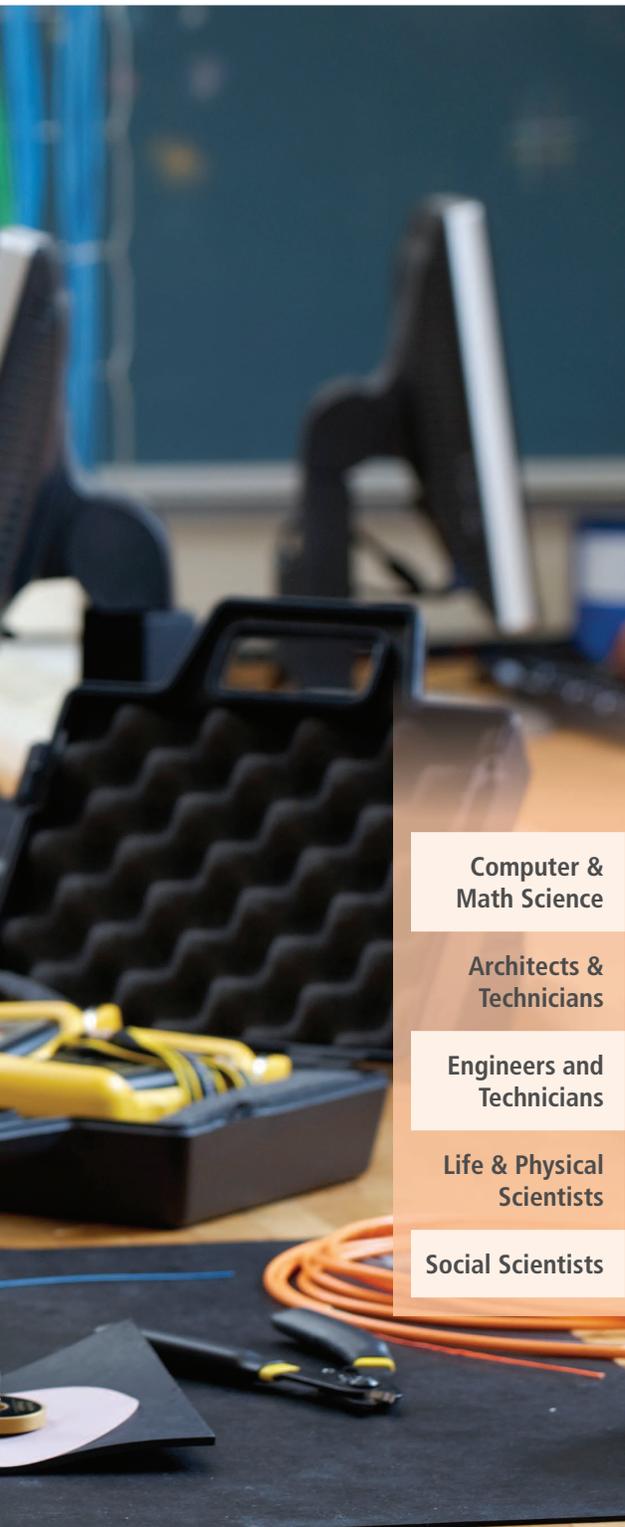
Many of the anticipated 25,000 new STEM jobs in West Virginia will require education that can be completed at Career and Technical Schools and Community Colleges. See *table below*. These colleges often offer more affordable tuition options. However, to get students interested in those programs, exposure to STEM careers at the middle grades is vital.



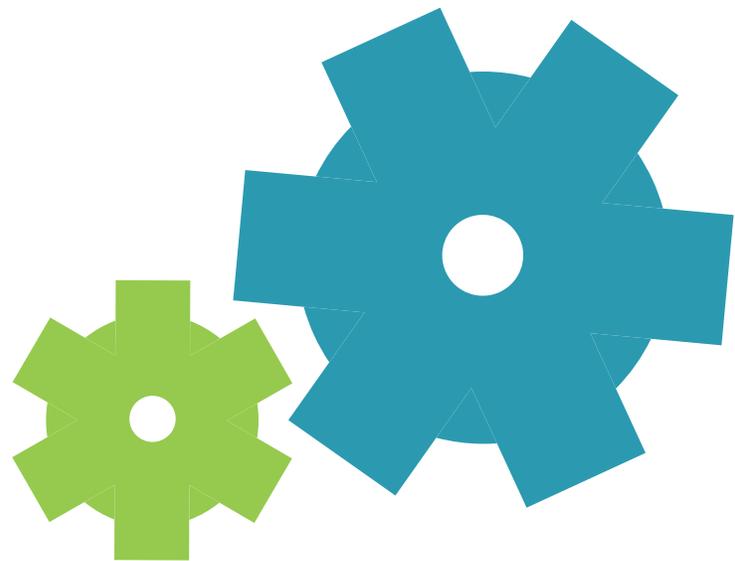
### 25,000 STEM Jobs in WV by 2018

	High School Dropouts	High School Graduates	Some College	Associate's Degree	Bachelor's Degree	Graduate Degree	Total
Computer & Math Science	0	1,000	2,000	1,000	4,000	1,000	9,000
Architects & Technicians	0	1,000	0	0	1,000	0	2,000
Engineers and Technicians	0	1,000	2,000	2,000	4,000	1,000	8,000
Life & Physical Scientists	0	1,000	1,000	1,000	2,000	1,000	6,000
Social Scientists	0	0	0	0	0	0	0

Source: [http://usinovation.org/state/pdf\\_cvd/CVD2014West Virginia.pdf](http://usinovation.org/state/pdf_cvd/CVD2014West Virginia.pdf)



Long-term growth and sustainability of STEM jobs in West Virginia will depend partly on the quality of STEM education in our state. It will also **rely heavily on the degree to which we can engage students, families and communities with interest in STEM education.** Unfortunately, we have much work to do in this area. ACT states in its report *The Condition of STEM — West Virginia 2013* that only 98 graduates had an expressed and measured interest in studying some form of computer science and programming beyond high school. This is in light of the fact that *Change the Equation* reports that there will be 1.4 million computing job openings nationwide by 2020, a 22% increase, and 9,000 of the 25,000 new jobs in West Virginia are projected to be in the *Computer and Math Science* category.



The lack of interest, and more importantly measured interest through the taking of advanced courses, in STEM fields is not limited to computer science. The table below illustrates the four major STEM areas examined in the ACT report.

Former President of the National Science Teachers Association, Francis Eberle insists that STEM education is essential to meet the need of future job markets. In 2010, he said the following:

In summary, West Virginia is at a crossroads. A blossoming economy and great economic opportunity is not being met with sufficient interest or educational preparation by students in STEM. **The WV Council on STEM recognizes the urgency for increased STEM education in West Virginia to meet future workforce demands and recommends the state take immediate action to address this critical need.**

**“STEM education creates critical thinkers, increases science literacy, and enables the next generation of innovators. Innovation leads to new products and processes that sustain our economy. This innovation and science literacy depends on a solid knowledge base in the STEM areas. It is clear that most jobs of the future will require a basic understanding of math and science.”**

See *Why STEM Education is Important*.



## 2013 West Virginia Graduates ACT Interest Inventory — The Condition of STEM

STEM Category	Expressed and Measured Interest	Expressed Interest Only
Science	310	516
Computer Science and Math	98	268
Medical and Health	1,331	1,529
Engineering and Technology	389	628

# Recommendations

Following extensive research and dialogue, The WV Council on STEM makes three strong recommendations:

1. Develop local capacity for STEM education across the state by establishing 3-5 Regional STEM Network HUBS.

2. Strengthen the public's awareness of STEM as a vital economic development advantage for quality job growth through an aggressive public engagement plan.

3. Establish a virtual STEM clearinghouse to review current STEM resources and assets across the state to ensure alignment and eliminate redundancy.

## 1. Establish Regional STEM Network HUBS

A Regional Network HUB serves as the nucleus of STEM activity within a geographic region. It represents a formal partnership among school districts, postsecondary institutions, STEM businesses, and community organizations. Regional Network HUBS have been established in several states as the cornerstone of their STEM initiatives. Iowa, Tennessee, Oregon, Washington all have established six HUBS and Ohio has seven. Due to the proven impact observed in the aforementioned states, **The WV Council on STEM recommends that approximately \$500,000 in annual funding be provided to establish 3-5 regional HUBS that will be part of a West Virginia STEM Network.**

The goal of a HUB is to amplify and accelerate the impact of existing STEM programs within a particular region. It is designed to support STEM programs and schools, increase the ability of existing STEM assets to generate regional impact, grow linkages between and support of existing STEM assets in a region, identify gaps in the system, and connect other STEM initiatives to that region's STEM efforts.

A Regional Network HUB can be affiliated with several different types of institutions: public/private organizations, foundations, or post-secondary institutions. In West Virginia, it is recommended that the host entity be determined by the regional stakeholders as part of their application proposal. The host entity offers support through a wide variety of services. For example, the institution may donate office space to house the administration of the HUB. It may offer professional development courses in STEM education, sponsor STEM camps, outreach programs, and dual credit courses for K-12 students. In the case of higher education, some of its faculty may serve in advisory roles for the HUB. Successful HUBS throughout the nation have strong involvement with both K-12 public education and postsecondary institutions from two-year and four-year colleges.

Although the type of HUBs affiliation is determined by regional

stakeholders, the impact and efficacy of the initiative is strongly correlated to the network approach of HUBS. As part of the state's Network, each regional HUB is required to meet a standard metrics of outcomes that is consistent regardless of the host entity. Some examples of these outcome measures include increasing the number of students that participate in meaningful STEM activities, and expanding the number of STEM internships provided by businesses. Through collaboration and competition among the HUBs, each region can both "import and export" successful strategies. The resulting network bolsters their individual and collective ability to affect change.

Business partnerships are essential to a Regional Network HUB. STEM related businesses serve to drive workforce development by advising K-20 educational systems as to what requisite skills graduates need. Moreover, they provide funding and work-based learning experiences for students and teachers. For example, the Tennessee STEM Innovation Network and its six HUBS have formed over 200 partnerships with STEM related businesses, such as Texas Instruments, Toyota, Eastman, and Biomimetic to name a few. These 200 plus businesses have provided over two million dollars in new funding to support STEM education in Tennessee. Moreover, they have allowed teachers to learn more about STEM businesses by sponsoring teacher externship programs during summer months. Each West Virginia Regional STEM HUB will be required to cultivate and support strategic business partnerships that enhance STEM education opportunities within their region.

Government organizations and non-profit groups provide a crucial role to the success of a HUB. For example, in Tennessee, the US Army Corps of Engineers, Oak Ridge National Laboratory, and the Tennessee Valley Authority are actively partnered with the Tennessee STEM Innovation Network and its six HUBS. They sponsor academic competitions, assist with STEM Expos, volunteer time and provide expertise through tutoring programs, guest lectures, and field trips. Likewise, West Virginia Regional STEM HUBs have a wide variety of organizations and

non-profit groups whose collaboration will be an essential component of any regional application.

Regional Network HUBS serve to develop strong STEM teachers and faculty. Services that are fostered by HUBS may include shared lesson plans, curriculum mapping, teacher externships with STEM businesses, STEM professional development, STEM leadership development for principals, stronger partnerships with postsecondary schools and exposure to new and emerging classroom technology. One successful example is a STEM HUB in Ohio where STEM Teaching Fellowships have been awarded and many teachers have been trained in STEM pedagogy. Additionally, the Upper Cumberland TN Rural STEM HUB has developed a 53-foot mobile STEM classroom that services 20 rural counties and provides technology to Pre-K-8th grade students. Furthermore, over \$138,000 in classroom mini-grants have been awarded to teachers within the Tri-Cities HUB of northeastern Tennessee.

The development of Regional Network HUBS and the coordinated and collective efforts of businesses, non-profit groups, and K-20 educational systems have proven to be fruitful endeavors. For example, 2013 statewide assessment results show that on average, students who participated in Iowa STEM Council programs ranked 10 percentage points higher in math and 8 percentage points higher in science, respectively in national percentile rank of achievement scores on Iowa Assessments (data source: Iowa Assessments, Iowa Testing Programs 2012-13). Moreover, Tennessee, Oregon, Washington and Iowa have experienced double-digit gains between 2011 and 2013 in student performance across all four tests of the National Assessment of Educational Progress (NAEP). Tennessee has shown the largest increase in student NAEP performance with a scale score growth of 21.80 points. These results have occurred since the establishment of coordinated STEM Network HUBS within each state.

Following the Regional STEM Network HUB model used in other states, Request for Proposals (RFP), key documents, templates, FAQs, and other documents deemed necessary will be made public on the website of a selected public relations managing partner within West Virginia. Prospective HUBS will have 30 days to complete a Letter of Intent. Informational sessions will be conducted within each prospective HUB region in which the assessment rubric will be distributed that will emphasize the importance of partnerships between various regional entities, and community buy-in through in-kind investments. Sixty to ninety days will be allotted for RFP submissions. The Governor's STEM Council will conduct scoring sessions via the aforementioned rubric. Regional Network HUBS will then be designated based upon the scoring results.

Each Regional Network HUB will have a director that reports to the statewide director. Funding for the regional directors will be allocated from a required 50% in-kind match from regional partners in the HUB application. The major responsibilities of HUB Directors will include the establishment and regular convening of a STEM Advisory Board within its geographic

region, and the carrying out of duties assigned to advance the goals of the WV Council on STEM. Such duties may include, but not be limited to the following (courtesy of the State of Iowa).

- Be the "voice" of and for STEM in meetings and venues within the Region and convene region-wide dialogs to build awareness, interest and shared beliefs in STEM-related activities and opportunities.
- Foster the involvement of businesses in the region to help advance STEM education.
- Inventory and lead discussions of regional gaps and needs and convene key groups and individuals to explore and develop initiatives to address those needs.
- Develop and address Regional STEM Goals through comprehensive Statements of Work and Action Plans based on data and deliverables.
- Measure and refine all STEM initiatives and goals regionally and contribute to a statewide STEM expansion process.
- Participate in the development, implementation, maintenance and promotion of a seamless and collaborative communication system with other West Virginia STEM Regions so that there is open and continuous sharing and development of resources, opportunities and promising practices, particularly those that span Regions.
- Create and maintain a comprehensive catalog and asset map of STEM activities and resources within the Region that can be shared and promoted.
- Oversee the implementation of programs at the community and regional level under direction from the WV Council on STEM.
- Help develop and staff a Regional Advisory Council made up of private and public STEM business representatives, non-profit STEM organization leaders, and officials from K-12 and post-secondary education to guide and promote the activities within this Region with guidance from the WV Council on STEM.







- Resource development to meet the WV Council on STEM goals for the Region, including sustainability activities.
- Utilize the Governor’s Workforce Planning Council data regarding the identification of trending jobs for the region and support STEM-related training/ education programs recommendations.

The establishment of Regional Network HUBS will allow for coordination and amplification of current STEM programs that are in place or being piloted in different locations of West Virginia. Some examples include: middle school robotics and gaming programs, STEM summer camps for girls, Maker festivals, and STEM-related apprenticeship programs. It will also allow for innovation so that each HUB will focus on specific goals that are unique to the resources of its region. Moreover, it will allow investments to be made on a local level through the input of local business, industry and education professionals.

## 2. Strengthen Public Awareness of STEM

West Virginia is projected to have 25,000 STEM job openings by 2018, many of which will be associated with the Marcellus Shale and potential Wood County cracker plant. Approximately 4,000 (16%) of those jobs can be filled by high school graduates. The remaining 21,000 positions (84%) will require some form of post-secondary education (<http://usinovation.org>). STEM education and workforce development is critical to filling the needs of our changing economy. However, much

of the public is unaware of the opportunities for STEM-related jobs and what kinds of skills they demand. Considering the urgency for 25,000 STEM skilled workers within the next 3-4 years, **The WV Council on STEM recommends that a full-scale public engagement campaign be launched at an annual cost of \$50,000 (with a required 50% local match) to increase the public’s awareness of STEM employment opportunities and educational requirements.**

From a workforce perspective, the forthcoming 25,000 STEM jobs can be classified into the categories of Computer Science and Math, Architects and Technicians, Engineers and Technicians, and Life and Physical Scientists. A broad-based STEM program would enable more West Virginia to take advantage of these and help fill the available vacancies with West Virginia workers. During the WV Council on STEM discussions, several state businesses reported that they had a number of STEM-related positions available, however, they were unable to fill these positions with West Virginia residents. This is unfortunately the norm not the exception.

The West Virginia Higher Education Policy Commission has recognized the trend and upcoming need for STEM graduates. It has indicated in its master plan that increasing the number of STEM degrees awarded annually is a top priority. Consequently, Vision 2015 was enacted to increase the number of bachelor and PhD level STEM programs statewide. In 2014, the number of students who began in a STEM related degree areas increased from 7,700 to 11,000. And, the number of students who completed a degree in a STEM related area increased from 1,100 to 2,200. This is a positive step. However, retention of

students in STEM degree areas is critical to meeting present and future job demands.

Following the model used in Iowa, it is recommended that the state partner with a reputable public relations company to develop a public message that consists of a few, clear components that will be reiterated over an extended time period in the public engagement campaign. From there, the following public engagement strategies that were employed in Iowa could be employed in West Virginia as well.

- Images of students doing STEM activities
- Regular updates about STEM job opportunities
- Statewide STEM activity events at community centers
- Statewide STEM website with links to each Regional HUB
- Public awareness campaign similar to text-free driving campaign
- Radio and television public service announcements
- Combination of traditional and social media

The WV Council on STEM recognizes that consistent, coherent messaging leads to sustainability. Contracting with a reputable public relations firm is encouraged because it will have greater contact with the media, and investment in quality media coverage is invaluable. Utilizing earned media opportunities is also a helpful strategy. Iowa's Governor promoted their STEM initiative at every function he attended. Additionally, social media is employed by most states (Iowa, Ohio, Tennessee, and Washington) in their messaging campaigns. Iowa's STEM initiative is present and continually updated on Facebook, Twitter, Instagram, YouTube, and LinkedIn. This strategy is also recommended in West Virginia. Finally, officials from Iowa cautioned against linking the STEM initiative to a State agency already in place. They suggested keeping STEM separate and neutral by appointing a STEM lead in the state to network with STEM leads from other states. The WV Council on STEM recommends this approach.

### 3. Establish a STEM Clearinghouse to Develop and Align STEM Resources

STEM assets refer to STEM activities or programs connected to public K-12 school districts, post-secondary institutions, and STEM related businesses and non-profits. Great things are happening throughout the State of West Virginia. However, the assets are often fragmented and isolated to certain parts of the state. **The WV Council on STEM recommends that a STEM clearinghouse be established to review current STEM resources and assets across the state to**

### **ensure alignment, promote efficiency and eliminate redundancy.**

How would the Clearinghouse benefit West Virginia students? One example can be found in the many eastern panhandle schools that participate heavily in the Intel International Science and Engineering Fair. Local support and diligent coordination allow hundreds of students to participate and exhibit their projects locally with a few travelling to the international fair each year. This is the exception not the norm. Science fairs are almost non-existent in other parts of West Virginia. The Regional Network HUBS would provide a platform for collecting and coordinating information for the STEM Clearinghouse regarding regional STEM activities and programs. The data from the regions could be aggregated to a state level for a "one-stop-shop" for parents, students, employers and other STEM providers. In the example of Science Fairs, by collecting and highlighting information about science fairs, the clearinghouse would serve to get students and teachers much needed resources to implement regional fairs, which would ultimately grow and improve the West Virginia State Science Fair.

The availability of regional businesses to partner with schools for job-shadowing, internships, and externships is another resource that currently lacks coordination and often is left to individual educators or individual businesses to facilitate. Several examples of these types of partnerships can be found across the state. For example, Appalachian Power Company's Eco-Stewards program is being piloted within several high schools in Kanawha and Putnam counties. Moreover, workshops are in the planning phase for the West Virginia Department of Environmental Protection to train teachers on their Project WET program. Furthermore, Dow Chemical is beginning its statewide You Be the Chemist (YBTC) Challenge this spring at middle schools. However, this is not true in other parts of West Virginia where lines of communication are non-existent between school systems and STEM businesses. The establishment of a clearinghouse approach to STEM activities and programs within the Regional Network HUBS would provide a much needed interface between K-12 school systems and STEM businesses/ government agencies that promote STEM initiatives.

The projected increase in STEM jobs in West Virginia should precipitate the need for additional STEM instruction within K-12 schools. Many instructors, especially at the elementary level lack confidence in their ability to implement STEM lessons. Their uneasiness often causes them to resort back to what is comfortable. Therefore, STEM programs do not flourish as they could. The establishment of a clearinghouse of STEM professional development opportunities would enhance communication between post-secondary institutions within each region and provide incentives for stronger partnering with K-12 school systems to offer professional development and/or STEM certifications to teachers. A knowledgeable and confident teaching force is essential for STEM education to succeed in West Virginia.

Community members could learn about these programs

via a drop-down menu and examine them more closely via a hyperlink to a website. Many programs and services are currently provided that parents and students are unaware of or are confused about. One such example is The Southern Regional Education Board's Advanced Careers program. These high-level programs are being offered in select Career and Technical Centers throughout West Virginia. However, enrollment is low primarily because the message about these programs has not fully reached its intended audience. The establishment of a STEM Clearinghouse could serve to bring high schools and Career Technical Education (CTE) Centers closer together and allow for the alignment of curriculum for embedded credit, planning of master schedules to allow for higher student enrollment, and the projection of a coordinated message that

Advanced Careers and other CTE programs are viable and beneficial for all students.

The STEM clearinghouse would also provide regional and state level review of current programs to enhance alignment and development as well as to reduce inefficiencies or eliminate programs that lack a strong research base. This alignment will provide a myriad of benefits including more efficient coordination of services, better communication between STEM businesses and K-12 school systems, increased professional development and licensure opportunities for teachers. Ultimately, the clearinghouse would enhance collaboration and communication in the current pipeline of STEM education across K-12, Community-Technical Colleges and Higher Education institutions across the state.

**In conclusion, this report highlights the benefits of increased STEM education and programs in West Virginia to meet the state's current and future workforce demands. The specific recommendations include developing local capacity for STEM education and programs across the state by establishing 3-5 Regional STEM Network HUBS; strengthening the public's awareness of STEM as a vital economic development advantage for quality job growth; and establishing a virtual STEM clearinghouse to review current STEM resources and assets across the state. Today, the presence of technology in the workplace and the need for critical thinkers is pervasive. Therefore, the Council recommends the state take action to address this reality and ensure that West Virginia is well-prepared for the future with a STEM-skilled citizenry and labor force.**

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