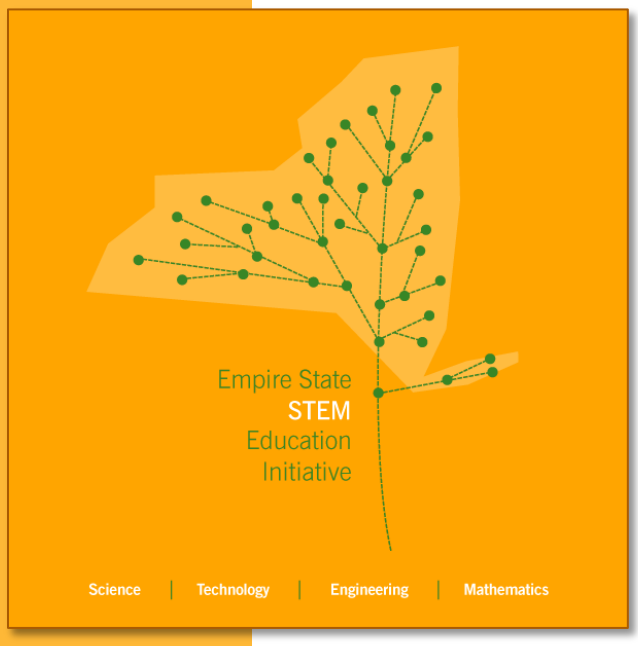
Ethnographic Analysis of the 2009 Empire State STEM Initiative Progressive Dialogues:



Engaging Communities in a 21st Century Approach to Learning in New York State

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Foreword

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The PAST Foundation and the Empire State STEM Education Initiative are proud partners working collaboratively toward transforming New York education through STEM teaching and learning to attain 21st century skills and a new look in public/private educational partnerships. The work presented in this study has the primary aim of empowering community, regional and state decision makers across the realms of government, business, community organizations, labor, and higher education, as well as both formal and informal K-12 educators, parents and students with valuable information and insights on current and potential shifts in New York State education.

Over the past year, the Empire State STEM Education Initiative (ESSEI) has engaged partners across the state in a *Progressive Dialogue*, intended to touch as many regions as possible and strategically collect information regarding available resources, regional perceptions and recommendations for transforming education in New York State. The response was both overwhelming and gratifying, reflecting a universal commitment to overall education reform from the 'cradle to the grave' for New Yorkers. The information in this report coalesces opinions and recommendations into pathways derived from diverse voices from across the state.

In this project, PAST partnered with faculty, staff and graduate students from Rensselaer Polytechnic Institute, University at Albany, Dowling University, University of Rochester, Syracuse University, University of Buffalo, and the City University of New York to document the *Progressive Dialogues* conducted in summer and fall of 2009. PAST ethnographers and the team of graduate students assembled for this effort were committed to ensuring that the broad range of voices present at the *Dialogues* were documented and included in this report. The *Dialogue* process is an efficient and effective tool that allowed the teams to capture local knowledge and perceptions about public education across the diverse regions of New York. The stepped process of producing short reports for each region, followed by a full report of the entire set of dialogues enabled the STEM Initiative team to provide real time feedback to decision makers and other stakeholders who participated in the regional dialogues.

In less than a single year, over the course of nine dialogues yielding a wealth of contributions by more than five hundred participants, this report distills common themes and perceptions as well as unique regional characteristics which can be used as powerful tools in shaping and managing the transformation of education in New York State.

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1. Introduction

Introduction: Progressive Dialogue on Advancing Education in Science, Technology, Engineering and Math (STEM)

During June to December 2009, the PAST Foundation participated in a *Progressive Dialogue* led by the Rensselaer Polytechnic Institute to support a process designed to identify ways to advance PK-20 science, technology, engineering and mathematics (STEM) education in New York State. The *Progressive Dialogue* included an *Inaugural Dialogue*, held in June 2009, followed by eight *Regional Dialogues* conducted during October to December throughout the state.

This report presents ethnographic analysis of the issues explored in the *Progressive Dialogue Breakout Group* "brainstorming" sessions that were conducted during the *Inaugural Dialogue* and eight regional meetings. Over (500) participants engaged in (60) breakout group sessions, in a structured process designed to consider ways to improve education in science, technology, engineering and mathematics (STEM).

The ethnographic analysis resulted in identifying 2100 data points that document the knowledge and information contributed by the individuals who engaged in the *Progressive Dialogue*. The research findings also present a view of regional differences and common issues, as well as challenges facing educators and those who have a stake in reforming education in New York State.

2. Ethnographic Knowledge Capture

Ethnographic Knowledge Capture

The PAST Foundation's *Knowledge Capture (KC) Program* is designed to support planning and implementation processes within learning communities, as well as to provide structured analysis of stakeholder and other community actions focused on PK-20 education. The *KC* research process is a collaborative undertaking that engages directly with diverse members of the community through ethnographic methods to systematically document planning and implementation of programs, projects, and other types of activities that require broad and diverse participation within educational settings.

The *Progressive Dialogues* provided the opportunity for PAST to join with others including Rensselaer, the TIES organization, and leaders in education in New York State to conduct an information gathering process to help define educational issues in the state, and to gain cultural insights on how those issues differ across the regions. *Progressive Dialogue* participants included members of K-12 education, higher education, state and local government agencies and programs, parents, community-based non-profit organizations, teacher unions and associations, STEM-related professional associations, and business.

To achieve this perspective on the *Progressive Dialogues*, PAST utilized ethnographic methodology to systematically record the process, gaining detailed documentation of the ideas and issues identified by participants, focusing on potentially innovative views and strategies that may provide the essential elements of future actions. An important component of this process is the development of an anonymous record that captures specific ideas and regionally grounded perspectives, without linking these to any single individual. This allows participants to engage freely in critical dialogue on the issues, problems, gaps, and strategies that potentially respond to the issues.

The PAST research team includes anthropologists who have worked in educational settings throughout the country collecting data, studying underlying systems, and providing real time data to clients. Eight regional teams were assembled for the *Progressive Dialogue Project*, consisting of a PAST lead anthropologist, working with a group of 6-8 anthropology or education graduate students from each of the eight regions who have familiarity with the local community setting and training in ethnographic methods. The regional ethnographic teams, who were assigned to conduct ethnographic note taking for each breakout group discussion session, produced the primary data derived from this effort.

Ethnographic reporting to the *Progressive Dialogue Project* includes three categories: 1) *Bullet Point Reports* were issued for the *Inaugural Dialogue* and

for each of the eight regions following the conclusion of the *Dialogue* in that region; 2) initial development of major topics and sub-themes were developed and reviewed with the *Progressive Dialogue Project* team throughout the series of *Dialogues,* providing mid-project input to the structure of the meetings; and, 3) a *Final Report* presenting breakout data point analysis including figures illustrating major topical categories, as well as exploration of major themes that can inform future efforts.

The *Bullet Point Reports* were developed from analysis of the ethnographic notes from each of the sessions. These notes were analyzed and compiled in a format that was designed to provide brief but informative summary reports for *Progressive Dialogue* participants. This process generated approximately (2100) *breakout data points* across all eight regions representing key perspectives and strategies for action on STEM education for New York State. The *Bullet Point Reports* were circulated to regional participants for comment as part of the information provided through the *Progressive Dialogue Updates* distributed within each region.

Analysis of the *Dialogue* breakout sessions was initiated early in the project to assess major topic areas identified by *Progressive Dialogue* participants, and provided the organizational framework for ethnographic analysis that evolved as the *Dialogue* series was being conducted. Nine topical categories were identified and were incorporated into the *Dialogue* framework. Through this process we had the opportunity to gain feedback from both the *Progressive Dialogue Project* team, as well as the *Dialogue* participants of each region.

In the sections of this report that follow, a brief summary overview of the nine topical categories identified during the *Progressive Dialogue* process is presented in *Section 3*, followed by further analysis of the major themes and regional differences on common issues identified through the *Progressive Dialogue* process (*Sections 4-8*). *Appendix A* of this report presents Tables A-F, which provide breakout data points in full detail by region and are referenced throughout this report. *Appendix B* presents a set of three tables that provide detailed lists of proposed actions that are of national, state, and regional significance.

3. Summary of Regional Findings

Summary of Regional Findings

Issues discussed across all eight regions were organized into nine topical categories for initial ethnographic analysis:

1) Federal and State Policy, Regulations and Standards
2) Models/Strategies for Action (STEM implementation)
3) Regional Issues and Local School Districts
4) Teachers: Training and Professional Development
5) Student Needs and Potential Engagement in STEM Education
6) Partnering: Learning Community Stakeholders
7) Curriculum and Instruction
8) Assessment (Measurement)
9) Access to Tech Resources

Figures 1-8 present these categories by region. Percentages shown for each category are based on the total number of breakout data points for that region (see the *Bullet Point Report* for complete lists of breakout data points for each region). For example, in the Buffalo region *(Figure 1),* the top three issues addressed indicate that the Buffalo groups were most interested in identifying

Figure 1. Buffalo

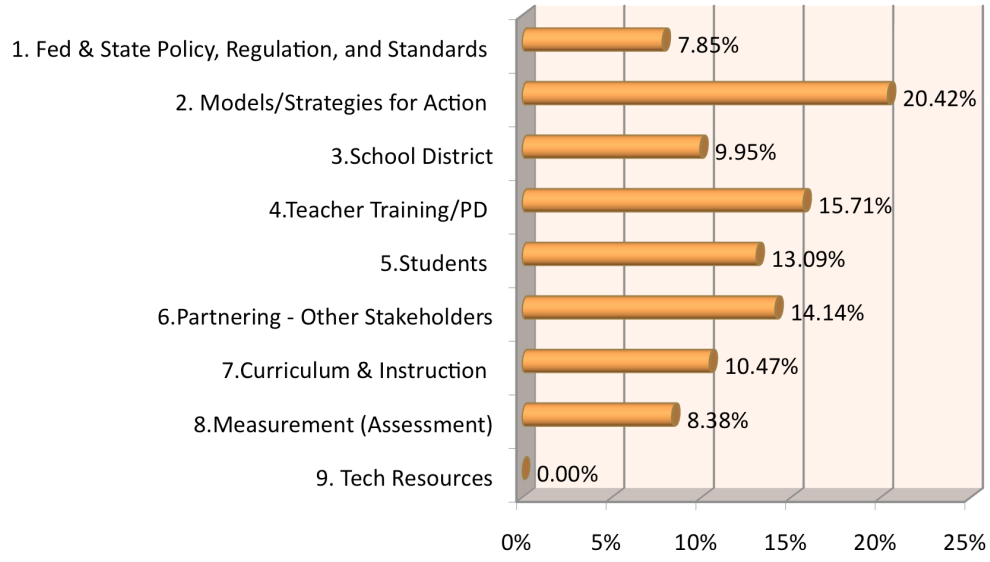

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Figure 2. Capital Region

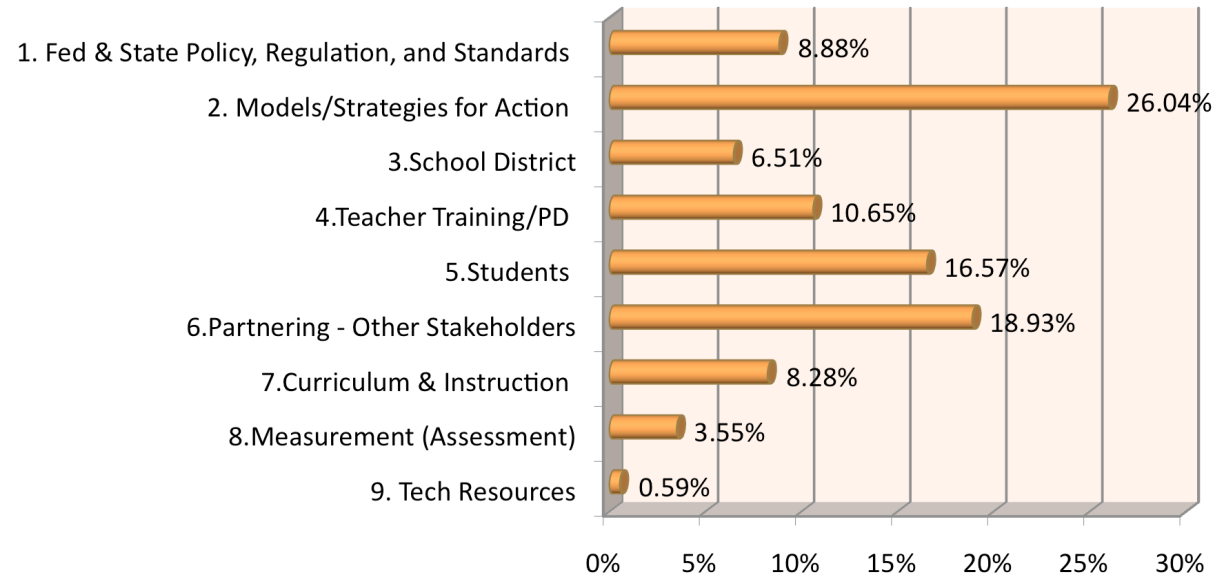

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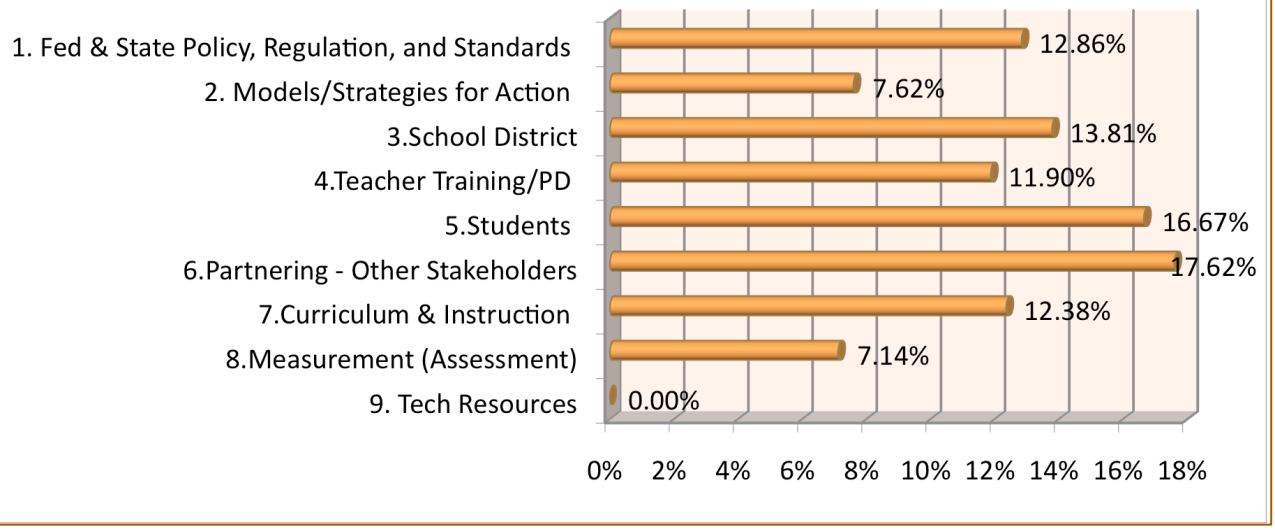
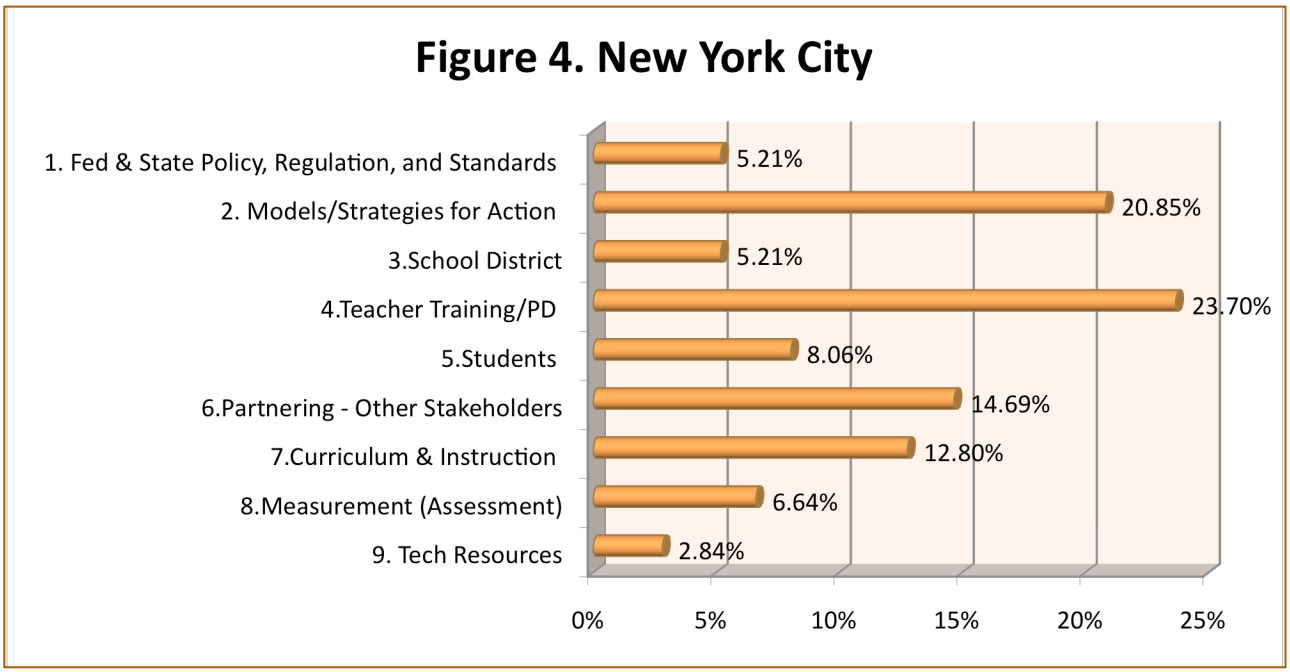
Figure 3. Long Island





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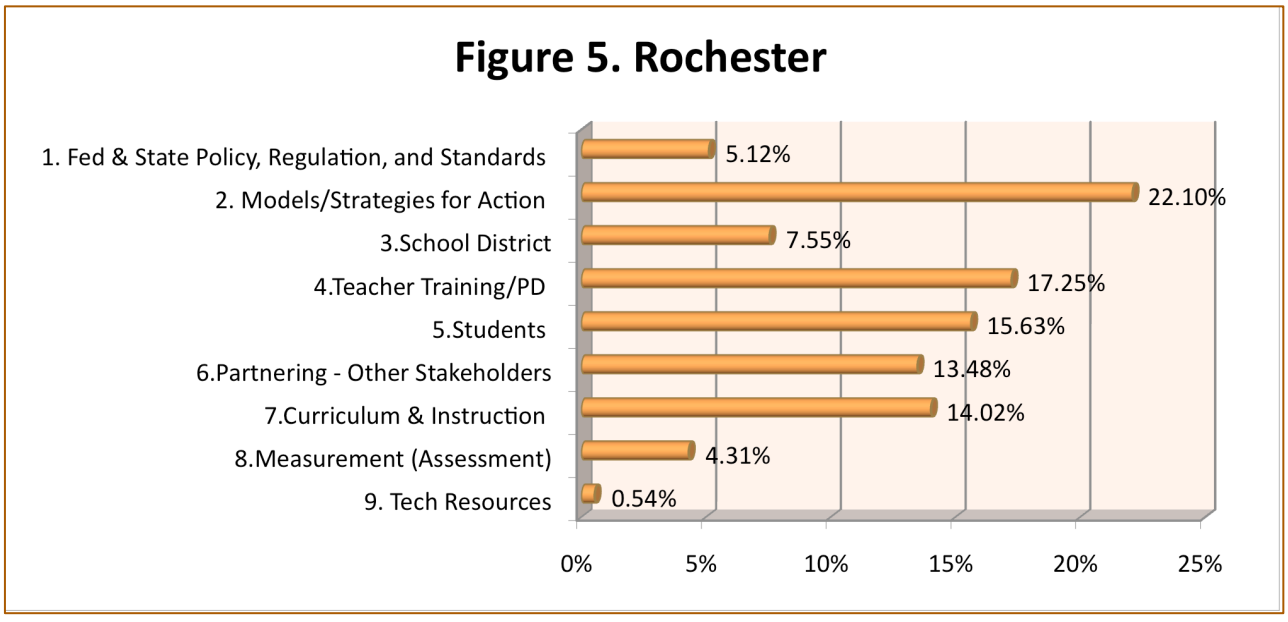

Figure 6. Southern Tier

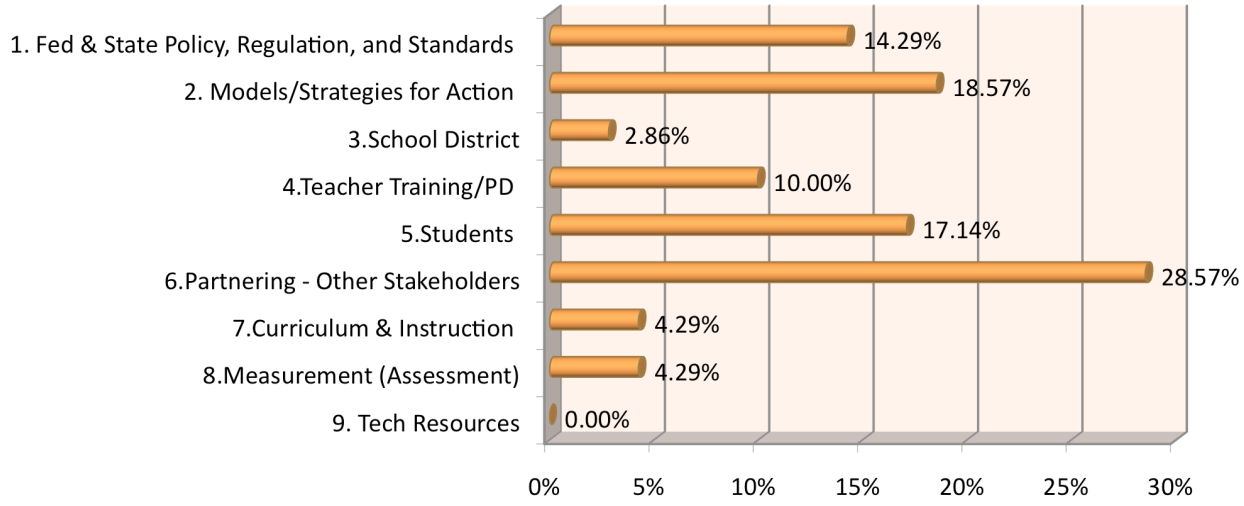

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Figure 7. Syracuse

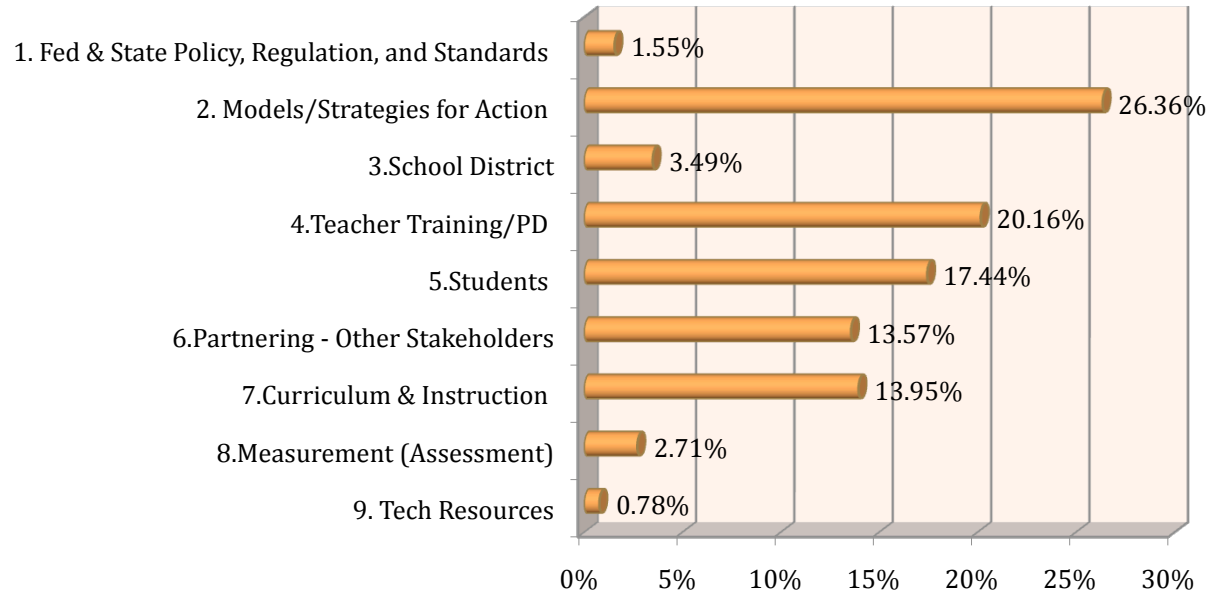
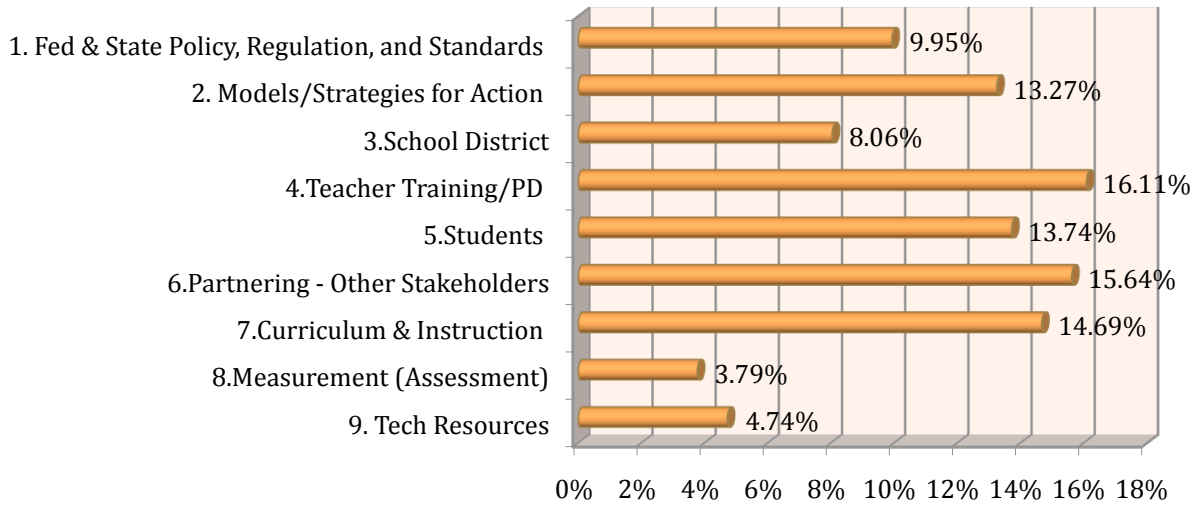


Figure 8. Yonkers



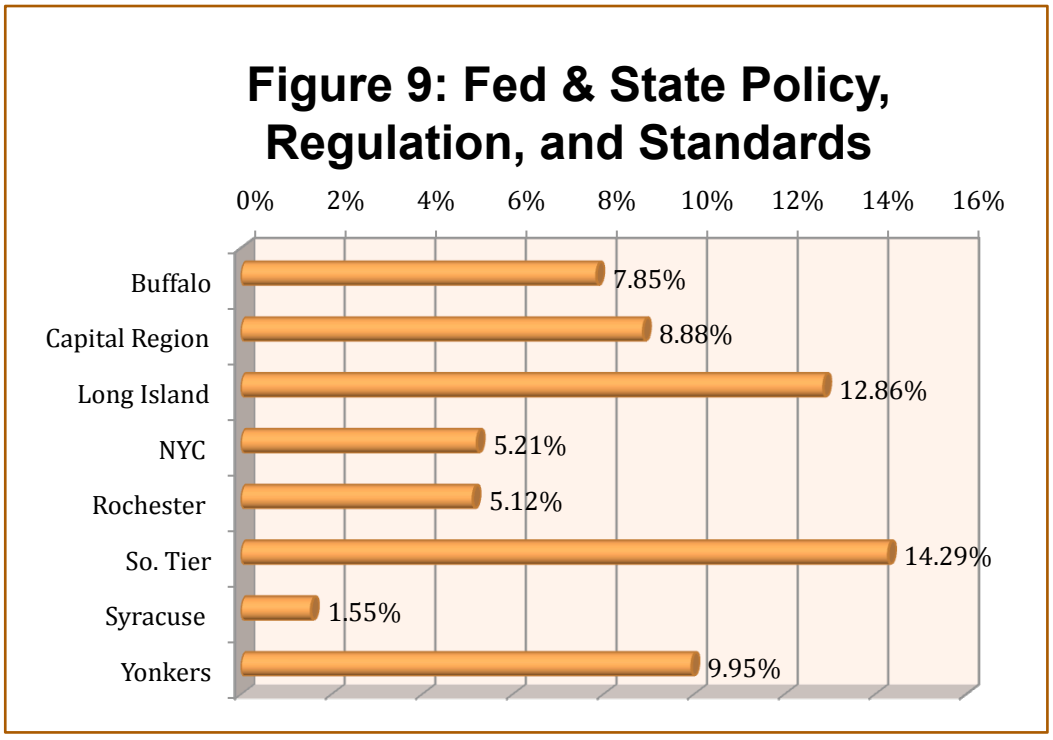
"Model Programs and Proposed Strategies for Action," followed by issues related to "Teacher Training and Professional Development," and "Partnering."

Figures 9-17 present a comparison of each of the nine categories across the regions. Percentages shown are based upon the total number of breakout data points for that category across all regions. For example, in *Figure 9: Policy*, we see that Long Island (13% of data points) and the Southern Tier Region (14% of data points) were the two regions that ranked highest in their interest in policy actions that could potentially implement the state's STEM Initiative.

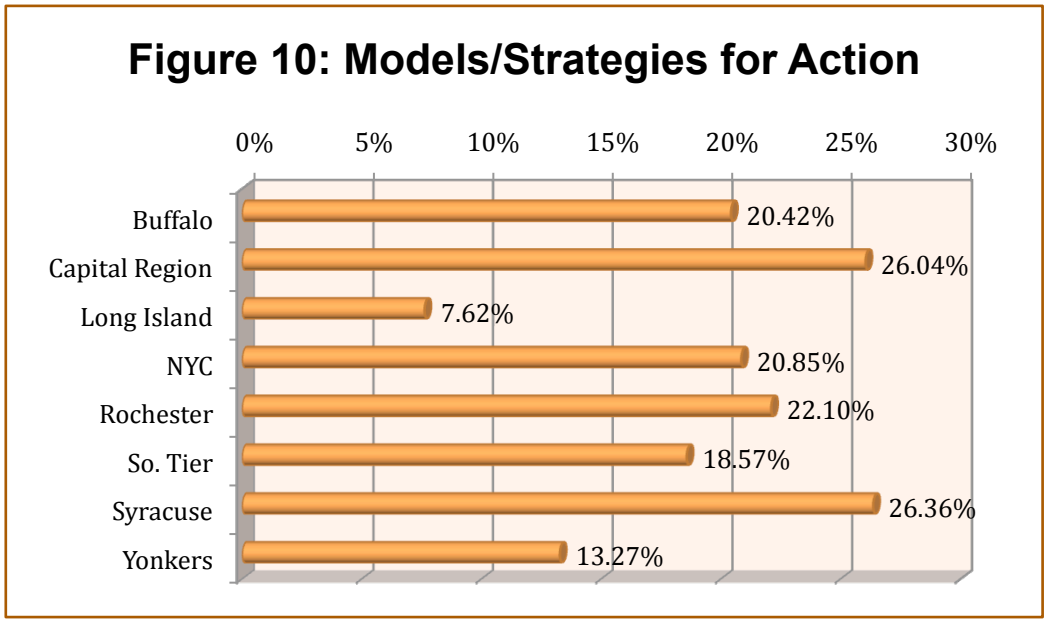
Across the regions, the top three categories discussed were:

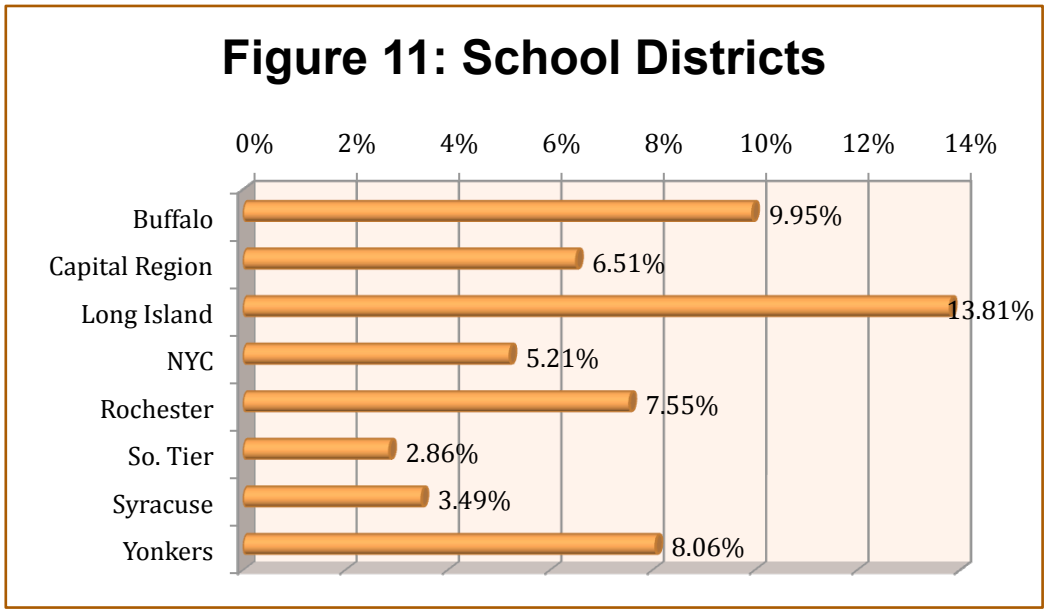
1) *Models and Strategies for Action (Figure 10)* with six of the eight groups ranging from 19% to 26% of total data points;
2) *Initiate New Forms of Partnering and STEM Network Development (Figure 14)*, ranging from 13% to 29% of total data points across all eight regions; and,
3) *Develop STEM Teacher Training and Professional Development (Figure 12),* ranging from 10% to 24% of total data points across all eight regions.

The leading issue across all regions presented in *Figure 10: Models and Strategies for Action* shows that the regional participants effectively responded to the structure and purpose of the *Progressive Dialogues*. This included presentations on STEM goals and program development from various perspectives from within the state as well as from outside the state, followed by small group discussions in the form of breakout groups. Additionally, breakout sessions were focused on a set of questions designed to stimulate ideas considered innovative for the region to implement



Figures 9-17 present a comparison of each of the breakout data categories across the eight regions. Percentages shown are based upon the total number of breakout data points for that category across all regions.





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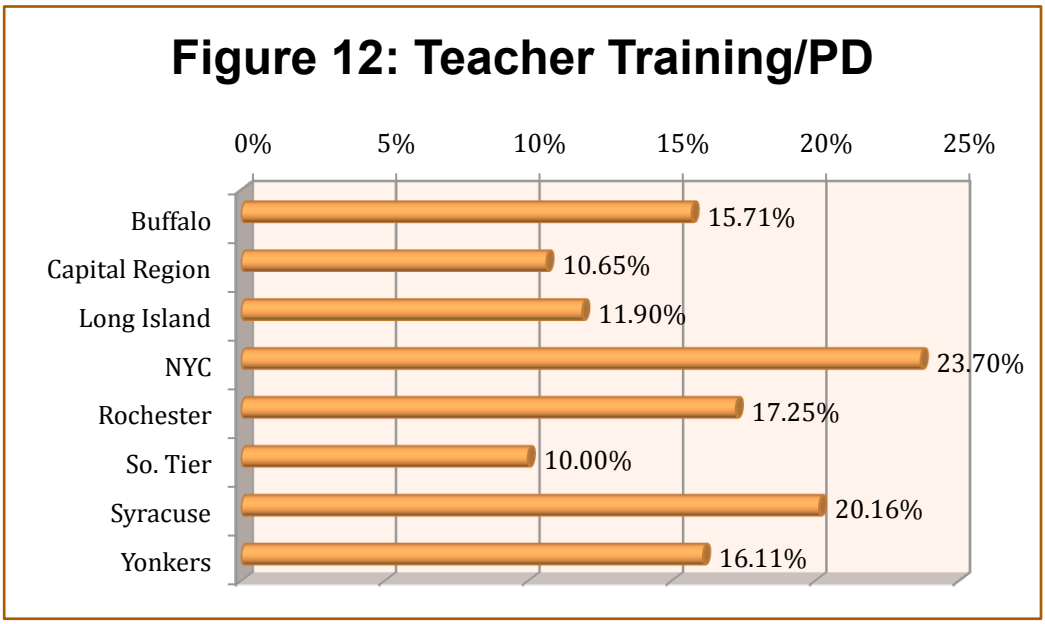

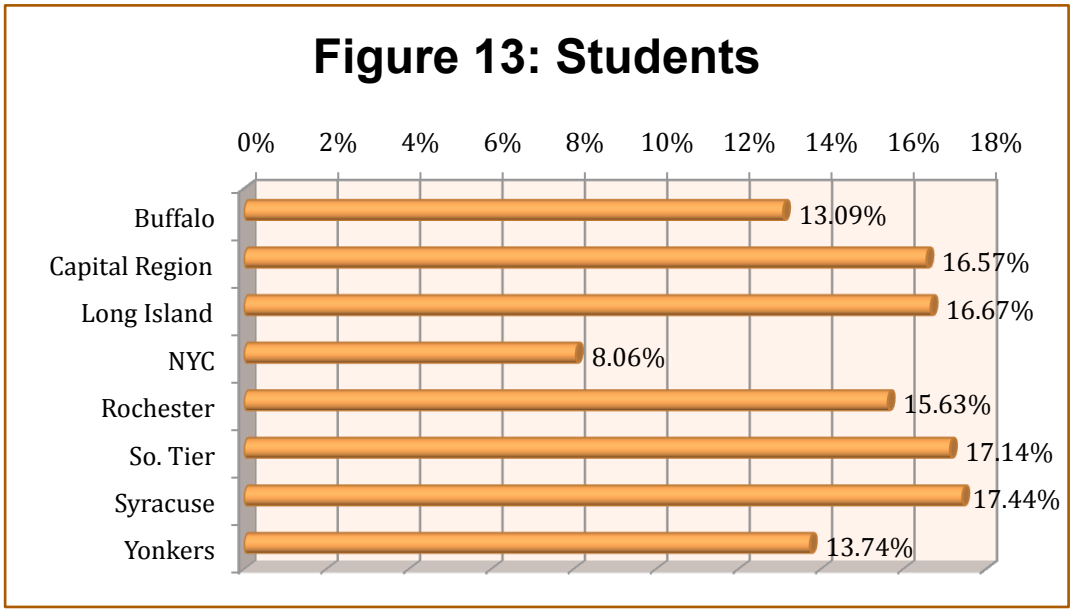

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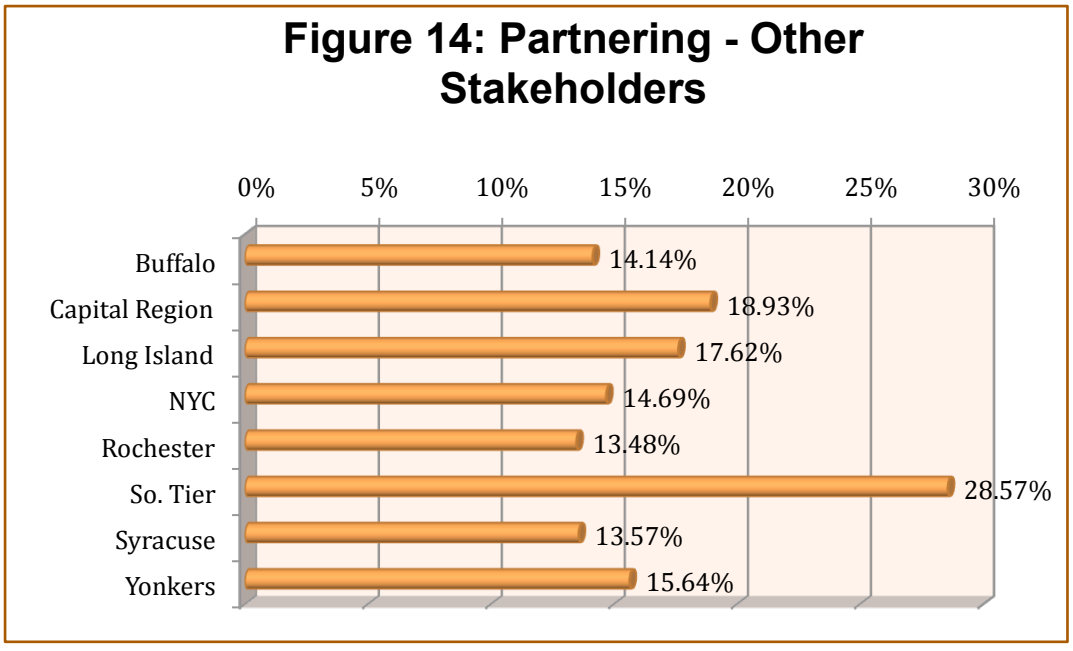
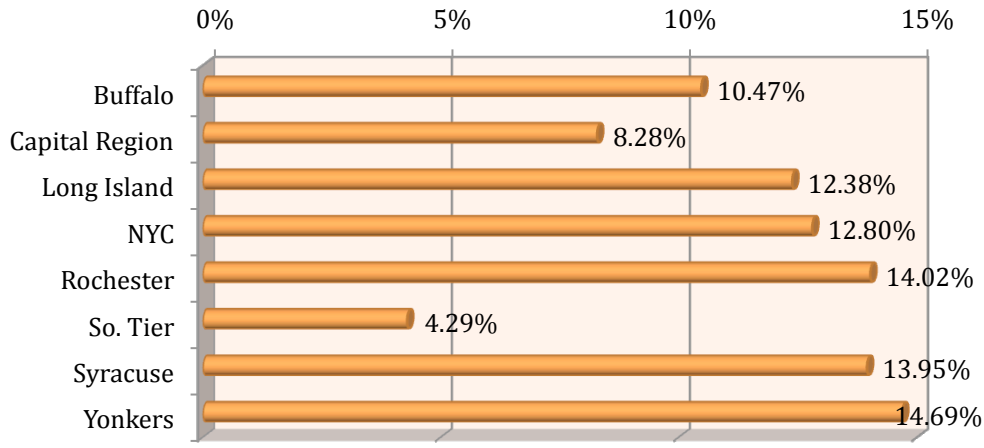
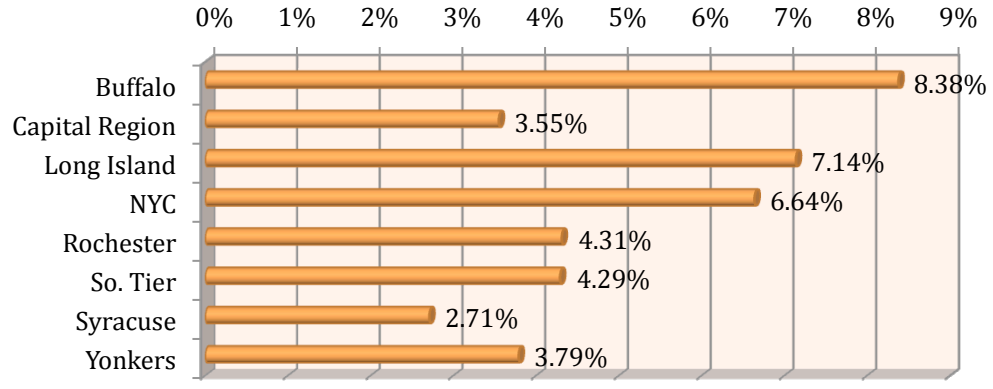


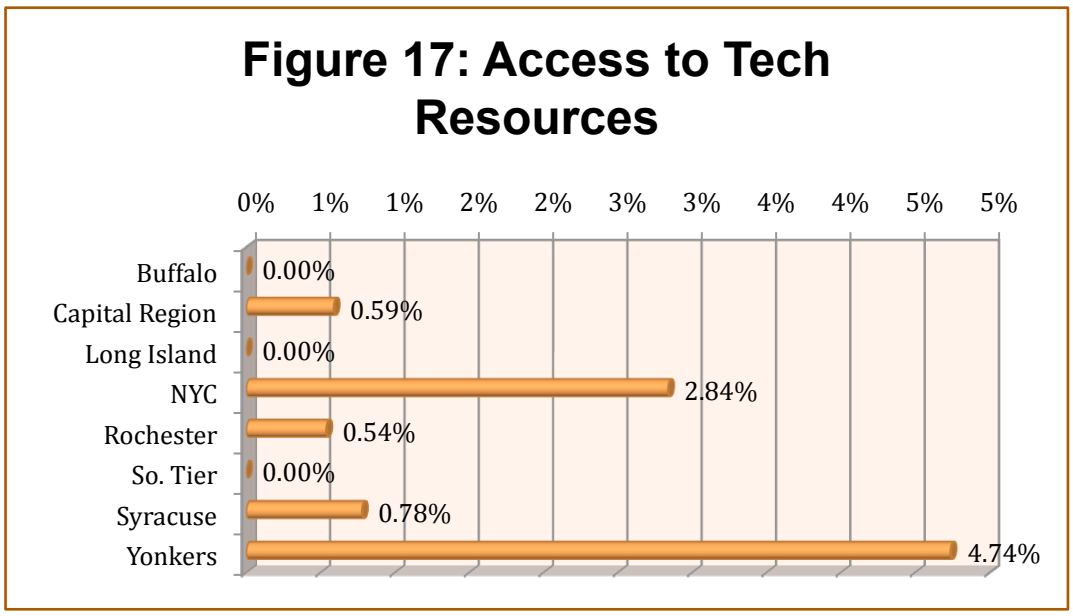
Figure 15: Curriculum & Instruction



Figures 9-17 present a comparison of each of the breakout data categories across the eight regions. Percentages shown are based upon the total number of breakout data points for that category across all regions.

Figure 16: Measurement (Assessment)





STEM Initiative goals. *Figure 10* shows that among four of the eight regions, identifying models and new strategies for action was the number one area of discussion (Buffalo, Capital Region, Rochester, and Syracuse), and was the second highest issue of interest in the Southern Tier Region and in New York City.

The next topic of interest, formation of new partnering relations and development of STEM program networks *(Figure 14),* ranged from 13% to 19% for seven of the eight regions. The eighth region, Southern Tier, lead with an interest level of nearly 29%. The spread here suggests that there is a high interest in exploring partnering and new ways to connect schools with community resources and funding support for STEM program development across all the regions. Note that the high of 29% for the Southern Tier Region most likely reflects the fact that this area may be more ready for STEM network development as there has been significant steps taken toward establishing a broad-based plan for action, with strong leadership from the Corning Corporation. The high level of regional interest in formation of partnerships and network engagement with community stakeholders suggests that once a plan for action is clearly laid out, and leadership defined, there can be rapid acceptance and buy-in as stakeholders are brought into the process. These issues will be discussed further in *Section 8* of this report, *Future Steps to Support STEM Implementation in New York State.*

Issues associated with *STEM Teacher Training/Professional Development (Figure 12)* were next as a topic of discussion with an associated set of concerns related to the status quo in teacher training and professional development standards. The range here of 10% to 24% was led by New York City at 24%, followed by Syracuse at 20%. These issues also touch on changes that will require engaging with the higher education community and ideas to develop STEM teacher certification requirements, as well as engaging with business and industry to restructure these programs and grow the pool of certified STEM instructors. These issues will be discussed further in the following

section, *Defining the Status Quo in Education in New York State: Cultural Principles and Expectations.* Related policy issues and aspects of network development presented later in this report will also consider important dimensions of preparing teachers for STEM programs.

"The current classroom learning model has been in place since the 1880s, and the current system for teaching math and science has not changed significantly since the 1960s."

The two topics of the nine categories discussed across the regions that ranked the lowest in percentage of breakout data points were, *Development of STEM Assessment (Figure 16)* and *Access to Tech Resources (Figure 17).* The former, *STEM Assessment*, ranged from 3% to 8% of total data points. When considered in relation to *Development of STEM Curriculum and Instruction (Figure 15)*, where we see five of the eight regions ranging from 12% to 15%, it is likely that this difference is consistent with expressed frustration with current testing practices that were frequently characterized as forcing teachers to "teach to the test" (K47C, K90C, K14Y, K59Y, K25A, K84R). The higher rating for curriculum development may not indicate a lack of concern about STEM assessments, but instead may signal that the priority is to develop the instructional approach and materials to meet STEM education goals, followed by design of the assessment as a way to step away from the current situation, often described in the *Progressive Dialogues* as "assessments driving curriculum" (K76N).

Access to Tech Resources (Figure 17), while distinctly ranging at the lowest level of breakout session interest, nevertheless is an important topic which reflects issues related to equity of access, and differences among urban, suburban, and rural school districts and the urgency of action in what was referred to as, "leveling the playing field" (H13A). Note that the only two regions that addressed this issue were also the last two in the series of regional summits, and both face major challenges associated with urban school districts. This included New York City (3%) and Yonkers (5%).

These regional differences will be explored further in the following sections of this report that address key themes and specific aspects of implementing STEM education as characterized in the *Progressive Dialogues*. These themes include a view of the current perceptions on problems and associated challenges and potential actions to implement STEM education *(Section 4),* policy development necessary to support STEM education requirements *(Section 5),* and potentially innovative actions that can strengthen both regional level and statewide program development *(Section 6).* In the final section of this report, we explore issues and ideas expressed by *Progressive Dialogue* participants that concern network and public/private partnership development *(Section 7),* as well as present a brief set of recommended actions to consider for future efforts in New York State *(Section 8).*

4. Defining the Status Quo in Education in New York State

Defining the Status Quo in Education in New York State: Cultural Principles and Expectations

Progressive Dialogue participants were asked to consider how to best implement STEM education from their individual perspectives, representing both their knowledge and experience in their respective professions, as well as considering their institutional missions, goals for the future, and available resources. *Progressive Dialogue* participants included members of K-12 education, higher education, state and local government, parents, community-based non-profit organizations, teacher unions and associations, STEM-related professional associations, and business. Initiating a dialogue across the diverse perspectives of *Dialogue* participants was intended both to help build a robust and highly informed context in which to focus on STEM education, as well as to explore a wide range of views on "innovative" actions, best strategies and resources available to support STEM implementation.

Each breakout group went through a process to define the relevant issues, which then became the focus of strategy development, including identifying resources and models for action within the region, as well as within and outside the state. In this section, we review the major themes and issues identified as essential aspects of the current situation in the K-12 system across New York State, and also present a set of ideas that were proposed across the regions as a way to implement systematic change in education that are consistent with the STEM Initiative for the state.

Reference citations that appear as a letter/number/letter code (e.g., L55Y) refer to data sets that were developed for this report. The first letter is the data set title, the number is the specific data point in the "L" set, and the last letter refers to the region, in this case, Yonkers. Data sets A-F are presented in *Tables A-F* in *Appendix A* of this report. Data Sets G-W include specific breakout data sub-themes associated with the nine categories presented in Section 3 of this report, (e.g., "students," "teachers," etc.), and are not included in this report. The full set of breakout data points organized by category are presented in the *Bullet Point Report* for each region and are available upon request.

4.1 Student and Parent Understanding of STEM Education and Career Pathways

The general premise of the breakout discussion was designed to consider STEM as a new paradigm for public education. Goals associated with a STEM approach include program development through a broad-based effort to address student needs in the context of the 21st century and workforce skills essential to support economic growth. Some participants noted that the current classroom learning model has been in place since the 1880s (A136C,

K35L), and one region noted that the current system for teaching math and science has not changed significantly since the 1960s (K49C).

"Many parents convey to their children that math and science are too hard and do not hold expectations that their children can master these subjects."

A primary issue identified by groups across the regions includes new ideas about the importance of involving students and parents directly in crafting the new 21st century classroom and approach to learning (I8Y, I14R, I27N, H37N). However, the challenges to engaging students and parents more fully in designing and implementing STEM education also touch on fundamental issues embedded culturally within the school and its community and a lack of awareness on the importance of STEM education (I25N) and national priorities to achieve sweeping changes in education (I30R). Addressing these challenges will require a coordinated set of actions to advance new perspectives on STEM education, as well as to effect a shift in career expectations held by students, families, and the community as a whole (I5C, I11A, I15R).

Student interest in STEM disciplines, and therefore, in STEM career pathways has not kept pace with their interest and active engagement with technology outside of the classroom (W12L). This disconnect is believed to have several aspects that were characterized both in terms of the lack of real world connections with the classroom learning experience (K7L, K33L, K42R), and in terms of the family's capacity to guide students to pursue the study of science, technology, engineering and math (I3Y, I10B, I15R). The idea that math and science are "hard" and only for "smart" students is one that is shared by parents, as well as teachers and others in the K-12 setting, including guidance counselors (H8B, T13C, T14S, T17Y). Yet, each plays a role in influencing students in what they think is "cool" about learning and education, as well as in perpetuating old stereotypes that are no longer valid in today's high tech global economy.

Considering the importance of role models for students touches on the fact that as primary role models (I6S, I17R, I20S, K5A), many parents convey to their children that math and science are too hard and do not hold expectations that their children can master these subjects (I9B), nor do they believe that these are important to their child's future (J20S). This may in part be due to the fact that in some cases the parents did not enjoy school as students or because they are not interested in math or science themselves (I23Y).

Another factor impacting students across many of the regions derives from the lack of exposure to other adults who are passionate about math and science (IBL, H30N). One region noted that where parents cannot engage with a student's academic life, teachers and others in the school system must be able to fill the gap (H16R, H33R, I18R). During the K-6 years, students are primarily influenced by elementary school teachers, many of whom lack training in these areas (A57R, A72Y, A63Y, A74N, A85N, L15B, L27L, L85S), and therefore also convey a lack of interest or "passion" for math and science as a way to explore and learn about the world. Some participants observed that elementary school teachers often choose their elementary teaching career because they are not expected to train in math or science and characterized them as math phobic or "fearful" of

teaching math (L96L, L97S).

Students, their families, and especially their parents, need opportunities to learn more about STEM careers as a way to view math and science in a new light (I10B, I15R, W7S). It is also true that many parents and teachers lack an understanding of the skills that are needed in the STEM professions, and therefore, are not able to guide their students toward careers and industries they do not understand (J17C, J29N, R73N, R15B). These skills include not only the ability to conduct research, but also the capacity to keep pace with advances in technology. They must also possess strong communication skills and ability to work collaboratively in team-based approaches to problem solving (S32A, S33A).

Exposing students and parents to the STEM industries and professions can occur in several ways, and should occur early in the student's school experience, and continue throughout the academic life of a student as well as their parents (I10B, I11A, I15R, K3R, K11C, K116S). This is especially true for minority and low-income students who lack connections to role models who they can identify with, including women and minorities among the STEM career professions (I32N, H8B, H11A, H14R, H20C).

"K-6 students are primarily influenced by elementary school teachers, many of whom lack training in math and science."

Linking young students with STEM career role models who can excite them about the possibilities for exploring through science and math, as well as giving their parents a clearer picture of the new tech businesses and industries that can offer future career potential for students is an important step that will require community support and involvement (H7B). Exposing students and parents to the possibilities for STEM careers could also help shift traditional views of some parents whose expectations are more limited (in the case of female students) (I7Y), or who direct students to pursue sports as a way to earn college scholarships (I33B, I11A, I21S). Students also need to see themselves pursuing academic careers that are potentially as exciting as seeking college entrance through athletic programs (R25R).

Other opportunities to open up a new understanding of math and science can be pursued outside the pubic school system by partnering with informal learning programs including museums, libraries, and summer camps. This was viewed as another approach to implementing short-term action outside the regulated environment of the public school system where exploration of new approaches to hands-on learning, and project-based or problem-based learning could be developed to show what students can achieve through these types of learning experiences (R24R, R28R, R103A, R150R, R111C, R115S, R120Y, R122N, R126N).

Views on the differences between affluent school districts and those in inner city urban areas or in rural areas include the idea that over the course of 12 years, affluent students are more likely to experience K-12 afterschool programs, summer science camps, and participate in museum or

other informal learning environments where they are exposed to math and science in programs that are both fun and educational (H2K) (see *Appendix A, Table B: Existing STEM Related Programs for Students*). Rural areas are less likely to have access to these types of programs (H2A, H3S, H5Y), and urban youth may or may not take part in children's programs depending on the parent's ability to guide the student's activities toward these types of extracurricular learning experiences during after school hours or in the summer (H16R). Among low income communities, as students grow older, they may need to work during after school hours and during summers and are also not likely to have the opportunity to engage in these kinds of learning experiences (H19R).

4.2 Access to Tech Resources and the Digital Divide

Another set of challenges is connected with the idea that parents need to be more involved in their child's education, especially in the early years, engaging with their child in the classroom and through classroom projects (I27N, I28R). However, the range of factors that include work schedule conflicts, child care needs, lack of engagement due to language barriers or other cultural expectations about the appropriate role of parents can present enormous barriers for parental involvement in the child's education (I23Y).

The use of social networking tools to increase community involvement with education and to open access to education through new technologies is an important dimension of the STEM Initiative. However, a digital divide exists for parents and others in the community who are not engaged with technology either in their social interactions (e.g., Facebook, Twitter) or through their jobs, who may not have access from home or libraries, or may not understand the benefit of linking into their child's school and classroom through technology (V5Y).

The digital divide also includes teachers as well as administrators and others who have not had reason or opportunity to gain in their proficiency with new technologies and modes of communication (V7B, V8L). A significant challenge of a STEM Initiative will be to develop programs for veteran teachers and school administrative staff to bring their skills up to contemporary standards to utilize new technologies including smart phones and laptops so that they are at least as proficient as their students in tech use (W16C, V10L). Convincing teachers and others to invest in this training will require that schools begin to develop STEM classrooms with access to the equipment and infrastructure that will support STEM instruction (W36N, W21R).

Students, on the other hand, are developing these skills, primarily through social interaction, and in most cases, are not permitted to utilize Internet, smart phone or in some instances, even laptop technology in the classroom (W13Y). In part this is due to outdated school district policies that ban the use of technology in the classroom as a way to control inappropriate uses within the school setting (W17B). However, these policies fail to provide guidance for teachers who do have technology skills and who could integrate their effective use into classroom instruction. Establishing district-wide policies that allow students to bring technology into the classroom can help to advance teacher and parental exposure to the use of this equipment in an educational context that will also allow students to explore learning through technology and access to resources beyond the classroom (R136L, V2L).

Additionally, providing students and teachers with a STEM environment in which to create innovative learning experiences can also help offset disadvantages for rural school districts and others who lack connection to STEM business and industry (R153S, H2A, J57A). Opening access to online instruction, project development, and distance learning programming (W2N, W18A) can also offset shortages of math and science teachers in rural areas (H4S). Concerns about urban area student access to technology were also cited as an economic issue with one region proposing the idea that all students should be issued a standard "kit" by the school which would include a laptop, requiring online access in classrooms and IT support (W35Y, W28Y).

Moving through these barriers to increase access to educational resources and to advance the learning experience of students through technology are fundamental to STEM education. Preparing teachers as well as administrators and others including parents to engage in this effort will require broad-based actions to build STEM awareness across all stakeholders. In the next section, teacher-training issues are reviewed more fully.

4.3 Teaching to the Test Versus Developing a STEM Philosophy of Education: The Role of Teachers and Others

Efforts to develop a STEM philosophy of education will depend on the success of retraining veteran teachers, and in developing STEM training for new teachers. Professional development must also involve school superintendents, principals, guidance counselors, and others who work with students including librarians (L2C, R137B, T2A, T11C, T12C), and those who play a formal role in setting school policy, such as school board members (T6R, S24N, T24N), in order to assure that systematic changes are put into place with strong leadership at all levels of the educational system (T7R, T10C).

"Professional development must also involve school superintendents, principals, guidance counselors, and others who work with students including librarians, and those who play a more formal role in setting school policy, such as school board members, in order to assure systematic change."

Establishing high quality professional development programs, providing leadership and support for STEM classroom instruction at the level of the school district, and creating a network of STEM professionals that can become involved with teachers and students in collaborative project development are all essential components of shifting to a 21st century approach to formal education. However, *Progressive Dialogue* participants identified an enormous hurdle that lies in the current curriculum and associated testing and formal student assessments that are rooted in "siloed" instruction, and which some view as forcing teachers to limit what is taught, focusing instruction on what students need to know to pass the test (K4A, K14Y, K26A, K47C, K59Y, K84R, K90C).

On this issue, it is noted that teachers alone cannot make needed changes in education (A1-172Y), and even as requirements are changed to meet STEM education goals, without local school district

leadership on these issues and buy-in from principals and superintendents, change cannot occur (T8R, T19N, T20N). Furthermore, it is noted that without strong leadership and ongoing support for teachers in the classroom, STEM instruction will not sustain itself as teachers slide back to familiar approaches to preparing students for standard assessments and testing (L70Y).

Providing adequate support for STEM curriculum and assessment development will also require that teachers be given a new structure in which to conduct their preparation for STEM instruction. In part these can be addressed in the way professional development and new teacher training courses are designed to meet STEM goals. However, aspects of these changes must also be addressed in terms of the institutional framework in which teachers are constrained by teaching contracts and other regulations regarding the school day and the school year, which may not be supported by those in the system who are not inclined to accept longer work days or year-round public school programs without the structure of negotiated institutional changes.

4.4 Constraints Related to Professional Development, Teacher Training, Contracts and Unions

Professional development for those teachers who are currently in the system, as well as training for new teachers who are entering the system, are largely structured through state and local school district requirements and defined by formal teaching contracts. New STEM teaching requirements are being explored at the state level and should be supported by local school districts and their communities to assure consistency across the state (A129C). These actions could lead potentially to the development of a new STEM teaching certification, which will help expand the pool of teachers with expertise in STEM disciplines (A70Y, A71N, A123R, A140C, J34N).

"There is a need to redesign 'siloed' instruction for student teachers to include interdisciplinary coursework in math, science and technology, as well as the need to initiate STEM professional development for higher education faculty to improve the quality of teacher training programs."

A new STEM teaching certification will need to be coupled with other changes that will require involvement of the unions and teacher associations as key participants, such as designing a new compensation structure and working conditions for STEM teachers. These can include ideas such as pay increases for teachers certified in STEM-related fields (A49A, A143S, L58R, L66S), compensation for required professional development (K57C), and restructuring of the school day and school year to provide teachers with adequate time for training and development of new STEM curriculum (K18B).

Teachers will also be expected to shift their role in the classroom to operate as "learning facilitators" where team teaching or co-teaching arrangements with STEM career professionals or with STEM graduate student researchers can occur (J7B). Teachers may also be required to complete internships and participate in STEM mentoring programs with the private sector (J49R), where they can become knowledgeable about STEM businesses, or with governmental STEM training programs operated by such agencies as NOAA or the NSF (C8N, C17R, L104R) where teachers can work directly with

scientists and others engaged in research and project-based application of STEM disciplines. (See *Appendix, Table C: Existing STEM Related Programs for Teachers*).

4.5 Disconnects Between Higher Education and the K-12 Education System

Training of new teachers was also identified as a major challenge in the shift to STEM education for the K-12 system for a range of reasons cited across the regions. Two regions noted that some universities and colleges are not interested in taking an active role in the K-12 system (S12N, S13B) and therefore, are not aware of the changing needs of students. As a result, few universities and colleges have instituted changes in the way teacher training programs prepare student teachers to enter the classroom (H21Y, L13Y). Data sharing and the possibility for utilizing student data to provide feedback to teacher training programs were also viewed as a means to create links with higher education programs (R1C, R44C). Participants also cited the need to redesign "siloed" instruction for student teachers to include interdisciplinary coursework in math, science and technology (I40L, S39B, S46Y), as well as the need to initiate STEM professional development for higher education faculty to improve the quality of teacher training programs (I46Y, S43R).

Changing the structure of higher education teacher training programs and ongoing professional development are critical aspects of achieving STEM goals to prepare students for a 21st century career. These include expanding training to include paid teacher residency programs for the first year of teaching (L83N), creating mentorship programs with STEM master teachers or STEM career professionals (J40B), and creating teacher internships in the private sector within STEM business and industry so that interns can gain first-hand experience and understanding of the essential skills necessary for students preparing to enter the STEM professions (I93B).

These ideas are essential to preparing a teacher to enter the STEM classroom, as well as for their major role in supporting STEM curriculum development and new approaches to STEM instruction. When viewed as a PK-20 system, focus on meeting student needs must include coordinated efforts between higher education and the K-12 system in order to review gaps between the K-12 curriculum and graduation requirements, and higher education program requirements. This action is needed to assure that new K-12 STEM curriculum is vertically aligned with higher education requirements, and that students entering college are adequately prepared for undergraduate coursework in math and science (S3A, S4R, S10Y, S11N).

4.6 Businesses and Industry as Stakeholders and Partners in Reshaping Education to Meet the Needs of a 21st Century Global Economy

"Business must engage in development of STEM education to inject a 'real world' context for learning."

As technology advancements have dramatically changed the way businesses function and grow, the private sector has been confronted with a very obvious fact: graduates from US colleges and high schools are not adequately prepared to enter the workforce of the 21st century. To overcome this shortcoming, large corporations and small businesses alike have had to create training programs to provide basic applied skill development in communication, research methods, as well as training

people in team building and collaborative approaches to project development.

For these reasons, many in the private and public sector now view a new role for business and industry where they take a direct part in reforming education to achieve STEM education goals (A124R, K36R, K96Y, J265C). Belief that business must engage in development of new STEM curriculum standards (J1R, J52C) is a perspective that builds from the idea that classrooms lack a "real world" context, and that unlike business, which functions through access to information (R13A), the classroom is not similarly prepared for research and problem solving. Through partnering and other new approaches to developing STEM education, business can be more directly involved with establishing the standards and requirements that will produce workforce skills that meet future needs. In this new enterprise, expectations are high that there will be benefits for both the educational system and for business and industry that will accrue from the creation of a system of education that can truly prepare students to enter the STEM workforce, and that will also support the economic growth and vitality of our communities and of the state as a whole (J10R, J21Y).

Other ideas cited by *Progressive Dialogue* participants included: the formation of new types of partnerships with business in training STEM teachers (J21Y, J49L); providing support to STEM professionals to become certified teachers or create opportunities for involvement in collaborative K-12 STEM instruction and project development (J30N, J37R, J39Y); creation of STEM teacher and student internships and mentorships (J13R, J19S, J25Y); and access to research and lab facilities for students and teachers (J32N, W1R, W9N). Additionally, engaging with businesses in structuring educational programs that are based upon business models and entrepreneurial principles are expected to create new approaches to achieving self-sustaining programs that could also be funded through new mechanisms (J43A, J48R, R14A), including tax benefits and other types of incentives that will encourage stakeholder involvement in educational reform actions (R118Y).

In the following sections, these issues will be explored further by considering local and state policy level action necessary to support STEM education goals, and by considering the range of innovative actions identified through the *Progressive Dialogue* process, including network development to support STEM Program implementation.

5. STEM Education Policy Development

STEM Education Policy Development: Local versus State Level Action

Views on implementing the state's STEM Initiative included ideas about needed policy and regulation to support local and statewide action. *Figure 9* shows that among the eight regions, the Southern Tier Region led in their interest in policy-based action at 14%, followed by Long Island at 13% of total breakout data points. Four of the eight ranged from 5% to 10% of total data points, with Syracuse at 2%. A breakdown of the subthemes appears in *Figure 18: Summary of Policy Actions by Region*, which captures a synthesis of the actions proposed across all regions (also see *Appendix*, *Table A: State Level Policy Actions* and *Table A-1: Local Level Policy Actions*). There are 17 areas for state level policy action presented in *Figure 18* and six areas noted specifically for local policy action.

While interest in policy actions for STEM program development was relatively low across all regions, there are aspects of policy and regulation that some felt are fundamental to initiating systematic change. Across the eight regions, ideas proposed for state level policy action ranged from addressing the work and authority of the New York State Regents (Rochester, Syracuse, and New York City); to development of STEM standards for teachers and students, including high school graduation requirements (all eight regions); developing new STEM teaching certifications for existing teachers and for second career STEM career professionals (all eight regions); and ideas about state policy to redirect existing funding or creating new types of incentives, including tax incentives, to support STEM program development (all eight regions).

On the local scale, the Long Island and Syracuse regions did not discuss the need to develop local policy actions. However, Long Island did pose local scale actions to assure local priorities are considered, and also noted the importance of recognizing regional differences in setting new STEM policies, and noted as well that short term changes are more effectively implemented at the local scale (A1-5L), suggesting that the long-term framework for change should be developed statewide.

Long Island also proposed actions to communicate needed policy changes to support local program development to the state as well as to the federal government (A112L). Syracuse alone proposed the need to identify additional new leadership at the state level, suggesting that the region views the role of the state in leading STEM policy development as a necessary factor to initiate STEM education.

	FIGURE 18: SUMMARY OF POLICY ACTIONS BY REGION	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. Southern Tier	6. Syracuse	7. Yonkers	8. New York City
TABLE A: STATE LEVEL ACTIONS									
1	*CROSS CUTTING ACTIONS**		*	*	*	*		*	*
2	*REGENT ACTION REQUIRED*				*		*		*
3	*LINK WITH FEDERAL ACTION*	*			*			*	
4	*STATE LEGISLATIVE ACTION REQUIRED*	*			*	*			*
5	*ISSUE STATE WAIVERS FOR STEM PROGRAM DEVELOPMENT*		*	*	*	*			*
6	*CHANGE K-12 EDUCATION REQUIREMENTS*		*	*		*	*		*
7	*CHANGE HIGH SCHOOL GRADUATION REQUIREMENTS INCLUDING REQUIRING A STUDENT PORTOFOLIO*	*		*		*	*		
8	*CHANGE ASSESSMENTS TO INCORPORATE STEM EDUCATION GOALS*			*	*	*	*		*
9	*CHANGE FUNDING POLICIES INCLUDING REDIRECTING EXISTING FUNDS TO ACHIEVE STEM INITIATIVE GOALS*	*	*	*	*		*		*
10	*CREATE TAX INCENTIVES TO SUPPORT STEM PROGRAM DEVELOPMENT*				*	*	*		
11	*CREATE OTHER REWARDS AND INCENTIVES TO IMPLEMENT THE STEM INITIATIVE*	*	*			*	*		
12	*THE STATE SHOULD COLLABORATE WITH BUSINESS AND INDUSTRY TO SUPPORT STEM INITIATIVE GOALS*	*			*	*			
13	*CREATE STEM TEACHING CERTIFICATION REQUIREMENTS*			*	*	*	*	*	*
14	*CREATE SECOND CAREER TEACHER TRAINING FOR STEM CAREER PROFESSIONALS*				*	*		*	
15	*REQUIRE STEM PROFESSIONAL DEVELOPMENT FOR TEACHERS*	*	*		*		*		*
16	*SALARY AND OTHER INCENTIVES SHOULD BE DEVELOPED FOR STEM CERTIFIED TEACHERS*		*		*	*			*
17	*THE STATE SHOULD DEVELOP POLICIES TO ADDRESS UNDERSERVED STUDENTS*	*	*						
	TABLE A-1: LOCAL LEVEL ACTIONS								
1	*COORDINATE LOCAL AND STATE ACTION*		*		*				*
2	*IDENTIFY AND IMPLEMENT POLICY THAT MEETS LOCAL PRIORITIES*	*		*	*	*			
3	*RECOGNIZE REGIONAL DIFFERENCES*			*	*	*		*	
4	*DEVELOP STEM PROFICIENCY STANDARDS AT THE SCHOOL DISTRICT LEVEL*	*						*	
5	*DEVELOP REGION-WIDE POLICIES ON APPROPRIATE USES OF TECHNOLOGY*	*				*		*	
6	*DEVELOP LOCAL SCALE FUNDING POLICIES*	*			*				

*Cross Cutting Actions are those which involve changes that relate to STEM education in one or more substantive areas, e.g., "redirect funding to support teacher training programs, increase STEM certified teacher pay, and extend the school year by 60 days"

5.1 State Level Policy Actions

The view that STEM will require changes to the system as a whole was expressed in different ways across the regions (A15C, A104A, A150Y). New York City *Dialogue* participants suggested that fixing the system as a whole, should be done in order to increase graduation rates (A91N). The Southern Tier Region posed the idea that legislative action is needed to mandate changes in educational requirements that will serve to change the formal state expectation that all children should go to college. In so doing, this action will create formal recognition of the value of tech or vocational education training for STEM professions (A159C). Two regions suggested that the state must also develop policy on broad scale social issues through legislation that addresses the needs of underserved student populations (A17B, A106A).

"Legislative action is needed to change formal recognition of the value of tech or vocational education."

Three of the eight regions suggested that the state will need to consider some form of program development waivers or test exemptions that will give time to school districts to develop STEM curriculum and assessments without risk of penalty (A29L, A32R, A33R, A36C). The Capital Region suggested the state should issue program development waivers similar to Tech Valley High (A102A). The Southern Tier Region suggested that the state should also fund pilot program school development as well as issue regulatory waivers (A127C). New York City suggested that the state should create "innovation zones" where the state could coordinate pilot program development with private sector funding (A160N).

Providing statewide criteria for curriculum and assessment standards was another area where state level actions are viewed as critical to meeting STEM education goals, including developing assessments for "problem-based learning" (A26A, A28L), setting STEM standards (A24S, A43N, A128C, A161N), setting math standards (A107L, A24S, A42N), and standards for tech education (A99A). Two regions proposed the idea that the state should develop science literacy standards equal to reading literacy standards (A42N, A108L); and the Syracuse Region posed the idea that the state should add engineering as a third science for students to master (A24S). Changing state level assessment standards to meet STEM goals will also provide formalization of "changing what is measured as a way to change what is taught" (A132C).

"Redirect funds to support STEM education development to assure that the state has both a 'policy' and a 'pocketbook' component for the STEM initiative."

Ideas about funding centered on the concept that the state could redirect funds to support STEM education development (A79B, A88S), in a strategy that assures that there is both a "policy" component and a "pocketbook" component to the state's STEM Initiative (A162N), and to secure broad-based engagement in STEM programs (AlllL). The Rochester region suggested that both the state and federal government should increase investment in education in order to compete with China and other countries that have increased their support for education (A118R), and two regions thought that the state should increase its investment in teacher training (A48A, A88S). Three regions suggested that the state

should develop policy to create incentives for stakeholder support and involvement in developing STEM education, including offering new kinds of tax incentives (A120R, A138C, A145S).

Developing joint efforts between the state and business and industry also touched on the idea that business could take the lead in utilizing its expertise in implementing systematic change (A119R), as well as take a direct role in setting curriculum standards (A124C, A137C). Two regions suggested that the state should mandate business partnerships in developing STEM teacher training, including required internships (A93B, A122R).

5.2 Local Level Policy Actions

Among the issues that the regions identified as important for local policy action, several of the eight regions noted the need to recognize regional differences (A1-113R, A1-116C), as well as recognize local priorities in setting state regulations that are flexible and can accommodate local needs (A1-102C, A1-108L, A1-115C), and providing state funding to support local needs (A1-171R). Regional actions are also viewed as more immediate and more likely to accomplish necessary action in the short term (A1-107L), and that regions should act now and not wait for the state and federal government to support needed action (A5L, A1-111R).

"Regional actions are more immediate and likely to accomplish necessary changes in the short term."

Another important area for local policy action concerned setting appropriate tech-use policies on a district-wide basis in order to give guidance to teachers and principals on integration of technology into the classroom environment (A1-2B, A1-117B, A1-120N). One region considered the need to establish district policies for STEM proficiency for school board members an important and beneficial change at the local level (A105B).

This section has presented a review of the proposed set of actions across the regions from a policy perspective and suggests that there are important differences to consider in designing institutional changes in order to implement STEM education both in the short and long term. In the next section, we present strategies for innovative action in ways that can fit within the existing framework of the extended educational system, whether through partnering with organizations and programs to explore new approaches to learning, or by turning to other successful programs outside the public school system to learn more about how to restructure and redesign educational programs to meet STEM education goals.

6. Innovative Concepts and Actions for STEM Implementation

Innovative Concepts and Actions for STEM Implementation

Identifying innovative ideas to advance STEM education in New York State was a major focus of the *Progressive Dialogues*. As noted earlier in this report, *Figure 10: Models and Strategies for STEM Implementation* presents one measure of regional capacity and willingness to consider important strategic actions as well as creative uses of existing resources to support STEM program development. The set of 2100 breakout data points can also be evaluated for the different levels of impact that can be achieved using innovative approaches to STEM implementation, recognizing as well how these approaches can meet local, state, and national priorities.

The PAST research team considered three main questions in identifying innovative actions:

1) What can New York State do to develop model programs that would assure the state is a national contender for STEM funding?

2) What can New York State do to develop model programs and/or program components that meet high priority needs within the state, and that can be replicated across the regions?

3) What can the regions do to implement effective programs for the long-term to strengthen the state's standing nationally?

A total of 276, or 13%, of the 2100 *Progressive Dialogue* breakout data points were selected under the criteria above. The remainder of the proposed actions represents 87% of the issues and ideas discussed across the regions. It is important to note that these represent actions that may be considered "low hanging fruit," that could be more easily developed, or that fall within the range of known or somewhat known ideas to pursue. This could include ideas that can be explored within existing rules and regulations, or that fall within the prerogative of local authority to initiate new directions.

While the majority of the 276 actions were gauged to have regional significance (n=208), many had implications on multiple levels and are presented in summary form in *Figure 19: Summary of National, State, and Regional Level Innovative Actions for New York State.* The full set of actions is presented in detail in three data sets in *Appendix B: Innovative Actions for National, State, and Regional Levels (see Table AA: National Level Innovative Actions; Table BB: State Level Innovative Actions; and, Table CC: Regional Level Innovative Actions)*. Each set is also linked to the region in which the idea was proposed in order for this information to be utilized as work precedes across the regions. In

FIGURE 19: SUMMARY OF NATIONAL, STATE, AND REGIONAL LEVEL INNOVATIVE ACTIONS

	CATEGORY	TABLE AA: National	TABLE BB: State	TABLE CC: Regional
		Number of Actions		
	STEM Program Development			
1	Cross Cutting Actions*	7	29	20
2	Create New School Programs Utilizing Best Programs and Models for STEM Education	2	15	21
3	Initiate STEM Program and Career Development with Young Students	-	3	2
4	Address Access to Technology Resources	-	8	9
5	Change the Structure of the School Day/Year to Support STEM Education Goals	1	3	3
6	Build STEM Programs that Utilize Successful Business Models	2	3	6
7	Create K-20 Program Connections	-	6	1
8	Develop Partnerships with Community-Based Informal Learning Programs	-	4	13
9	Increase Student Awareness of Vocational Education Career Pathways	1	2	3
10	Develop STEM Programs to Address Underserved Student Needs	2	2	4
11	Create Programs for Students to Engage with STEM Career Professionals as Role Models	-	2	1
12	STEM Programs Must Address Broad Social Issues to be Effective	1	-	-
	TEACHER TRAINING AND PROFESSIONAL DEVELOPMENT			
13	Require Teachers to Complete STEM Professional Development	6	14	21
14	Create STEM Teacher Training/Pre-service Programs to Prepare New Teachers for STEM Instruction	–	8	7
15	Create STEM Teacher Certification Programs	1	4	1
16	Create Collaborative Programs for Teachers and STEM Career Professionals to Work Jointly on STEM Course Development and Instruction	3	4	3
17	Change Standard Teacher Evaluations to Incorporate STEM Education Goals	2	3	3
18	Change STEM Teacher Compensation and Work with Unions to Address Changes Needed to Support STEM Education Goals	4	5	3
19	Develop Teacher Training Programs for Second Career STEM Professionals	3	7	5
	STEM CURRICULUM AND EDUCATION REQUIREMENTS			
20	Develop STEM Curriculum, Instruction, and Assessments	8	35	40
21	Change Education Requirements	1	1	3
	STAKEHOLDER NETWORK DEVELOPMENT			
22	Build Broad Network Engagement	1	9	19
23	Create New Types of Partnerships with Business/Industry	4	11	14
24	Build STEM Awareness in the Community	2	4	5
25	Redirect Existing Funding/Form New Types of Funding Partnerships/Identify New Incentives to Support STEM Program Development	–	6	1
	Total actions for each level	51	188	208
	*Cross Cutting Actions are those which involve changes that relate to STEM education in one or more substantive areas, e.g., "redirect funding to support teacher training programs, increase STEM certified teacher pay, and extend the school year by 60 days"			

this view, regional actions offer many ideas that can be initiated at the local scale, and that have the added potential of linking with statewide partnerships or other state and federal initiatives that address high priority areas and that as a consequence may make it possible to garner outside support for local action. For those regions that are ready to move on any of the particular actions noted in the tables in *Appendix B*, strategies that build on state and federal interests should be actively pursued to assure all potential forms of partnering and support are evaluated as part of the design and implementation process.

Figure 19 is organized into four general categories that include:

1) *STEM Program Development*
2) *Teacher Training and Professional Development*
3) *STEM Curriculum and Education Requirements*
4) *Stakeholder Network Development*

Figure 19 also provides an overview of the number of actions for each of 25 sub-categories that further help define the types of actions that have been proposed for STEM implementation. A review of the numbers of actions within each of the sub-categories also provides a broad scale view of the kinds of actions the regions may pursue to achieve STEM Initiative priorities.

One action category, *(No. 20) Develop STEM Curriculum, Instruction and Assessments*, with 40 actions deemed significant for regional level priorities and 35 important to meet state level priorities, offers at least twice the number of proposed actions as the next highest categories for state and regional level action. This suggests that action at the local level can build upon a broad set of ideas and issues related to curriculum development that schools may feel they are ready to explore in developing STEM programs, which are at the core of school district authority in preparing for STEM classroom instruction.

Below that, the next group of proposed actions that can be considered for comparison are four that range from 14 to 21 ideas for the regional level, which also include relatively high numbers on actions that potentially meet state level priorities. These include:

(No. 2) Create New School Programs Utilizing Best Programs and Models for STEM Education
(No. 13) Require Teachers to Complete STEM Professional Development
(No. 22) Build Broad Network Engagement
(No. 23) Create New Types of Partnerships with Business and Industry

Two of these four action categories (Nos. 2 and 13), when considered in concert with curriculum development, suggest that the regions may be ready to explore a related set of actions that are integral to STEM program implementation. These include identifying model programs and approaches to pilot school development *(No. 2),* and addressing STEM professional development programs and mandates *(No. 13).*

The remaining two categories *(No. 22 and 23)* concern network development, including building new types of partnerships with business and industry and are explored further in the next section.

7. STEM Network Development

STEM Network Development for Local, Regional, and State Levels

The advancement of STEM education in New York public schools involves initiating a series of changes that will redefine the traditional role of teachers and school administrators, and will also introduce new roles for stakeholders to work collaboratively to redesign education for the 21st century. These include students, parents, higher education, teacher unions and teaching associations, the broader community, and business and industry. Building new relationships outside the schoolroom to engage with the community in STEM program development can be supported through the formation of networks, including public/private partnerships, to expand the educational environment beyond the four walls of the traditional classroom (M68Y). Making connections to STEM-related businesses and other types of STEM-learning environments will also help link the classroom to new sources of support including funding and other resources that will be essential to creating 21st century learning experiences. In this effort, community support and engagement will play a critical part in connecting students with the "real world" where they will learn through exploration and discovery guided by teachers working jointly with scientists and others from the STEM professions (C20Y, I14R, I22S, I27N, M16R, M17R, M39Y, M41Y, M68Y, M70L).

Figure 14: Partnering and Other Stakeholders shows that ideas about new types of partnerships form an important component of STEM program development across all eight regions, ranking second in interest. Many of the *Dialogue* participants observed that locally, STEM networks should be a broad-based, collaborative enterprise. Involving diverse members of the community, including students, families and others, should bring those to the table who can contribute to actions that will achieve diverse outcomes, as well as leverage community resources for STEM program development (M16R, M17R, M20R, M26C, M27C, M36S, M39Y, M51N, M62N, M65N).

Engaging students in planning for STEM education is also an important aspect of defining educational goals that will help identify student interests (M63L), including ways to integrate technology into the classroom culture that can also begin to break down the digital divide for teachers and parents (M12L, M14L). Creating new relationships across schools districts can also link students and teachers in collaborative, virtual "learning communities" to design curriculum and new approaches to sharing ideas and other resources to support project-based learning (M2A, M7C, M8S, M16C, M66Y). Virtual learning communities can also provide an important access point for parents and families in the community to engage with schools, stay informed of classroom projects, and

help identify needed support and resources available in the community (M16C, M25R, M30C, M39Y).

School district networks can help link decision makers regionally to include superintendents, principals, and school board members across districts so that they may work collaboratively to share innovative approaches to developing new district-level STEM policies and meeting new program challenges (M6R, M11N, M2A). Regional networks can also help link rural, suburban, and urban school districts to provide greater access to partnerships with higher education and STEM business and industry and the resources they can offer to K-12 educators (J57A, M4L).

One region noted that university and college involvement cannot be sustained on a "volunteer basis" and will require adequate funding (M24R) or other types of incentives to allow faculty and graduate students to engage in K-12 program development (S19S). Another dimension of the K-20 framework was the idea that universities and colleges must be encouraged to share their expertise and information with the community so that it may benefit from the work of university researchers (M33S). New York City proposed the idea of developing "innovation centers" to bring colleges together to establish an approach to track STEM students and to provide this data to the K-12 school system in order to assess STEM program gaps and achievements (R125N).

STEM networks can also help expand teacher and school administrator relations beyond the public school system to strengthen relationships with informal learning programs and institutions, including museums, libraries, and research and science centers (M32C, M56N, R102B, R111C). In this view, one region suggested that partnerships with non-profit community-based programs could open up opportunities to better utilize existing learning resources within the community (M42Y). The benefit of working outside the regulated school environment could also lead to "short-term" successes in initiating jointly conducted STEM learning programs (M44N, R120N, R150R). Two regions proposed regional partnerships, including formation of a "foundation" that could bring the informal learning community together (R116S), or, in another approach, creating a "collaboratorium" (R102B) to focus on "soft skill" program development. Connecting with parents who are already engaged with community organizations in growing and sustaining these kinds of relationships was also identified as an important opportunity for local level program development (M55N, R103A).

Others in the community who have been identified as essential partners in developing STEM education include STEM career professional and business and industry leaders who as members of communities have an interest in the social as well as the economic well being of their communities (M50N). Taking a direct part in reshaping education will inject new views on urgently needed changes in curriculum and assessment, and inform approaches to STEM instruction that will capture the essential skills for the STEM professions that teachers need to understand in order to prepare students for success throughout their lives (J29N, J52C). Engaging with business through STEM networks during early stages of planning and design of STEM programs can also bring their expertise to the process of identifying new models for building sustainable public education programs and other innovative ideas that will help create a self-sustaining approach to long-term

program development (J43A, J48R).

Working collaboratively at different scales — statewide networks, regional networks, and networks within and across schools districts — will provide the framework to address a wide set of related goals and implement actions that will need to be coordinated to be effective. Several regions commented on the need to identify new leadership to shepherd STEM program development (M1B, M5R, M58N, R147R), with one region suggesting that determining what level of leadership would be most effective needs to be explored (M37S). Focusing on local priorities and designing state regulations to maintain flexibility of local control over program development was cited as an important aspect of STEM implementation (M10N, M48N, M57A, M61C), with two regions noting the importance of linking regional goals with state and national mandates (M10N, M18R). One region also suggested that the state should develop its policies to support "bottom up" change (M64L).

Creating a system of networks that can function effectively will require communication across regions, and from local/regional networks to state level networks in ways that will inform the state of regional priorities, the best strategies being implemented and state support necessary to fill the gaps (M48N). Early efforts to initiate the formation of community-based networks may also create informed advocates for STEM education who can work with local political leadership and other influential community members, who can then engage in statewide efforts at the highest levels to lobby the state as well as the federal government for needed support and resources (M43N).

Networks will need to be mapped out within each region as various communities take action to initiate steps to identify key stakeholders representing these various components of STEM program development (M51N). Through the *Progressive Dialogue* process, it is apparent that interest in building new relationships to expand community involvement in education is taking shape across the eight regions. This includes leaders in K-12 education, higher education, teachers unions and associations, as well as the non-profit and private informal learning institutions, which have traditionally played a role in education. The prospect of adding new perspectives from among leaders in business and in engaging directly with STEM career professionals presents new challenges that will need strategies to find common ground, and to engage in ways that will lead to mutually productive and successful outcomes.

8. Future Steps to Support STEM Implementation in New York State

Future Steps to Support STEM Implementation in New York State

The PAST Foundation prepared this report to provide a summary of the *Progressive Dialogue* breakout sessions that were conducted during the summer and fall of 2009. The report presents a review of the issues and strategies identified by *Progressive Dialogue* participants that will need to be addressed to support the state's STEM Initiative, as well as participants' ideas on ways to initiate new directions, working both within the existing framework of public education as well as through changes in New York State policy and regulation.

The work ahead will also need to consider innovative and creative ways to break with long-standing traditional practices in education; these changes will alter the fundamental role of teachers and school administrators and will bring new insight, talent, and expertise to the public education system. Proposed actions that have emerged from the 2009 *Progressive Dialogues* offer substantial possibilities for systematic changes that will be part of every region's plan for action. To these efforts, the PAST Foundation offers the following observations on critical variables that were identified by the *Progressive Dialogue* participants that are essential aspects of change in education:

- ***Roles***: The amount of knowledge readily available through computer technology has shifted the roles of teachers, scientists, students, parents, and partners. This directly links with new concepts for training, pedagogic approach, delivery, and access to education that can better respond to the needs of the broader community.
- ***Professional Development:*** The academic schedule and the amount of professional development necessary for the kind of educational change envisioned by *Progressive Dialogue* participants cannot be achieved through the existing framework of the school day and year. For teachers to morph from "the sage on the stage" to "the guide on the side" requires a shift from 'time clock' thinking and minimal professional development, to 'outcome' thinking, regularly focused professional development, and providing adequate teacher planning time to work both individually and as members of teams. The new framework for professional development should be integrated within the school day and punctuated by intensive training programs that are part of the regular school cycle throughout the year. Professional development for guidance counselors, librarians, and school administrators, including superintendents and principals, will also assure that everyone is

prepared to move forward with STEM educational reform.

- ***Interdisciplinary Learning***: In interdisciplinary learning, skills and knowledge are combined; concepts are not learned by rote training or memorization, but rather pursued as an integrated approach to holistic learning. The challenges of every society come from everyday life and so education must embrace 'real world' issues as the ultimate laboratory of learning and the very best preparation for college and career. In this view, education becomes a collaborative effort that includes students, mentors (teachers and scientists), and the community (the laboratory).
- ***Students:*** Education should no longer be driven by time (grade advancement, testing cycles), but instead focus on mastery and outcomes. Switching from solely "college ready" to "career ready" promotes post K-12 education in new ways that can also elevate vocational and tech career training. This shift allows for more tailored education and better alignment with K-12 and higher education, as well as better defined career paths that are directed toward growth areas of local and state economies.
- ***Network Development:*** Expanding the learning community to connect with those outside the public school system in a structured, partnered development of knowledge and skills expands available resources and facilitates effectively addressing 21st century societal needs. This requires engagement of all community stakeholders including business, non-profit organizations, community organizations, and government. These changes will ultimately change the look of the school term and schoolroom, and will also affect access to knowledge in ways that will level the playing field and assure that society is tapping the full potential of our youth to grow and sustain future economic development. Private/public partnerships are collaborative enterprises that can promote a model of 'teamwork' that is essential for advancement in the 21st century. Responding to the reality of modern, local community needs will allow the school term, the classroom, the teacher, the parent, and the surrounding community infrastructure to better tailor resources and approaches to meet contemporary educational needs.

The process of tapping the existing expertise, insights, and knowledge of a broad range of stakeholders is a bold enterprise with the potential to renew the quality and success of the American public education system. This report is part of this effort and seeks to present participants' views about how to maximize the resources of New York State, as well as how to reform the way educators and communities think about education in and for the 21st century. Through the process of the *Progressive Dialogue,* New York State is poised to take the steps that could precipitate action within the state toward achieving the new set of goals and priorities outlined by the state's STEM Initiative and prepare all of its students for more effective participation in the new century.

Appendix 9.1

Tables A through F:

- ***A. State Level Policy***
- ***A.1 Local Policy***
- ***B. Existing STEM Related Programs for Students***
- ***C. Existing STEM Related Programs for Teachers***
- ***D. Other Related Programs within the State***
- ***E. Out of State Model Programs/Practices***
- ***F. Second Career Teacher Training***

	TABLE A: STATE LEVEL POLICY (N=129)	REGION								
	KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	Subtotal by Category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
1	***CROSS CUTTING ACTION***	**22**		*	*	*	*		*	*
15	**New regulations should foster a cultural shift in education to align with STEM goals through reorganization of the system at all levels**						*			
55	Utilize private/philanthropic funding sources to initiate STEM professional development in the short term, and seek funds from the state and federal government to sustain professional development programs including the *Department of Labor, U.S. Department of Education,* and *NSF* program grants.					*				
84	**Extend teaching contracts from 10 months to 11 months to include 1 month of professional development annually; change the school work day to look more like the business work day; work with unions to develop compensation to match new contract conditions**						*			
86	Develop a 48-week school year based on teacher rotation, where students are enrolled in 4 sessions/year with the potential for 5-6 sessions if needed; costs savings of $900K could accrue from reduced staff (from 300 to 200); the program would allow more time for teacher training and also support a 30% pay increase for teachers, and more effective use of facilities; students could advance through grades at their own pace not tied to age; high school students could work when not in school session through work study program; call the program, "consolidation of services"						*			
87	**Change the school year to improve the connection between the teaching world and the real world;** lengthen the school day to 8 hours, and start later (scientists recommend the latter) to keep students later so that they are not going home in the middle of the day when their parents are at work; pay teachers for an 8 hour day; consider benefits of extending the school day for rural students who have transportation challenges with before-school and after-school programs						*			
91	Fix the system as a whole so that more students graduate									*
100	Change policy in order to allow redirecting funds from existing sources to support development of problem based learning (PBL) including teacher training and professional development for K-20 instructors			*						
104	**Institute policies that reform education as a whole, not just to support STEM implementation;** integrate all systems, P-20; develop single sex K-12 education; **seek changes that support inclusiveness and experimentation, freedom to fail and rewards for creativity**			*						
112	Lobby Albany (new Chancellor and Ed Commissioner) and Washington, D.C., to communicate needed policy change that supports STEM education, innovation in the classroom, and restructuring of the learning environment (e.g. school day and year-round schedule to support problem based learning, classrooms to include labs, enhanced technology, performance-based instruction, teaching innovation)				*					
117	Utilize existing state and federal funds more effectively, stop throwing money at failing programs, and instead shift dollars to meet needs including hiring more teachers, paying higher salaries, providing programs that address family needs, and creating paid summer internships					*				
130	The state should develop three key areas of policy to implement effective change: extend the school calendar to year-round, implement problem based learning, and develop high quality professional development for teachers, including new STEM requirements for pre-service training; policy should consider what education should look like in 5 or 10 years; state STEM policies should provide guidance on transitioning to problem based learning; throw out the text books						*			
131	Changes in state standards should address all content areas through an interdisciplinary framework for curriculum design; provide an adequate timeframe for new curriculum development with exemptions on exams for 3-5 years; provide adequate funding for curriculum expertise and design						*			

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136	Initiate policy that focuses on teacher professional development to break away from the 1880s model of teaching; provide adequate funding for professional development; restructure the school day to allow adequate time for teacher innovation and creativity; new policies must include mandates and timeframes that will assure sustainability of the STEM initiative and therefore, garner investment by teachers; teachers have a role to play in pressuring the state to sustain STEM programming through legislative action; legislators need to respond to that pressure to assure that STEM education is adequately supported and sustained through permanent restructuring of the system						*			
147	Redirect funding from state tests that do not have constructive value for improving education, to other priorities including improvements that will provide for safe schools, transportation, technology in the classroom, and providing high speed access to classrooms; redirect funds from state tests to increasing teacher salaries and providing professional development; increase teaching salaries to attract STEM career professionals to the field to increase the quality of STEM instruction								*	
148	The state should develop new measures for assessing the state's education system, including the growth of the economy, quality of life, number of jobs filled, or increases in the domestic product; assessments are controversial and are not the best use of educational dollars, they are nonscientific, e.g. too many variables across school systems, and therefore have little benefit for evaluating the effectiveness of instruction								*	
150	State policy should foster inclusiveness statewide in order to reach the most number of people (systematic approach)								*	
151	The state must also address broad issues that are related to meeting educational goals that include unemployment rates and stress on families and children, communities need assistance to support families in crisis								*	
152	New York State teaching contracts should be changed to support STEM implementation in terms of allocating more time to teachers for planning, collaboration, and innovation; teachers need time to adequately provide science instruction; mandates should direct schools to teach science daily in elementary school; policy should infuse science into ELA instruction								*	
155	The Governor should focus on two key areas: 1) leverage existing resources and 2) collaboration is key (see *SUNY Nanotech* and *Structural Biology Center* for models of pooled capital)									*
156	The state should consider a range of incentives, both economic and other types of incentives to support collaborative action that include tax incentives and scholarships									*
157	Consider changes in policy to support new practices including waivers to allow pilot programs, changes in teacher certifications that can expand the teaching pool to include business and industry professions, post-graduate students, and second career individuals									*
163	**Develop policy that expands beyond current emphasis on test scores to incorporate new types of incentives, e.g. more resources for school districts, better professional development for teachers, reward creative teaching**									*
2	***REGENT ACTION***	**4**				*		*		*
124	Regents' standards for high school graduates should relate to career readiness and competitiveness in a global market; work with business and industry to develop curriculum and standards that meet state needs					*				
125	Regents should consider the differences between the pressure to meet deadlines to cover topics, versus approaching instruction as a way to provide deep essentials to enjoy and understand topics					*				
142	**New York State standards should expand to include a Regents diploma for a science or math major**							*		

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164	**Current emphasis on Regents exams and meeting benchmarks does not support innovation; create policies that give schools and teachers freedom to develop innovation in the classroom**									*
3	***FEDERAL ACTION***	**3**	*			*			*	
94	National education mandates (and funding) make it difficult to drive state and local change		*							
113	Work with the federal agencies to define and link in with the national referendum on STEM education and STEM career urgency; parents and students need to see the urgency and need for workforce development expressed at the national level as well as the state level; the federal government should take the lead in the position that we "cannot let education fail" similar to their role in banking crisis, their role has to be bigger					*				
154	The federal government should create a small grants program to encourage teachers around the country to develop problem based projects for students, focused on real world problems, launching a broad based "STEM invasion"								*	
4	***STATE LEGISLATIVE ACTION***	**5**	*			*	*			*
97	Legislature should change policy on assessments that inform tenure practices		*							
114	STEM requires changes to occur at the state level including legislative action to support STEM education implementation					*				
133	**Legislative action is necessary to change formal expectations of the state,** including the idea that every child must attend college						*			
158	Engage the Regents in the *Progressive Dialogue* process to assure that they are directly informed of the potential strategies and actions to support urgently needed changes in educational policies and programs; encourage the Regents to take action to implement STEM education, including changes in formal policy and legislation/regulations governing educational standards that are consistent with STEM									*
159	Legislate critical incentives to support industry research and development that builds intellectual capacity and economic development concurrent with investment in education to assure that public schools are generating STEM graduates to fill STEM jobs created within the state									*
5	***ISSUE STATE WAIVERS FOR STEM PROGRAM DEVELOPMENT***	**7**		*	*	*	*			*
29	Reinstate state waiver to allow exploration of new approaches to assessment				*					
32	Waive the exams for one year and design new methods to determine value as a teacher, value as a learner					*				
33	Set a one semester time period in which to develop STEM teaching and assessment methods; include STEM, as well as communication and writing performance					*				
36	Changes in assessment require state policy and waivers to allow time for design and development						*			
102	**Create a structure that will allow pilot program development without punitive effects for efforts that don't succeed, e.g. allow three to four years for pilot program development; Tech Valley High received waivers from the state allowing adequate time to develop programs that meet state requirements (state determines what you learn, not how you learn it)**			*						
127	**New York State should fund pilot STEM schools and provide regulatory waivers for experimental program development;** scaling pilot programs to expand statewide will be a challenge that must be addressed at the state level						*			
160	**Develop innovation zones supported by coordinated state and private sector funding**									*
6	***CHANGE EDUCATION REQUIREMENTS***	**12**		*	*		*	*		*
24	Incorporate STEM requirements as core subjects mandated to meet the standards, otherwise students will not pursue; make engineering a third science to master; design a multidisciplinary problem solving course; must require students to develop problem solving skills							*		

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26	Develop clearly defined criteria for assessing problem based learning including what content and skills a student must master, and what constitutes project completion and level of achievement			*						
42	Develop core standards for math (equal to ELA standards)									*
99	Develop state level policy and standards for tech education, e.g. nanotech and green technology; use *BOCES* as a model			*						
107	**New York State science requirements should be raised to the level of other states across the nation**				*					
108	Equate goals for science literacy with those of reading literacy of the past				*					
109	Physical science requirement should be increased to 4 years (equal to social science requirement)				*					
128	**New York State must take action to support STEM education in response to the national crisis;** review all state educational policies and remove those requirements that do not meet goals or add value to educational outcomes						*			
161	State Education Department (SED) should develop state policy and guidance on STEM curriculum									*
166	Change requirements for physical science (currently 80% of students do not take physical science where most tech is taught); change math and science requirements (currently one science course required in high school and no math after age 14)				*					
167	Change the requirements to add math, science and technology; accelerate 8th, 9th, and 10th grade levels; integration should also include 11th and 12th grades							*		
168	Require 4 years of math science similar to required 4 years of English; require college level math and science for HS students							*		
7	***CHANGE HIGH SCHOOL GRADUATION REQUIREMENTS/PORTOFOLIO***	***7***	*		*		*	*		
25	Include STEM readiness, service projects as requirements for high school graduation		*							
28	Goal should be to assess student competency based on problem based learning, with portfolio that demonstrates student achievements; current mode (state tests) don't give meaningful information on student abilities; start early high school is too late				*					
39	**Develop student digital portfolio with student projects throughout academic career; creates continuum and interdisciplinary framework**							*		
40	Redesign diploma track							*		
101	Students should pursue an individual path of achievement through the framework of "learning portfolios"; **redefine graduation requirements to incorporate personal digital portfolios;** students should be focused on STEM proficiency as their primary objective for graduation; define the 21st century student characteristics and all the skills necessary to function in the 21st century						*			
134	**Redefine graduation requirements to include a digital "personal portfolio" that supports education requirements based upon knowledge achieved; assess a student's competency, not credits earned; require a defined graduation product**						*			
144	Require New York State high school graduation requirements to incorporate a final project that requires math/science							*		
8	***CHANGE ASSESSMENTS TO INCORPORATE STEM EDUCATION GOALS***	***11***			*	*	*	*		*
30	Internship assessments could be based on increased work load and real tasks conducted in the work place				*					
31	**Eliminate the standardized state exams and promote real assessment, make the concept work**					*				
34	District dollars spent on conducting exams do not benefit the student or the district, e.g., the 5th grade math exam results are returned to the school half way through 6th grade					*				

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37	Expand assessment of schools beyond test results, identify measures of connection to real world, e.g., partnerships with business and industry						*			
38	**Change assessments in ways that provide important data to the state that ties in with the national crisis in education and that directly informs state STEM program development**						*			
40	Redesign tests to help students excel (not just regurgitate information)							*		
43	Develop assessment standards for STEM fields, in this way STEM can lead the way to more rigorous curriculum standards and assessment									*
44	***Race to the Top* reinforces cultural attitudes and practices that rely on standardized tests as the best measure of program outcomes, and performance of schools and teachers; decouple high stakes evaluation by tests to broaden the way teachers and schools are evaluated**									*
45	Standardized testing lacks flexibility to accommodate new knowledge, what has changed; BETA testing of new assessment scenarios is now being explored									*
46	Regents exams can't accommodate assessing hands on (HO) learning that is important to science instruction, and through legal review, the state has determined that HO is too subjective to measure, this puts us in a box with testing									*
132	Develop new policy on educational assessments; develop policy changes on what is measured as a way to change what is taught						*			
9	***CHANGE FUNDING POLICIES***	**7**	*	*	*	*		*		*
48	Prioritize funding for teacher training			*						
79	Redirect funds to achieve goals versus seeking new funding		*							
88	Determine best approach to diverting funds to STEM education versus developing new funds (more challenging) and create ways to show return on investment							*		
90	Utilize resources and existing funds to hire more teachers, decrease class size, or support a shorter day, providing more time for curriculum development and planning									*
111	STEM education policy must be a statewide mandate, including a collaborative approach and funding, in order to get around those who would otherwise not support the change to STEM education (supporters of the status quo)				*					
118	Federal and state investment in education has to increase similar to other countries like *China* where they have increased their support of education; it is not just about the dollars spent, other countries spend less per capita and are producing better results					*				
162	Support state level action to develop "pocketbook and policy" for effective STEM implementation									*
10	***CREATE TAX INCENTIVES TO SUPPORT STEM PROGRAM DEVELOPMENT***	**3**				*	*	*		
120	Create statewide programs that offer tax incentives or grants to businesses that establish internships or apprenticeships for students before graduation; a *monster.com* study shows that Rochester has the fewest internships available to college students than other similar cities					*				
138	**Introduce tax incentives to gain support of business and taxpayers and motivate constituents to fund STEM education;** long term benefits of tax breaks are generally positive, but short-term impacts may be detrimental to the educational system and may require that schools are funded through different mechanisms						*			
145	Create tax incentives to encourage industry participation in STEM education reform							*		
11	***OTHER REWARDS AND INCENTIVES TO IMPLEMENT THE STEM INITIATIVE***	**6**	*	*			*	*		
50	Create incentives that encourage teachers to explore STEM instruction and enhance delivery of problem based learning; provide framework for teachers to explore problem based learning without punitive action, e.g., under current practice, if students fail teachers are punished			*						
62	**Create a "loan forgiveness" program for student teachers who pursue STEM related teaching certifications**						*			

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82	Assess school district outcomes and reward innovation and creativity in implementing STEM with increased support and resources,and increased autonomy for superintendents and principals			*						
96	State level aid leads to short-term gains only, must add a long-term pathway that also includes a system of incentives or changes will not be implemented		*							
103	Create rewards for innovation, and follow with regulatory change to support effective and successful program innovation			*						
143	New York State should give teachers incentives (scholarships, grants) to encourage STEM training; increase teacher pay to be more competitive							*		
12	***STATE COLLABORATION WITH BUSINESS TO SUPPORT STEM INITIATIVE GOALS***	**7**	*			*	*			
93	State should be involved in developing industry-based professional development for teachers		*							
119	The state needs to partner with business and industry to benefit from their expertise and ability to lead in implementing change, e.g., 911 technology problems shows that government doesn't understand what needs to change					*				
121	Address liability issues that constrain students and teachers from entering the workplace					*				
122	Create mandates that require teacher training to include business/industry apprenticeships, internships or other forms of involvement to gain experience outside the classroom					*				
124	Work with business and industry to develop curriculum and standards that meet state needs					*				
137	**The state should work collaboratively with business and industry partners to create policies that define new goals for curriculum that align with potential areas of economic development; businesses** that engage in STEM program implementation should communicate to state officials and elected representatives about necessary policies to support education linked to economic development						*			
139	The new state commissioner should review discontinued business and industry programs that effectively worked with children, and restore those that meet new STEM goals; promote policies that will allow instruction and learning to occur beyond the school walls						*			
13	***STEM TEACHING CERTIFICATION REQUIREMENTS***	**14**			*	*	*	*	*	*
53	**Mandate science and math certified teachers to utilize project based learning**					*				
51	Science teaching certifications must be restructured to integrate across sciences and shift away from single science certifications that reinforce teaching to the test				*					
54	**Require a masters degree in math, biology, etc. for certification to assure content expertise**					*				
57	Focus on elementary school teacher training that requires 6 units of math and science and develop a good model that includes problem solving; mandate required lab experience; **increase the New York State standards from 6 units in math to meet national requirements of 9-12 units for a math degree; require an integrated Master/STEM unit plan with required hours for student teachers**					*				
60	Professional development for teachers who leave the classroom for the business world should address a systematic plan for replacing them in the classroom, how to assess necessary expertise, new certifications, appropriate level of classroom management, and how to reenter the classroom and teaching profession					*				
63	Require math and science courses for all teachers; **mandate math and science for elementary school teachers;** elementary school and middle school teachers should have dual certifications in math and science; provide ongoing professional development to support required certifications							*		
66	Extend teacher preparation to 5 years to incorporate interdisciplinary training; provide pay for teachers in their 5th year of training							*		
67	**Teacher preparation should be the development of benchmarks in STEM for the content specialty area, e.g. exit exams;** teacher requirements need to change; Teachers need to be assessed on technical ability								*	

	TABLE A: STATE LEVEL POLICY (N=129)	REGION								
	KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	Subtotal by Category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
68	Use the mandated 175 hours of professional development to focus on STEM; restructure to incorporate stem content instruction								*	
69	Some teachers are teaching in areas where they lack rich learning experiences; teachers completing their masters degrees are required to intern with professional teachers and there is no guarantee that they are content experts								*	
72	Long-term changes in teacher training include extending to a six-year program									*
76	Restructure the New York City teacher excess labor pool to recertify teachers in math and science									*
78	Create a teacher certification for engineering									*
129	Support Regents' actions to require all school districts to reapply for teacher certifications as a way to push more teachers into STEM certifications						*			
14	***SECOND CAREER TEACHER TRAINING FOR STEM PROFESSIONALS***	**5**				*	*		*	*
70	Reconsider the pipeline into teaching; compensation needs to be restructured to encourage business career professionals to enter the field, they are not enthusiastic about becoming teachers (considered to be low man on the totem pole)								*	
71	Regulate alternative certifications to support a shared workforce with STEM professions									*
169	Develop online process for second career teacher certifications (better utilization of existing resources)									*
123	Create mechanisms for career professionals to enter the teaching profession including mechanisms such as tax credits for businesses that "lend" industry professionals to fill the shortage of STEM teachers					*				
140	Develop policy to allow career professionals to begin a second career at retirement as STEM instructors and teacher coaches						*			
15	***STEM PROFESSIONAL DEVELOPMENT FOR TEACHERS***	**8**	*	*		*		*		*
47	Centralize teacher professional development by developing a resource network		*							
56	Utilize the existing mandate for 175 hours of professional development to engage teachers in work outside the classroom, e.g., a teacher who spent one year working at Kodak returned to the classroom as a different person, providing great counseling to the student as a result of that business experience; allow K-12 teachers six months' immersion in industry, and pay teachers a stipend					*				
64	Require current teaching staff to retrain in STEM subjects and provide support [veteran teachers]; teachers will rely on their strengths, design professional development to give teachers the "aha" science and math moment to respark and reinvest in teaching; require that they complete the science and math professional development before they can get the materials for classroom instruction (e.g., science kits) so there is assurance that they know how to use the material; develop instructional delivery standards for veteran teachers; veteran teachers should have one semester to retrain and revitalize their approach to teaching; develop field training for veteran teachers							*		
65	**Include lab training/experience as part of the current professional development requirement (175 hrs in a five-year period); utilize existing professional development framework (20 days/year beyond school year, and also half-day professional development development during the school year)**							*		
75	Create and fund a professional development center to support coaching and other essential aspects of STEM professional development for teachers									*

	TABLE A: STATE LEVEL POLICY (N=129)	REGION								
	KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	Subtotal by Category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
77	**STEM teachers should be given a lighter teaching load in years 1-3, e.g. two classes instead of five, as well as support in delivering hands on instruction and developing research-based curriculum through mentorships, and access to expertise in math and science, peer group development; STEM teachers need a different start in their teaching career and require instructional resources and classroom equipment; give new STEM teachers funds, e.g., $50K, to set up a laboratory in the classroom**									*
81	**Conduct state paid workshops and summer camps for teachers**			*						
16	***SALARY AND OTHER INCENTIVES FOR STEM CERTIFIED TEACHERS***	**7**		*		*	*			*
49	Create pay scale for teachers that will attract those with strong skills and passion for math and science and ability to inspire students			*						
58	Increase teacher salaries; **double the salary of science certified teachers**					*				
59	Eliminate tenure and start "grading" teachers, they are dying for meaningful feedback, e.g., observation and written feedback is rarely done; design differential pay structure based on grading scale; not everyone is motivated by salary alone, create ways to recognize excellence in teaching that elevates quality teaching practices					*				
61	Teachers need to be paid for their time in professional development and made to feel valued for their role in implementing STEM education						*			
73	Subsidize teachers for professional development beginning with elementary school level ("stop playing catch up in higher grades")									*
74	Support differential pay for excellence in teaching; restructure collective bargaining contracts to support rewards and pay scales that compete with private industry; develop a 5-yr bonus structure, require 3 years in STEM teaching									*
105	Institute policies that support teacher mobility between school districts (to protect benefits), current system creates disincentives for teachers to transfer to where they are needed			*						
17	***POLICIES TO ADDRESS UNDERSERVED STUDENTS***	**2**	*	*						
95	Political action is needed to address minority and low SES student needs		*							
106	Leaky pipeline problems must be addressed through changes in state policy and development of strategic networks			*						

	TABLE A-1. LOCAL POLICY (N=28) KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	REGION								
		Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
1	***COORDINATE LOCAL AND STATE ACTION***	**8**	*	*		*	*		*	*
100	Changes to support STEM education must be developed by state entities to create a state platform to coordinate and lead necessary changes statewide; local scale of change cannot support "champions" that can overcome barriers to STEM including barriers to integrate informal education; Create local level change that the State Education Department can embrace and support			*						
101	This is at least a 30-year effort of work between state and local level to implement change in the public schools					*				
103	Important to support leadership by the Chancellor on STEM implementation with coordinated local level action									*
121	Coordinate local action with state level leadership to assure dedicated focus on school districts and regional STEM priorities; principals must make better use of data to communicate local needs and priorities to SED									*
169	**Support state policy that enables local scale changes and an experimental approach at the district level**						*			
170	Statewide policy is necessary in order to initiate STEM at local level		*							
171	Provide state funding during initial phases of STEM program development understanding that long term funding will be required at the regional level (local tax base, business and industry investment)					*				
172	Implement state STEM policies that direct school administrators, principals and teachers to develop and implement STEM education, and shift from sole focus on teaching and preparing for exams; without statewide STEM policies, systematic changes will not occur, and program investment will be transient, ending with school staff turnover, e.g., a new principal comes into a school with new ideas and new programs to implement								*	
2	***MEET LOCAL PRIORITIES***	**7**	*		*	*	*			
102	**Focus on policy that enables schools to make changes at the local level and that includes all key stakeholders including students and parents; policy should support community driven processes that are flexible in order to meet ongoing local needs that will change over time**						*			
106	National standards are "washed away" by local concerns that drive individual school standards		*							
107	Change implemented at the local scale are easier and more immediate than statewide changes, utilize local scale to effect short term change and do not wait for federal and state mandates to initiate change				*					
111	Utilize local authority in setting rules and regulations at the district level in ways that allow change to occur without having to wait for state support					*				
115	**Support state policy that enables local scale changes and an experimental approach at the district level**						*			
5	Utilize local scale to effect short term change and do not wait for federal and state mandates to initiate change				*					
110	**Focus on developing regional mandates that bring industry and education together to develop STEM programs; identify a strong leader that can make the right things happen and get the essential people committed**					*				

	TABLE A-1. LOCAL POLICY (N=28)	REGION								
	KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
3	***RECOGNIZE REGIONAL DIFFERENCES***	**5**			*	*	*		*	
108	Statewide policy should provide flexibility to allow local districts to adapt through experience to design, redesign, reconfigure at the regional scale ("change from the bottom up"); engage students, parents and other stakeholders in bottom up change				*					
109	Local scale competition among school districts needs to be addressed (socioeconomic differences); differences among school districts would not support a uniform statewide STEM policy				*					
113	Each school district should develop their own technology plan and leadership in seeking funding, training and professional development, implementation and program vision					*				
116	The framework for change should address unique differences that will occur at the district level that are necessary to meet local priorities, including aligning STEM programs with local resources						*			
118	Every school district and every school are unique and have unique goals and needs; business and state and federal officials say that the schools do not know what they need; it is up to the schools to clearly define and communicate what they need and how they will measure progress toward achieving goals								*	
4	***STEM PROFICIENCY STANDARDS***	**3**	*						*	
105	There needs to be standards for school board members that measures their proficiency in areas related to STEM		*							
104	Professional development should continue to be developed at the school district level to assure a good "fit" with existing infrastructure, but should also develop standards that raise the quality of current professional development provided for teachers		*							
105	School districts can direct mandated professional development (175 hrs/5 years) to focus on STEM								*	
5	***DEVELOP POLICY ON APPROPRIATE USES OF TECHNOLOGY***	**3**	*				*		*	
117	Develop new policies on technology across the 21 school districts that fosters appropriate use of technology for students, and that teaches them how to explore and learn through technology; consider strategies to scale up *BOCES* example of teaching students appropriate uses of technology; work with adults in the professional learning community to model appropriate uses of technology for students						*			
120	Stop taking technology away from students, instead develop policies to guide student learning with tech tools; students focus on tech because it isn't allowed in school								*	
2	School districts need to develop internet access policies that address student abuses without banning internet access for all		*							
6	***FUNDING POLICIES***	**2**	*			*				
1	School districts should redirect funding to develop math and science academies		*							
112	Use tax dollars more efficiently at the district level to achieve STEM goals					*				

TABLE B: EXISTING STEM RELATED PROGRAMS FOR STUDENTS BY REGION (N=43) KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region		REGION								
	Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
1 *K-6 STUDENT PROGRAMS*	**6**	*			*			*	*
B1 The focus should be on rigor early on, but teachers do not have the time necessary, e.g. "Math Counts" promoted for use in elementary schools where is it not being used due to lack of time								*	
B2 Work with parents to involve them in teaching science at home; consider *Harlem Success Academy* model where parents are required to read to their children in the evening and report to the teacher weekly on books read									*
B3 Buffalo public schools currently include math/science consortiums that are partnered with lower level schools which function as feeders; older students work with younger students, including grades K,1,2; high school students doing half-day field research internships		*							
B4 Identify potential program components that can be mapped out and launched, then work backwards to build a comprehensive approach; utilizing existing resources will give students the opportunity to experience different ways to learn, e.g. the *Wegman* 4th grade program					*				
B5 School 58, the *World of Inquiry* K-6 School in Rochester produces scores in the 90s in math through expeditionary learning, where 90% of students are poverty level (determined by free and reduced lunch program participants); elementary school students "defend" their performance with presentation of portfolios; program practices are being expanded to K-12					*				
B6 Consider the example of the Yonkers elementary school program, "*College in My Future*," where Pre-K students are presented with a T-shirt with the year of their anticipated high school graduation stamped on the front; starting with Pre-K, K, and 1st graders to study STEM courses is a different approach than what they normally experience with elementary school teachers who are math, science, and tech phobic								*	
2 *MIDDLE SCHOOL STUDENT PROGRAMS*	**5**				*			*	*
B7 STEM related programs could be offered before or after school, or weekends, similar to the *Science STARS* program *(Students Tackling Authentic and Relevant Science)* offered by the *Warner School of Education,* where graduate students meet with 7th and 8th grade female students on Saturdays; the *Science STARS Program* allows students to pursue projects in the field of optics to find problem based questions, whether case analysis or research					*				
B8 The *School Without Walls*, established in Rochester in 1971 (7th -12th grades) requires students to complete Senior Projects that are like Ph.D. dissertations; initially students selected courses to be taught and no grades were given, now assessments are required					*				
B9 Consider a program for 7th and 8th grade students who were about to drop out and were instead placed in a class with no curriculum where students developed a project based on their interest in illness and began a research project using the internet to study blood-borne diseases demonstrating "learn by doing"					*				
B10 Consider the *World Science Festival* "Cool Jobs" Program as a model to inform middle school students about potential careers; bring the "Cool Jobs" Program to schools to engage teachers and students in follow-up on outcomes; consider that students in other countries begin career planning in 9th grade; in China political leaders are engineers, while in the U.S. political leaders are lawyers; in India diverse elite go into teaching									*
B11 The "Future Cities Competition" is an annual event where middle school students submit entries to compete, and work with mentors, teachers, and engineers, and are required to present/describe their project as part of the competition								*	

	TABLE B: EXISTING STEM RELATED PROGRAMS FOR STUDENTS BY REGION (N=43)	REGION								
	KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
3	***HIGH SCHOOL STUDENT PROGRAMS***	**14**		*	*	*	*	*	*	*
B12	*Tech Valley High (TVH)* students are expected to pass at a higher level on exams; anecdotal data shows that most *TVH* students go on to post-secondary education with completion rate somewhere in the 90s				*					
B13	*Tech Valley High (TVH)* students are expected to pass at a higher level on exams; anecdotal data shows that most *TVH* students go on to post-secondary education with completion rate somewhere in the 90s			*						
B14	*Tech Valley High* "mini-internship" program in partnership with small business									*
B15	Consider strategies to scale up *BOCES* example of teaching students appropriate uses of technology						*			
B16	*BOCES* training facilities allow student access for ages 16-18; work with *BOCES* to identify other situations that students can access for STEM training (liability issues)					*				
B17	*BOCES* provides a model of earning credits for alternative learning experiences; consider the *New Vision Program* for high school seniors as well as the *Franklin High School Program* linked to the *Rochester General Hospital* for examples of ways students can earn credit in alternative programs					*				
B18	*Project Lead the Way* is helping students to go from a career path leading to refrigerator repairman, to designer of the refrigerator; students are not less smart, but need a different orientation to math and science								*	
B19	Need to create curriculum in computer science and multimedia design, currently those that exist are add-ons, "shoe-horned" into programs; must be part of the core curriculum with robust assessments (see *Project Lead the Way*)									*
B20	Align K-12 math and science curriculum with higher education requirements, e.g. *Project Lead the Way* students cannot meet physics requirements for college engineering programs									*
B21	See Electric Car competition conducted by *Project Lead the Way*							*		
B22	Consider the program at *Aviation High School* in New York City, where students can achieve certification as mechanical inspectors					*				
B23	The *Youth Apprenticeship Program* of Rochester requires students to complete capstone projects that link school with community					*				
B24	See the *JPMC* high school apprenticeship program; develop a six-week, job-related internship, to start as early as age 13; consider student pay; develop mentor teams to avoid time constraints/burden on a single working professional; draws from interested adults, e.g., *Big Brothers, Big Sisters*							*		
B25	Consider local example of a high school that offers vocational education in partnership with the community college to students who want to drop out of school, and remarkable turnaround in motivation and scholarship						*			
4	***K-12 PROGRAMS***	**7**	*		*				*	*
B26	The Yonkers area has access to the "science barge" and should be linked to every school to provide all youth with an opportunity to visit the program; funding for buses can be provided by private support and can be offered in both spring and fall								*	
B27	The "Future Cities Competition" is an annual event where students submit entries to compete, and work with mentors, teachers, and engineers, and are required to present/describe their project as part of the competition								*	
B28	Developmental math curriculum is available nationally, and is effective at exciting students about math in ways that relate to everyday life								*	
B29	Buffalo public school statistics show a graduation rate of 90% for students in computer/tech education programs, when overall graduation rate for BPS is 50%; demonstrates value of tech education in engaging students in ways that they can connect their interests with their education		*							

TABLE B: EXISTING STEM RELATED PROGRAMS FOR STUDENTS BY REGION (N=43) KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region		REGION								
		Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
B30	Explore potential for model programs including the World Science Festival									*
B31	*Adirondack Park* (provides students an opportunity for science-based learning experience)									*
B32	Consider ESL model to support student needs				*					
5	***COLLEGE AND UNIVERSITY PROGRAMS***	**8**	*			*		*	*	
B33	*University of Rochester* has a pilot project for seniors to train peer leaders in junior courses (weekly meetings)					*				
B34	Consider *St. John Fisher* program for students to expose them to careers, hands on learning and opportunities for employment, e.g. pharmacy technician					*				
B35	Consider *RIT* program that connects college age female students with 5th grade girls					*				
B36	*SUNY* has a program that allows students to design their own tech courses							*		
B37	Community colleges are the best kept secret: graduation rate is low because not all students are there for a degree, but to benefit from certificate programs or to advance their job skills through specific courses								*	
B38	*Westchester Community College* has a robotics program that meets everyday after school; the program receives donations of food and equipment and offers students opportunities to work with mentors								*	
B39	*Fordham University* has a successful robotics program that is very effective with 80 members involved in the robotics club from the *Saunders School;* the *Roosevelt High* mentoring program is not as successful as *Saunders*								*	
B40	Consider *UB* gifted math program to scale for access by "at risk" students		*							
6	***BUSINESS AND INDUSTRY STUDENT PROGRAMS***	**3**				*		*		
B41	*Wegman's* has students rotate through six-week programs in different departments					*				
B42	Consider the *Xerox* adult mentoring program as a model for outreach to students about how to pursue STEM careers; demonstrate potential careers through product outcomes, e.g. robots to show student potential exciting technology they can pursue					*				
B43	See the *Grippen Institute* project that supports two student industry internships to determine process to scale up this type of program							*		

TABLE C: EXISTING STEM RELATED PROGRAMS FOR TEACHERS BY REGION (N=23) KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region		REGION								
	Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
1 STEM PROFESSIONAL DEVELOPMENT	**17**	*	*		*	*		*	*
C1	Principals must seek better STEM professional development (PD) and require teachers to complete available training, e.g. New York City (NYC) currently offers summer, hands on science instruction PD that can potentially service 50% of all NYC teachers over the next five years								*
C2	Create summer programs for teachers to work with career professionals, then follow with a fall program where students become involved in hands on learning; provide teachers with a framework to develop collaborative relations with other teachers, transforming the concept of teaching practices; develop skill set to promote team dynamics and project based instruction [PBL]; utilize strong teachers as lead to collaborate with weak teachers and new teachers; utilize the *BOCES* PD model				*				
C3	Develop program opportunities for teachers to gain training and experience in STEM education within a process that returns them to their home school (e.g. *Beacon Institute)*								*
C4	Build on existing successful programs, like *Tech Valley High,* to foster changes in administrative and teaching practices				*				
C5	Utilize the *Tech Valley High (TVH) Program* as a model for teachers to see problem based learning in the classroom; develop teacher training that builds on *TVH* program approach								*
C6	Work with *NASA* to develop *STAR* teacher training programs similar to those conducted in California that give teachers the opportunity to earn an *Endeavor Science Teaching Certificate* through 10-week summer courses, followed by mentoring during the school year, and a 10-week lab opportunity; long-term links can be established as part of the *STAR* program with all STEM agencies including *NASA, NOAA,* and *NIH* to support ongoing teacher professional development								*
C7	Buffalo has 30 middle school teachers who are teaching "multi-modally using cameras and probeware"; need school district support for ongoing professional development		*						
C8	Build upon existing "Character Development"professional development		*						
C9	Build upon the recent program funded by *Engineers for the Future* ($2 million) that supported a summer program conducted by a math/science/tech collaborative for 400 teachers to work with engineers and scientists to develop lessons in robotics, cloning and the environment		*						
C10	Build upon the recent formation of a NYS *STEM collaborative* supported by the NYS teachers of science, math and tech; they are planning a summer institute		*						
C11	In 1995, a college workshop program for chemistry teachers to learn to work together was initiated with good results, later it was expanded to the biology department by request where it has also been effective; take this program to the lower grades and show what can be achieved				*				
C12	*NSF* funds three schools to support inquiry based learning in math and science, providing mentors and opportunities for teachers to collaborate in Yonkers, Buffalo, and New York City; principals are strong supporters of the program and this has had a big effect on the program's success; teachers also experience summer sessions that include travel to work with mentors in intensive project development processes				*				
C13	Consider *Beacon Institute* as a model for teacher training and professional development of current teachers to gain STEM skills through summer courses and other opportunities, returning to their home schools to apply new skills to teaching								*
C14	Modify New York State *Teach for America* to support STEM education goals								*
C15	Consider teaching at Williamsville, Orchard Park, Amherst Elementary for integrated lessons and instruction		*						

TABLE C: EXISTING STEM RELATED PROGRAMS FOR TEACHERS BY REGION (N=23)		REGION								
KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region		Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
C16	Consider the "Technology Tuesdays" program at *Prattsburg School District* in NYS as a model for providing effective instruction for teachers on application of technology in the classroom, where teachers experience one-on-one training with the opportunity to return immediately to the classroom to use new skills						*			
C17	Consider new *Schenectady Community College* "Super Power" summer program as a model for high school and college instructors to link with businesses to inform their instruction			*						
2	***STUDENT TEACHER TRAINING AND PRE-SERVICE PROFESSIONAL DEVELOPMENT***	**6**							*	*
C18	*Fordham University* has a professional development school where student teachers are trained for one year on school operations and dynamics of being involved in a school community, and is lead by university faculty								*	
C19	*Columbia Teacher College* is offering a new certificate in building leaders through participation in shared leadership where everyone is expected to contribute to successful outcomes, and also fosters a long-term approach to successful program development								*	
C20	*Mount Sinai* is conducting a program for teachers to learn science through disease; program outcomes are being studied now and should be tracked for useful approaches to incorporate in new science curriculum, assessment and testing									*
C21	New York City has a teacher residency program (pay is $10k/year for 3 years) that could be leveraged across the state; identify new sources to fund expanding the residency program									*
C22	Explore the *Bard College program* (Open Source Content; Teacher Training, terminal certificate in content area and placement program)									*
C23	*SUNY Teaching College* should partner and provide model for teacher training									*

	TABLE D: OTHER RELATED MODEL PROGRAMS WITHIN THE STATE (N=41) KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	REGION								
		Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
1	***SCHOOL PROGRAMS***	**17**	*	*		*	*		*	*
D1	Follow *Tech Valley High* model in bringing business and unions early to the planning and design process			*						
D2	Middle school "Future City" competition can be model for others to follow; includes competition that involves engineers and students in project development		*							
D3	**Follow charter school models to foster innovation and creativity in meeting student needs**			*						
D4	**Develop new strategies for public schools that fix the problems and build on what has been learned through the charter school process; utilize the *Tech Valley High* experience to shift away from top down, highly structured, highly regulated environment to restructure the school and approach to teacher certification**			*						
D5	Cannot replicate *Tech Valley High,* the window of opportunity for that was very top down and is no longer a viable approach (change in leadership)			*						
D6	Develop a competitive project proposal system to gauge best projects region wide; students should play a role in developing proposals; *East High School* offers seven opportunities each year to submit project proposals for the following year; the *East High Go Green Club* has been successful in this competition, and engaged students in developing environmental projects					*				
D7	Create a STEM institute similar to the *Oswego* program where scientists, mathematicians, engineers and educators can share and learn from each other to be able to make changes in elementary, middle, high school and college level classrooms					*				
D8	Consider the *Hillside* scholarship education liaison as a model for STEM School District Coordinators; *Hillside* has grown in partnerships, causing the program to be spread thin; the program has effectively provided workplace mentors who work with students and with the school advocate/liaison					*				
D9	Take immediate steps to make changes based on the success of the *Tech Valley High* model of *High Tech High,* and *BOCES* as a system within a system, pushing the envelope; follow their model as an example of developing a local solution						*			
D10	Consider NYS programs, BOCES and *MST Connect* as examples of programs that have achieved consensus through action, gaining parent and community support						*			
D11	Programs that do not meet Regents standards are not valued, e.g. *BOCES,* and should be considered for their potential to demonstrate innovative solutions for teachers and students								*	
D12	Consider changes that build upon creating "virtual" schools, collaborative schools, and virtual classrooms; develop online virtual instruction that can open up opportunities for students and teachers; Yonkers is already offering online instruction; courses can be blended, i.e., in-class instruction, online and distance learning								*	
D13	Consider the *New Tech Schools* as models for changing the organization of the school and changes in teacher training									*
D14	Organize a process to consider infrastructure needs, identify problems and solutions, catalog innovative institutions (models) and map a strategy for changing the organization of the school and structure of teacher training (see *New Tech School*)									*
D15	The *Harlem Success Academy* can be a model for developing new types of educational incentives									*
D16	Develop state level policy and standards for tech education, e.g. nanotech and green technology; use *BOCES* as a model			*						
D17	*Bard College* (continuing education for prison population; new learning facility has resulted in attracting students, increased enrollment)									*

	TABLE D: OTHER RELATED MODEL PROGRAMS WITHIN THE STATE (N=41) KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	REGION								
		Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
2	***INTERNSHIPS***	**5**				*	*	*		*
D18	Capitalize on resources in Rochester, including the *Rochester Regional Photonics Cluster,* the *National Teaching and Machining Association, Rochester Business Alliance,* and *FAME*; seek methods to link these resources with student opportunities to earn credits					*				
D19	Consider the *Raymond Corp.* internship programs, as well as offering training and instruction						*			
D20	Internships should be part of the curriculum; see the *Syracuse Research Center* where intern teams are created, work collaboratively and are mentored more than managed							*		
D21	**Modernize organizations like *Big Brothers, Big Sisters* to develop engagement in STEM mentoring, internships**							*		
D22	Consider the *Cornell University* apprenticeship program									*
3	***PARTNER PROGRAMS***	**10**	*	*		*		*	*	*
D23	Consider the *SUNY Nanotech* project as a model for K-12 business and education partnerships			*						
D24	Yonkers is working with a real estate company to help design the *Roosevelt College Center* and is an example of different ways business interests can be developed, e.g., owning part of a school								*	
D25	*Con Edison* already gives $8 million/year to education, but the collaboration and agreement are missing; *Kodak* was supporting school programs, but recently discontinued its participation due to rough economic times								*	
D26	Cultivate relations with content experts and scientists through "adopt-a-school" programs; utilize career professionals and other STEM content experts in conducting PD for teachers									*
D27	Charter school program uses career model beginning with kindergarten; students and teachers required to complete business internships; career counseling conducted by industry professionals brings business professionals to the school on a regular basis, exposing teachers and students to working professionals		*							
D28	Consider the state *Center of Excellence* for STEM science camp opportunities in partnership with *SIMI Semiconductors*					*				
D29	**Use the *Cornell Cooperative Extension Program* to set up a STEM clearinghouse as a "donor choice model" open for businesses and teachers to connect school needs with business resources; could also be used by business to promote jobs/positions aimed at students; develop the infrastructure to support partnership building, matching businesses and schools by county/city, identify internships, and coordination to assure good outcomes**							*		
D30	NYC *Hall of Science* (*HOS*) coordinates clinical work between college students and *HOS* staff providing practical experience for students; program offers 500 hours of teaching practice coordinated with school courses; scale this across the state with other museums									*
D31	Utilize information being developed through the *Tech Valley High* research-based program to demonstrate success of collaboration and involvement of partners in design and implementation of STEM education									*
D32	The *Leadership Academy* is a major business investment and should be directed to implement STEM education and to monitor outcomes									*
4	***DATA SHARING***	**2**							*	*
D33	Support the Regents to implement "connectedu.net," an electronic database that will be linked across all school districts; give students access to the database								*	
D34	**Develop data sharing mechanisms and processes;** create innovation centers and invite everyone in, including *SUNY* and private colleges, to share important data on graduates entering post secondary education to track STEM students; see example of *CUNY* on sharing graduate data; develop training and support for higher education professors to provide effective student data									*

	TABLE D: OTHER RELATED MODEL PROGRAMS WITHIN THE STATE (N=41) KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	REGION								
		Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
5	***STEM AWARENESS***	**4**	*	*				*		*
D35	Coordinate across the various community activities that relate to science and math, e.g. "Body Worlds," upcoming exhibit on Darwin jointly developed by *UB* and the library; these can help to change people's perspective on science		*							
D36	Use the *SUNY Nanotech* program to effectively show the community what is possible as well as to demonstrate the excitement of science			*						
D37	Use the annual *GEAR UP* parent conference in the spring to embed ideas on science fair opportunities with parents who need to engage and support community involvement; see *POTTERS FOR PEACE*, where artists and scientists came together to study water supply challenges; rename science fairs, "problem fairs," to emphasize multidisciplinary, multiple stakeholder process, including all ages, incentives, problem banks, industry/business partners, real life connections with STEM professions, and opportunities to create experiences that change life trajectories; **showcase student projects through competition**							*		
D38	**Utilize *National Lab Day* held in NYC as a center point for the STEM initiative for students in NYC; work with stakeholders to engage all views**									*
9	***FUNDING SUPPORT***	**3**							*	*
D39	*Fordham University* offers a successful program for schools in grant writing targeted to local, regional and national grant programs								*	
D40	See the website, *donorschoice.org* to find support for classrooms where the community can offer sponsorships or respond to school needs through small contributions toward fundraising to meet education needs, and all that is required is a letter of thanks from the school for funds received								*	
D41	Consider the *SUNY Nanotech Program* and the *Structural Biology Center* for models of pooled capital									*

	TABLE E: OUT OF STATE MODEL PROGRAMS/PRACTICES (N=23) KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	REGION								
		Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
1	***CROSS CUTTING PROGRAMS***	**7**					*		*	*
E1	Consider the *Ohio* model of STEM education where the state initiated legislative action to eliminate restrictions, and instituted a radical process to work on program development with committed people, creative outside the box thinking, and collaboration across different stakeholders; teachers are not pressured to meet seat time requirements, and are supported by superintendents and principals to explore innovative approaches to learning						*			
E2	Consider the *North Carolina* model of 21st century STEM education where they are identifying outdated measures and assessments and eliminating related requirements as students succeed, demonstrating that change is possible						*			
E3	Consider *Finland's* achievement as the #1 education system in the world in curriculum and assessment, where teachers mentor students in completing student-designed projects, and teachers coach each other						*			
E4	Connect with the *Workforce Investment Act* (*WIA*) board to explore common goals related to developing basic skills, fixing the pipeline, and addressing social issues related to job and career needs								*	
E5	Consider teaching model in *Singapore* where the school day is 8am to 1pm, and teachers have options to work with students or with other teachers during the afternoon; pay is equal to *U.S.* teachers, and teachers are treated with respect equal to university faculty and given time to develop curriculum, conduct student workshops, clubs, and engage in professional development and creative planning with other teachers									*
E6	**Create a systems approach to STEM program development through coordinated planning, similar to *NASA* model where projects are conducted by a master planner who has responsibility for organizing and coordinating project phases and components to project completion**									*
E7	Consider the example of the *Michigan* Governor who initiated a program to provide fiber optic connections for all schools, especially in rural areas where students have fewer resources based on his experience growing up in northern rural *Michigan;* the program also provided laptops to all teachers; how to impart this kind of insight and motivation in all decision makers?								*	
2	***SCHOOL PROGRAMS***	**8**	*	*			*	*	*	*
E8	Charter schools include *Stiner* outside of NYS: *Massachusetts* state integrating multiple agencies and developing a more holistic approach		*							
E9	Consider model program in *Boston* for shift to year-round program; incorporated STEM/problem based learning through creation of four interdisciplinary courses (and two separate humanities courses); program support required cutting operations and maintenance budget, negotiating furloughs with teachers, caps on line item expenses, and cutting under-enrolled programs			*						
E10	Consider the *Japanese* educational system, where teachers teach half day, and spend the other half of the day collaborating with other teachers						*			
E11	See *Denver* programs where incentives have been established for effective higher education engagement with high schools; eliminate tenure as a major way to effect change in higher education							*		
E12	Look at examples of integrated curriculum developed by private schools; *San Diego, Ca.* has a problem based learning school; *Yonkers* had one but there is room for improvement; *Westchester, NY* is using problem based learning								*	
E13	*MIT* (open access to lectures and other course materials online, and more value placed on *MIT* learning experience)									*
E14	Consider *Project Zero, Harvard University,* "Learning for Understanding," program for problem based learning that can build a wide range of skills									*

	TABLE E: OUT OF STATE MODEL PROGRAMS/PRACTICES (N=23) KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	REGION								
		Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
E15	Consider the *Ohio* STEM schools, where there is more local control over designing change, built into legislation, e.g. control over scheduling, development of off-site projects, and creating summer programs for credit									*
3	***STUDENT PROGRAMS***	**5**	*				*	*		
E16	Consider *Rhode Island* program where students learn through internships, or *Bronx* program where students match curriculum and courses to internships		*							
E17	*German* apprenticeship model is focused on two goals: education and professional development on a fulltime basis							*		
E18	See the *GLOBE Program* (*NSH/NASA*) where students are linked online and can gather data on problems in their environment to load directly to web where scientists can review and use the data; students are engaged real time with real world issues, and data can contribute to outcomes							*		
E19	Utilize *NASA* capacity to develop problem-based projects that can be delivered to schools, and virtual competition can be conducted by *NASA* scientists creating links between *NASA* resources and schools							*		
E20	Consider the *German* apprenticeship system where trade schools are respected and only 15% of students enter college						*			
4	**TEACHER TRAINING/PROFESSIONAL DEVELOPMENT**	**2**							*	*
E21	Consider the *NASA* teacher science certification program as a model for pre-service, in-service training								*	
E22	Create a *STAR Program* with *NASA* similar to California, to provide teacher training in research and content expertise, and build links to STEM agency resources, e.g., *NASA, NOAA,* and *NIH,* including STEM scientists									*
5	***STEM AWARENESS***	**1**								*
E23	Consider the *Nike* model (marketing to influence interest before a product is "rolled out")									*

TABLE F: SECOND CAREER TEACHER TRAINING (N=20) KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region		REGION								
	Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
1	***SECOND CAREER TEACHING/PROFESSIONAL DEVELOPMENT/TEACHER CERTIFICATION***	**8**	*				*	*	*	*
F1	Business can support creation of second career teachers through training and coordination with State Education Department for certification process and job placement (100 *IBM* staff involved in "Transition to Teaching"); business can work with education to meet the need for science and math teachers now (short term solution) and not wait for new teachers to be trained for STEM education (long term solution)									*
F2	Train industry professionals to work in the classroom; open up other avenues to become a teacher, change the tradition; open up the certification so that career professionals can achieve adjunct status; develop job sharing between industry and teachers							*		
F3	Content expertise does not necessarily make good teachers; career professionals need training in teaching practices								*	
F4	Develop online process for second career teacher certifications (better utilization of existing resources)									*
F5	Open up teacher certifications to career professionals to meet urgent needs for STEM teachers and that will also involve industry in education; consider the *New Jersey* program as a model									*
F6	Work with the *Science Academy* to encourage its members to consider second careers in education (6K *Academy* members) to pursue a short term plan to meet the need for STEM instruction									*
F7	Develop a cadre of tech teachers among retired professionals (training can be completed in one year)		*							
F8	Develop policy to allow career professionals to begin a second career at retirement as STEM instructors and teacher coaches						*			
2	***STEM CAREER PROFESSIONAL CO-TEACHING***	**6**				*	*	*		*
F9	Career professionals that shift into teaching are entering urban classrooms and are struggling with classroom management; create a framework that partners the experienced teacher with the content expert so they both gain from their combined strengths; develop online courses for career professionals to eliminate the problem of classroom management for novice teachers					*				
F10	Utilize career professionals to provide coaching and/or co-teach with veteran and new teachers						*			
F11	Create opportunities for veteran teachers to co-teach with career engineers									*
F12	Create opportunities for career professionals and college students to co-teach STEM courses					*				
F13	Create summer programs for teachers to work with career professionals, then follow with a fall program where students become involved in hands on learning; provide teachers with a framework to develop collaborative relations with other teachers, transforming the concept of teaching practices; develop skill set to promote team dynamics and project based instruction [problem based learning]; utilize strong teachers as lead to collaborate with weak teachers and new teachers; utilize the *BOCES* professional development model					*				
F14	Develop "working scientist" program to bring career professionals to the classroom (nurses, farmers, people who use science in their professions everyday); consider developing a professional sabbatical or a scientist in residence program							*		
3	***BUSINESS SUPPORT FOR SECOND CAREER TEACHERS***	**6**		*	*	*		*	*	*
F15	Support professional development for industry to prepare for teaching different age groups; see *IBM* teacher preparation kit as model			*						

	TABLE F: SECOND CAREER TEACHER TRAINING (N=20) KEY: Boldface text=statements that were selected by a breakout group as an important idea; Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	REGION								
		Subtotal by category	1. Buffalo	2. Capital Region	3. Long Island	4. Rochester	5. So. Tier	6. Syracuse	7. Yonkers	8. New York
F16	Teacher training should be conducted in partnership with business to allow professionals to work “in service” with teachers (“create continuing education credits”); work with higher education to build teacher skills to teach “real science and real math” before they enter the classroom				*					
F17	The best approach to attract content experts to the classroom may be to offer career professionals cooperative engagements with schools so they can maintain their status in the business world, and still contribute in the classroom; recruit and select teachers for shared jobs and job appointments								*	
F18	Create mechanisms for career professionals to enter the teaching profession including mechanisms such as tax credits for businesses that “lend” industry professionals to fill the shortage of STEM teachers					*				
F19	Develop avenues for professionals and retirees to prepare to enter the classroom (volunteer or hire); set up one-on-one, or cohort of students to maximize student experience with career professionals; professional sabbaticals can be conducted for 1 year in a K-12 teaching assignment							*		
F20	Partner with business and industry to create pathways for career professionals to move between career and teaching; consider academic fellowship model; create opportunities for career professionals to shift to teaching in later years									*

Appendix 9.2

Tables AA through CC:
AA. National Level of Innovative Actions
BB. State Level of Innovative Actions
CC. Regional Level of Innovative Actions

TABLE AA: NATIONAL LEVEL INNOVATIVE ACTIONS (TOTAL N=51)			
	Region	KEY: A=Captial Region, B=Buffalo, C=Southern Tier, L=Long Island, N=New York, R=Rochester, S=Syracuse, Y=Yonkers; Boldface text=statements that were selected by a breakout group as an important idea;Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	Sub-Total by Category
1		***CROSS CUTTING ACTIONS***	**(7)**
AA1	C	NYS should develop three key areas of policy to implement effective change: extend the school calendar to year-round, implement problem based learning (PBL), and develop high quality professional development (PD) for teachers, including new STEM requirements for pre-service training; policy should consider what education should look like in 5 or 10 years; state STEM policies should provide guidance on transitioning to PBL; throw out the text books	
AA2	C	State standards should address all content areas through an interdisciplinary framework for curriculum design; provide an adequate timeframe for new curriculum development with exemptions on exams for 3-5 years; provide adequate funding for curriculum expertise and design	
AA3	C	Focus on teacher PD to break away from the 1880s model of teaching; provide adequate funding for PD; restructure the school day to allow adequate time for teacher innovation and creativity; new policies must include mandates and timeframes that will assure sustainability of the STEM initiative and therefore, garner investment by teachers; teachers have a role to play in pressuring the state to sustain STEM programming through legislative action; **legislators need to respond to that pressure to assure that STEM education is adequately supported and sustained through permanent restructuring of the system**	
AA4	C	**Develop a pilot school staffed by teachers in PB training by industry, and also traditional teachers who can convey how it works and can convey ideas, teach and collaborate with business to co-develop curriculum; use the pilot school to provide a demonstration classroom for training that can feed to local schools in the district; work with business expertise in training and instruction**	
AA5	C	**Extend teaching contracts from 10 months to 11 months to include 1 month of PD annually; change the school work day to look more like the business work day; work with unions to develop compensation to match new contract conditions**	
AA6	C	**Change the school year to improve the connection between the teaching world and the real world;** lengthen the school day to 8 hours, and start later (brain scientists recommend the latter) to keep students later so that they are not going home in the middle of the day when their parents are at work; pay teachers for an 8 hour day; consider benefits of extending the school day for rural students who have transportation challenges with before-school and after-school programs	
AA7	A	Clearly define goals for all stakeholders to establish common ideas about building a strong vibrant education community and workforce; it is especially important to link these two goals in order to engage teachers who are resistant to the concept of workforce development, but who would support building community; the underlying message is that without a strong workforce there is no community	
2		***CREATE NEW SCHOOL PROGRAMS UTILIZING BEST PROGRAMS AND MODELS FOR STEM EDUCATION***	**(2)**
AA8	A	State should coordinate business involvement to develop support for creating more *Tech Valley High School* programs	
AA9	A	**Create a structure that will allow pilot program development without punitive effects for efforts that don't succeed, e.g., allow three to four years for pilot program development; *Tech Valley High* received waivers from the state allowing adequate time to develop programs that meet state requirements (state determines what you learn, not how you learn it)**	
3		***INITIATE STEM PROGRAM AND CAREER DEVELOPMENT WITH YOUNG STUDENTS***	**-**
4		***ADDRESS ACCESS TO TECHNOLOGY RESOURCES***	**-**
5		***CHANGE THE STRUCTURE OF THE SCHOOL DAY/YEAR TO SUPPORT STEM EDUCATION GOALS***	**(1)**
AA10	C	**The school year is outdated and no longer meets student needs**, and ties school funding cycles to a timeframe that constrains state supported educational services	
6		***BUILD STEM PROGRAMS THAT UTILIZE SUCCESSFUL BUSINESS MODELS***	**(2)**

TABLE AA: NATIONAL LEVEL INNOVATIVE ACTIONS (TOTAL N=51)			
	Region	KEY: A=Captial Region, B=Buffalo, C=Southern Tier, L=Long Island, N=New York, R=Rochester, S=Syracuse, Y=Yonkers; Boldface text=statements that were selected by a breakout group as an important idea;Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	Sub-Total by Category
AA11	N	In the school environment, assessment is about measuring what you have learned; in the corporate environment assessment is a constant aspect of gauging productivity to determine what skills are needed to solve a problem, what is expected for effective team work and how to add value to the team, and producing good outcomes	
AA12	A	Build on business model to foster entrepreneurial approach to program development that includes adapting to new conditions, changing workforce thru retraining, and successful problem solving vs. going out of business, failing to adjust and survive	
7		***CREATE K-20 PROGRAM CONNECTIONS***	**-**
8		***DEVELOP PARTNERSHIPS WITH COMMUNITY-BASED INFORMAL LEARNING PROGRAMS***	**-**
9		***INCREASE STUDENT AWARENESS OF VOCATIONAL EDUCATION STEM CAREER PATHWAYS***	**(1)**
AA13	C	**Students should see viability of pursuing successful STEM career paths through trade schools as well as through college;** need to address student perceptions about trade schools, e.g., referring to BOCES students as "botards"; not all students can afford to go to college and are not aware of career choices through vocational training, e.g., plumbers, welders, that do not need a college degree	
10		***DEVELOP STEM PROGRAMS TO ADDRESS UNDERSERVED STUDENT NEEDS***	**(2)**
AA14	A	Need to inspire underrepresented students early in their education; identify role models from a broad spectrum of STEM careers and diversity of individuals (minorities, women)	
AA15	A	Consider options to increase female student interest and pursuit of science education; single sex schools show higher enrollment rate for females in science courses and accelerated courses than in public co-ed schools	
11		***CREATE PROGRAMS FOR STUDENTS TO ENGAGE WITH STEM CAREER PROFESSIONALS AS ROLE MODELS***	**-**
12		***STEM PROGRAMS MUST ADDRESS BROAD SOCIAL ISSUES TO BE EFFECTIVE***	**(1)**
AA16	B	Drug use is a factor in addressing workforce needs, affecting both students and employees (75% of employees cannot pass a drug test), need parents and broader community to work on the problem, not just a school problem	
13		***REQUIRE TEACHERS TO COMPLETE STEM PROFESSIONAL DEVELOPMENT***	**(6)**
AA17	N	NYC Hall of Science (HOS) coordinates clinical work between college students and HOS staff providing practical experience for students; program offers 500 hours of teaching practice coordinated with school courses; scale this across the state with other museums	
AA18	C	**STEM education requires huge changes in PD to provide adequate resources and training to effectively prepare teachers for STEM instruction; provide in-service and pre-service training so that all teachers are STEM trained when they enter the classroom and motivated to pursue ongoing STEM curriculum development; focus PD on developing skills in math and science**	
AA19	C	Teachers must have opportunities to leave the classroom to experience the world of business and industry to understand what is happening and what has changed; most teachers have been in school since age 5 and have never been a part of business and industry and need to learn through first hand experience and need support in translating that experience to the classroom, creating a lesson plan and integrating new knowledge into the curriculum, otherwise they will stick to the textbook; sensitivity should be incorporated into PD intended to build real world experience for teachers who resent being told they do not understand the world they live in	
AA20	A	Professional development should be embedded in the school day, not added to it	

TABLE AA: NATIONAL LEVEL INNOVATIVE ACTIONS (TOTAL N=51)			
	Region	KEY: A=Captial Region, B=Buffalo, C=Southern Tier, L=Long Island, N=New York, R=Rochester, S=Syracuse, Y=Yonkers; Boldface text=statements that were selected by a breakout group as an important idea;Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	Sub-Total by Category
AA21	A	Create incentives that encourage teachers to explore STEM instruction and enhance delivery of PBL; provide framework for teachers to explore PBL without punitive action, e.g., if students fail, teachers are punished; PBL is a two-way learning process for students as well as for teachers to learn new ways of teaching and new modes of student learning	
AA22	A	Teacher training should be designed to meet student needs; focus on approach to STEM education that embraces developing student "habits of mind" that support inquiry as a way of learning for teachers and for students	
14		***CREATE STEM TEACHER TRAINING/PRE-SERVICE PROGRAMS FOR NEW TEACHERS***	**-**
15		***CREATE STEM TEACHER CERTIFICATION PROGRAMS***	**(1)**
AA23	C	**Create a "loan forgiveness" program for student teachers who pursue STEM related teaching certifications**	
16		***CREATE COLLABORATIVE PROGRAMS FOR TEACHERS AND STEM CAREER PROFESSIONALS TO WORK JOINTLY ON STEM COURSE DEVELOPMENT AND INSTRUCTION***	**(3)**
AA24	R	Teachers can benefit from collaborating with career professionals; create opportunities for teachers to partner with career professionals for up to six months to co-design projects, identify common interests and build relationships	
AA25	R	Create summer programs for teachers to work with career professionals, then follow with a fall program where students become involved in hands on learning	
AA26	R	Provide teachers with a framework to develop collaborative relations with other teachers, transforming the concept of teaching practices; develop skill set to promote team dynamics and project based instruction; utilize strong teachers as lead to collaborate with weak teachers, and new teachers; utilize the BOCES PD model	
17		***CHANGE STANDARD TEACHER EVALUATIONS TO INCORPORATE STEM EDUCATION GOALS***	**(2)**
AA27	R	Eliminate tenure and start "grading" teachers, they are dying for meaningful feedback, e.g., observation and written feedback is rarely done; design differential pay structure based on grading scale; not everyone is motivated by salary alone, create ways to recognize excellence in teaching that elevates quality teaching practices	
AA28	C	**Track teacher performance through student performance and provide feedback to colleges of education**	
18		***CHANGE STEM TEACHER COMPENSATION AND WORK WITH UNIONS TO ADDRESS CHANGES TO SUPPORT STEM EDUCATION GOALS***	**(4)**
AA29	B	Union issues must be addressed, e.g., they have not been supportive of programs that threaten to reduce numbers of teaching or aide positions (such as college students teaching k-12 courses); need to be involved early in building collaborative processes; need to address union concerns with developing adjunct faculty (e.g., retired professionals)	
AA30	A	Institute policies that support teacher mobility between school districts (to protect benefits), current system creates disincentives for teachers to transfer to where they are needed	
AA31	A	Create pay scale for teachers that will attract those with strong skills and passion for math and science and ability to inspire students	
AA32	A	Engage unions early in the process to better understand their issues and interests; coordinate labor involvement to expand current local scale engagement to state level	
19		***DEVELOP TEACHER TRAINING PROGRAMS FOR SECOND CAREER STEM PROFESSIONALS***	**(3)**
AA33	N	Open up teacher certifications to career professionals to meet urgent needs for STEM teachers and that will also involve industry in education; consider the New Jersey program as a model	
AA34	N	Work with the Science Academy to encourage its members to consider second careers in education (6K Academy members) to pursue a short term plan to meet the need for STEM instruction	
AA35	C	Develop policy to allow career professionals to begin a second career at retirement as STEM instructors and teacher coaches	

TABLE AA: NATIONAL LEVEL INNOVATIVE ACTIONS (TOTAL N=51)			
	Region	KEY: A=Captial Region, B=Buffalo, C=Southern Tier, L=Long Island, N=New York, R=Rochester, S=Syracuse, Y=Yonkers; Boldface text=statements that were selected by a breakout group as an important idea;Underlined text=statements that were selected by a breakout group as a priority action to advance STEM education in the region	Sub-Total by Category
20		***DEVELOP STEM CURRICULUM, INSTRUCTION, AND ASSESSMENTS***	**(8)**
AA36	Y	Vertically align high school and college curriculum	
AA37	C	**The term "teacher" is archaic and does not reflect the new role of teachers as learning facilitators or counselors who should function as team leaders in collaborative learning teams that follow the industry model; teachers do not have experience working in teams or how to use other teachers as experts in collaborative team teaching, and lack the knowledge necessary to teach children how to be effective team members**	
AA38	C	Consider how students today like to learn through texting, social networking, smart boards, staying connected, this is their process and needs to be part of their school life; throw away the textbooks and give students computers, let them use their cell phones because this is their culture; they are multitaskers and "physiologically different" from adults	
AA39	A	Students are taught to learn what is on the test as the end goal; siloed education does not lead students to understand how all things are connected	
AA40	A	STEM instruction will require different teaching and measuring methods to capture creativity; STEM must be built into the curriculum in order to assure that the program is sustained	
AA41	A	Utilize team teaching (higher education model); need to address scheduling issues if team teaching is to be implemented	
AA42	A	Develop clearly defined criteria for assessing PBL including what content and skills a student must master, and what constitutes project completion and level of achievement	
AA43	A	Identify newly emerging and existing data to support assessment of STEM education goals	
21		***CHANGE EDUCATION REQUIREMENTS***	**(1)**
AA44	C	**Redefine graduation requirements to include a digital "personal portfolio" that supports education requirements based upon knowledge achieved; assess a student's competency, not credits earned; require a defined graduation product**	
22		***BUILD BROAD NETWORK ENGAGEMENT***	**(1)**
AA45	B	There is a generational/digital divide that must be addressed among broader partners	
23		***CREATE NEW TYPES OF PARTERNSHIPS WITH BUSINESS/INDUSTRY***	**(4)**
AA46	R	**Focus on developing regional mandates that bring industry and education together to develop STEM programs; identify a strong leader that can make the right things happen and get the essential people committed**	
AA47	N	Promote the *"Transition to Teaching"* Program to more businesses as an effective way to meet the teacher shortage in STEM fields for all grade levels	
AA48	A	Rural area challenges include fewer opportunities to partner with business	
AA49	A	Follow *Tech Valley High* model in bringing business and unions early to the planning and design process	
24		***BUILD STEM AWARENESS IN THE COMMUNITY***	**(2)**
AA50	B	Change the paradigm that math and science are for "smart" students	
AA51	B	Involvement of parents is limited; parents should be educated about STEM before their children even begin school; parents must be educated about career choices, stereotyping leads to narrow view of professional career choices, e.g., doctors and lawyers; consider developing "continuing education" courses for parents and others in the community	
25		***REDIRECT EXISTING FUNDING/FORM NEW TYPES OF RELATIONSHIPS/IDENTIFY NEW INCENTIVES***	**-**

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1		***CROSS CUTTING ACTIONS***	**(29)**
BB1	R	**Create a STEM advocate/coordinator for every school who reports to the Principal, with key responsibilities including: 1) coordinating required 175 hrs of professional development (PD) for all teachers; 2) network building linking the school with universities, business and the informal learning community; 3) meet with other STEM advocates and coordinate regionally; 4) identify community resources that match up with school needs; 5) coordinate afterschool programs; 6) work with school guidance counselors; 7/ coordinate student internships to ensure meaningful experience (not just standing at the copier); 8) coordinate STEM workshops as needed;** consider the Hillside scholarship education liaison as a model for STEM School Coordinators	
BB2	R	Develop a summer exchange program for teachers and career professionals linked to tax incentives for participating businesses, and provide sabbatical leave to support teachers	
BB3	R	Initiate a stakeholder-based STEM program development process across diverse interests in the community; focus on program development for younger students and get them engaged out in the community where everyone can see achievements and attract parents and students to new programs	
BB4	R	Augment the national referendum with a local regional mandate where it is easier to get stakeholders together, to reach agreement; "connect the dots" and take advantage of the existing resources	
BB5	R	Change the way collaborative projects are packaged to include access to tech labs, transportation, e.g., bus tokens, in order to develop research-based projects that expose students to their world; work collaboratively with universities and businesses to ground student projects in areas that are essential to business, and that also provide a student centered context; set up partnerships as 3-year commitments with year-end quality checks	
BB6	R	**Develop business input on curriculum and standards in order to serve the long term needs of business as well as society, and that also reflects important global challenges and real world issues that should be integrated into the curriculum; disseminate effective curriculum to other schools**	
BB7	R	Change the culture of math instruction so that student expectations are not about being shown what to do, and instead there is a different approach that engages students in an alternative kind of learning experience; engage parents in shifting expectations about math instruction	
BB8	S	Use the annual *Gear Up* parent conference in the spring to embed ideas on science fair opportunities with parents who need to engage and support community involvement; see *Potters for Peace,* where artists and scientists came together to study water supply challenges; rename science fairs, "problem fairs," to emphasize multidisciplinary, multiple stakeholder process, including all ages, incentives, problem banks, industry/business partners, real life connections with STEM professions, and opportunities to create experiences that change life trajectories; **showcase student projects through competition**	
BB9	N	**Develop innovation zones supported by coordinated state and private sector funding**	
BB10	N	Select four schools for a pilot program and create a STEM report card to assess program outcomes in ways that provide feedback to principals and teachers on what is working and what is not	
BB11	C	**Focus on policy that enables schools to make changes at the local level and that includes all key stakeholders including students and parents; policy should support community driven processes that are flexible in order to meet ongoing local needs that will change over time**	
BB12	C	**New York State must take action to support STEM education in response to the national crisis;** review all state educational policies and remove those requirements that do not meet goals or add value to educational outcomes	
BB13	C	NYS should develop three key areas of policy to implement effective change: extend the school calendar to year-round, implement problem based learning (PBL), and develop high quality professional development (PD) for teachers, including new STEM requirements for pre-service training; policy should consider what education should look like in 5 or 10 years; state STEM policies should provide guidance on transitioning to PBL; throw out the text books	

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BB14	C	Focus on teacher PD to break away from the 1880s model of teaching; provide adequate funding for PD; restructure the school day to allow adequate time for teacher innovation and creativity; new policies must include mandates and timeframes that will assure sustainability of the STEM initiative and therefore, garner investment by teachers; teachers have a role to play in pressuring the state to sustain STEM programming through legislative action; **legislators need to respond to that pressure to assure that STEM education is adequately supported and sustained through permanent restructuring of the system**	
BB15	C	**New regulations should foster a cultural shift in education to align with STEM goals through reorganization of the system at all levels**	
BB16	C	Teachers must have opportunities to leave the classroom to experience the world of business and industry to understand what is happening and what has changed; most teachers have been in school since age 5 and have never been a part of business and industry and need to learn through first hand experience and need support in translating that experience to the classroom, creating a lesson plan and integrating new knowledge into the curriculum, otherwise they will stick to the textbook; sensitivity should be incorporated into PD intended to build real world experience for teachers who resent being told they do not understand the world they live in	
BB17	C	**Create pilot schools where individual regional goals are defined by business and community partners; provide adequate connections for students and parents to use opportunities to engage in alternative routes to learning; it is essential that the product of the pilot program be defined by co-development and collaboration among stakeholders; build on the process to enlighten the community about what STEM is and what is possible through advertising to communicate information and to expand stakeholder interest at the local level [link with next idea - below]**	
BB18	C	Use demonstration schools to show other communities what is possible and concrete steps to implementation; develop ties to the community to leverage support and funding, as well as linkages to museums and other learning resources in the community in order to implement STEM education more broadly through strong stakeholder advocacy	
BB19	C	Work with stakeholders to redefine what the school room looks like both subject wise and time wise; formulate strategies framed by nonrestrictive parameters	
BB20	C	<u>Create explicit links with business and industry that are interactive and constant that support co-development of curriculum with teachers and students; identify incentives that link to the need for a better hiring pool and ways business can invest in education to make that happen; bring teachers and career professionals together to co-teach and work collaboratively on a regular basis to achieve program goals through exchange, participation and delivery; involve students in this process to demonstrate the power of collaborative action and the role of local stakeholders in implementing change</u>	
BB21	C	Throw out the curriculum and develop new curriculum that provides interdisciplinary problem based learning (PBL) that is individualized, and that incorporates apprenticeships for both students and teachers; new curriculum should accommodate changes in knowledge over time; **delivering integrated curriculum will require extending instruction periods**	
BB22	C	**Develop a pilot school staffed by teachers in PB training by industry, and also traditional teachers who can convey how it works and can convey ideas, teach and collaborate with business to co-develop curriculum; use the pilot school to provide a demonstration classroom for training that can feed to local schools in the district; work with business expertise in training and instruction**	
BB23	C	**Extend teaching contracts from 10 months to 11 months to include 1 month of PD annually; change the school work day to look more like the business work day; work with unions to develop compensation to match new contract conditions**	
BB24	C	Develop curriculum by September, 2010 that is project based, and that will be immediately linked to a network across all 21 school districts; superintendents must be on board to target the message to teachers to get their involvement	

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BB25	C	Consider the Ohio model of STEM education where the state initiated legislative action to eliminate restrictions, and instituted a radical process to work on program development with committed people, creative outside the box thinking, and collaboration across different stakeholders; teachers are not pressured to meet seat time requirements, and are supported by superintendents and principals to explore innovative approaches to learning	
BB26	C	Consider Finland's achievement as the #1 education system in the world in curriculum and assessment, where teachers mentor students in completing student-designed projects, and teachers coach each other	
BB27	A	Change policy in order to allow redirecting funds from existing sources to support development of problem based learning (PBL) including teacher training and professional development for K-20 instructors	
BB28	A	**Develop new strategies for public schools that fix the problems and build on what has been learned through the charter school process;** utilize the *Tech Valley High* experience to shift away from top down, highly structured, highly regulated environment to restructure the school and approach to teacher certification	
BB29	A	Consider model program in Boston for shift to year-round program; incorporated STEM/PBL through creation of 4 interdisciplinary courses (and two separate humanities courses); program support required cutting operations and maintenance budget, negotiating furloughs with teachers, caps on line item expenses, and cutting under-enrolled programs	
2		***CREATE NEW SCHOOL PROGRAMS UTILIZING BEST PROGRAMS AND MODELS FOR STEM EDUCATION***	**(15)**
BB30	B	Create a plan for change that works backwards from what we want for students, defined by important factors that lead to becoming a scientist	
BB31	L	Reinstate state waiver to allow exploration of new approaches to assessment	
BB32	R	State policy on teacher to student ratio should be reduced below 1 to 25 for all schools	
BB33	R	Extend high school credit for community service to include work with STEM related businesses and organizations	
BB34	R	Fund those schools and teachers who are willing to implement problem based learning; start an independent school to initiate the transition through a six-week pilot program; evaluation could require a control group to compare outcomes (control groups are controversial)	
BB35	S	Consider potential of portfolio schools that are exempt from Regents' rules (to initiate new programs)	
BB36	Y	Programs that do not meet Regents' standards are not valued, e.g., *BOCES,* and should be considered for their potential to demonstrate innovative solutions for teachers and students	
BB37	C	**New York State should fund pilot STEM schools and provide regulatory waivers for experimental program development;** scaling pilot programs to expand statewide will be a challenge that must be addressed at the state level	
BB38	C	Superintendents must take the lead in the districts, to set priorities, take risks, and establish the tone for each school; superintendents should be prepared to "step on toes" to implement needed changes, and to assure everyone is taking steps toward essential changes that must occur; early support for principals to lead teachers in STEM implementation is essential	
BB39	C	Develop a pilot STEM program to gain taxpayer support; create an individual school or an individual school district with one designated school at each level, including elementary, middle and high school to demonstrate system benefits and outcomes that can be achieved	
BB40	C	Develop STEM career training for guidance counselors so they are able to "effectively enlighten students about what the world is like" and to adequately prepare students for their lives after graduation	
BB41	A	**Create a structure that will allow pilot program development without punitive effects for efforts that don't succeed, e.g., allow three to four years for pilot program development; *Tech Valley High* received waivers from the state allowing adequate time to develop programs that meet state requirements (state determines what you learn, not how you learn it)**	
BB42	A	Create professional development, including externships, for guidance counselors to inform them of "pipeline" issues and expand awareness of STEM career options	

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BB43	A	**Follow charter school models to foster innovation and creativity in meeting student needs**	
BB44	A	**Develop new strategies for public schools that fix the problems and build on what has been learned through the charter school process;** utilize the *Tech Valley High* experience to shift away from top down, highly structured, highly regulated environment to restructure the school and approach to teacher certification	
3		***INITIATE STEM PROGRAM AND CAREER DEVELOPMENT WITH YOUNG STUDENTS***	**(3)**
BB45	B	Consider what interests younger students and build programs to engage their curiosity; reach students as early as pre-K	
BB46	R	Initiate program development at the earliest levels beginning with kindergarten; starting with high school is not the solution	
BB47	C	Students must be introduced to career development at an early stage so that they have time to explore their interests with an understanding of the career options they have ahead of them, and an idea of the importance of gaining important skills in their ongoing pursuit of knowledge; students must develop the understanding that they can do anything and have many options; prepare them for the world of 2050, not 1950	
4		***ADDRESS ACCESS TO TECHNOLOGY RESOURCES***	**(8)**
BB48	Y	Conduct a statewide survey of schools to determine existing tech resources and equity of access; a state study was completed on "content, capacity, and use," and found that computers were used less than 2 hrs/week (no date)	
BB49	Y	Use the internet to address differences in resources between urban areas, where there are more resources, and rural areas where there are fewer resources	
BB50	Y	Stop taking technology away from students, instead develop policies to guide student learning with tech tools; students focus on tech because it isn't allowed in school	
BB51	N	Rethink use of *distance learning* as a way to reach "best and brightest" in STEM fields increasing access for all students to best minds and most creative thinkers	
BB52	N	Utilize distance learning (DL) in high school and higher education to expand access to science instruction; selectively institute distance learning in schools where DL can be effective, and utilize instructors to support classroom instruction in schools where DL cannot be easily employed	
BB53	C	Develop new policies on technology across the 21 school districts that fosters appropriate use of technology for students, and that teaches them how to explore and learn through technology; consider strategies to scale up BOCES example of teaching students appropriate uses of technology; work with adults in the professional learning community to model appropriate uses of technology for students	
BB54	A	Utilize technology to engage students through virtual experiences (field trips, mentoring and linking to career role models in the professions)	
BB55	A	Develop online access to education, including distance learning	
5		***CHANGE THE STRUCTURE OF THE SCHOOL DAY/YEAR TO SUPPORT STEM EDUCATION GOALS***	**(3)**
BB56	B	Current school year only addresses core curriculum, need to add 60 days to accommodate expanded learning experiences	
BB57	C	**The school year is outdated and no longer meets student needs**, and ties school funding cycles to a timeframe that constrains state supported educational services	
BB58	C	**Change the school year to improve the connection between the teaching world and the real world;** lengthen the school day to 8 hours, and start later (brain scientists recommend the latter) to keep students later so that they are not going home in the middle of the day when their parents are at work; pay teachers for an 8 hour day; consider benefits of extending the school day for rural students who have transportation challenges with before-school and after-school programs	

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6		***BUILD STEM PROGRAMS THAT UTILIZE SUCCESSFUL BUSINESS MODELS***	**(3)**
BB59	R	Design PD to create a vision of STEM, to give teachers an idea of what to work toward in the future similar to the way business works, where the team leader makes sure everyone has a vision for the future of the company	
BB60	A	Business and industry are built on access to information, schools are not	
BB61	A	Build on business model to foster entrepreneurial approach to program development that includes adapting to new conditions, changing workforce thru retraining, and successful problem solving vs. going out of business, failing to adjust and survive	
7		***CREATE K-20 PROGRAM CONNECTIONS***	**(6)**
BB62	R	Create programs that "cross-fertilize" faculty from higher education and from K-12 through planned sabbaticals that allow teachers to trade places for a period of time	
BB63	R	Higher education should reach out to work with high school students	
BB64	Y	Community colleges are the best kept secret: graduation rate is low because not all students are there for a degree, but to benefit from certificate programs or to advance their job skills through specific courses	
BB65	N	Higher education should engage with K-12 students to inform them of program requirements to pursue post secondary education in math, science, engineering	
BB66	A	**Build a network across school districts to share best STEM practices across K-20; work on teacher resistance to share lesson plans (develop online structure and support);** introduce mechanisms to allow partnerships between school districts; restructure p-16 administrative framework to engage superintendents in policy and innovative action at the local level	
BB67	A	Utilize team teaching (higher education model); need to address scheduling issues if team teaching is to be implemented	
8		***DEVELOP PARTNERSHIPS WITH COMMUNITY-BASED INFORMAL LEARNING PROGRAMS***	**(4)**
BB68	B	Coordinate across programs outside the school to link community interests and ongoing informal education, e.g., *"Body Worlds,"* museum exhibit on Darwin	
BB69	R	Start project based learning through informal education programs in order to move ahead without delays; eventually successful programs can merge into school programs	
BB70	C	Develop formal partnerships with informal learning institutions	
BB71	A	Work with nonprofits (informal education) to focus on PBL afterschool programs; current state legislative support for informal education is not likely to succeed as this is best developed at the local level, not top down	
9		***INCREASE STUDENT AWARENESS OF VOCATIONAL EDUCATION STEM CAREER PATHWAYS***	**(2)**
BB72	R	Change the perception of apprenticeships as alternative paths to career development, to that of a "front burner" option along with traditional education	
BB73	C	**Students should see viability of pursuing successful STEM career paths through trade schools as well as through college;** need to address student perceptions about trade schools, e.g., referring to *BOCES* students as "botards"; not all students can afford to go to college and are not aware of career choices through vocational training, e.g., plumbers, welders, that do not need a college degree	
10		***DEVELOP STEM PROGRAMS TO ADDRESS UNDERSERVED STUDENT NEEDS***	**(2)**
BB74	R	Partner with the city as a potential funder of STEM programs that target out-of-school youth including pregnant and parenting young adults as a direct means of getting specific target populations into programs that will benefit the community through tax dollars at work	
BB75	C	Create mentoring programs and social networking tools to conduct outreach to schools to connect with minority students	
11		***CREATE PROGRAMS FOR STUDENTS TO ENGAGE WITH STEM CAREER PROFESSIONALS AS ROLE MODELS***	**(2)**
BB76	B	Create mentoring programs for college students to teach physics to 3rd and 4th grade students	

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BB77	B	Start an "alumni hall of fame" for former students who are now STEM career professionals	
12		***STEM PROGRAMS MUST ADDRESS BROAD SOCIAL ISSUES***	**-**
13		***REQUIRE TEACHERS TO COMPLETE STEM PROFESSIONAL DEVELOPMENT***	**(14)**
BB78	B	Buffalo has 30 middle school teachers who are teaching "multi-modally using cameras and probeware"; need school district support for ongoing PD	
BB79	R	Create mandates that require teacher training to include business/industry apprenticeships, internships or other forms of involvement to gain experience outside the classroom	
BB80	R	Utilize the existing mandate for 175 hours of PD to engage teachers in work outside the classroom, e.g., a teacher who spent one year working at Kodak returned to the classroom as a different person, providing great counseling to the student as a result of that business experience; allow K-12 teachers six months' immersion in industry, and pay teachers a stipend	
BB81	R	Design PD to create a vision of STEM, to give teachers an idea of what to work toward in the future similar to the way business works, where the team leader makes sure everyone has a vision for the future of the company	
BB82	R	Design PD to consider cultural differences in teaching styles that include two-way student teacher learning where the student is encouraged to point our errors by the teacher, versus the more traditional approach; teachers who lack confidence are sometimes uncomfortable when students ask questions, but this is not real learning; the best teachers learn from their students, but this is not part of their training; giving up control means teachers have to face not knowing everything and overcome their fear of not having all the answers	
BB83	R	Teachers enthusiasm for STEM would increase with increased support and leadership of principals	
BB84	N	Bring in content experts to conduct teacher training (not educators); rethink teacher training content to include training in use of sophisticated technology for STEM delivery in order for students to see applied uses of technology for learning	
BB85	N	Develop program opportunities for teachers to gain training and experience in STEM education within a process that returns them to their home school (e.g. *Beacon Institute*)	
BB86	N	Utilize the *Tech Valley High (TVH)* Program as a model for teachers to see problem based learning in the classroom; develop teacher training that builds on *TVH* program approach	
BB87	N	Teachers need opportunities to practice applied learning in a "low stakes environment" before being evaluated through formal assessment	
BB88	N	Consider *Beacon Institute* as a model for teacher training and professional development of current teachers to gain STEM skills through summer courses and other opportunities, returning to their home schools to apply new skills to teaching	
BB89	C	Develop STEM career training for guidance counselors so they are able to "effectively enlighten students about what the world is like" and to adequately prepare students for their lives after graduation	
BB90	C	**STEM education requires huge changes in PD to provide adequate resources and training to effectively prepare teachers for STEM instruction; provide in-service and pre-service training so that all teachers are STEM trained when they enter the classroom and motivated to pursue ongoing STEM curriculum development; focus PD on developing skills in math and science**	
BB91	A	Create professional development, including externships, for guidance counselors to inform them of "pipeline" issues and expand awareness of STEM career options	
14		***CREATE STEM TEACHER TRAINING/PRE-SERVICE PROGRAMS TO PREPARE NEW TEACHERS FOR STEM INSTRUCTION***	**(8)**
BB92	L	Teacher training should be conducted in partnership with business to allow professionals to work "in service" with teachers ("create continuing education credits"); work with higher education to build teacher skills to teach "real science and real math" before they enter the classroom; higher education should focus on "innovation in teaching" ("change the higher education model")	

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BB93	R	Provide scholarships for student teachers to get STEM certified; create research internships for teachers and student teachers (graduate students); graduate research assistants should be trained in teaching and how to communicate with students; provide a stipend/grant to fund teacher training for research assistants	
BB94	N	New teachers are trained in classroom management and do not have real teaching experience when they enter the classroom; provide adequate time for new teachers to develop curriculum, identify classroom resources, and to understand different learning modes and to experience the excitement of learning in order to be able to convey that to their students; new teachers typically have lowest improvement in test scores, and teacher retention is low (80% of teachers are gone in first four years, 52% of teaching fellows leave during first four years)	
BB95	N	Create teacher training residency programs that give teachers time to learn how to teach, how to interact with the school and to develop peer relations; train teachers in building relations with business and industry, and to utilize learning resources in the community, e.g., build peer relations with staff at the *American Museum of Natural History*	
BB96	N	*NYC Hall of Science (HOS)* coordinates clinical work between college students and *HOS* staff providing practical experience for students; program offers 500 hours of teaching practice coordinated with school courses; scale this across the state with other museums	
BB97	N	NYC has a teacher residency program (pay is $10k/year for 3 years) that could be leveraged across the state; identify new sources to fund expanding the residency program	
BB98	C	**Create a "loan forgiveness" program for student teachers who pursue STEM related teaching certifications**	
BB99	A	Mentoring and apprenticeships are essential aspects of STEM training for teachers	
15		***CREATE TEACHER STEM CERTIFICATION PROGRAMS***	**(4)**
BB100	L	Science teaching certifications must be restructured to integrate across sciences and shift away from single science certifications that reinforce teaching to the test	
BB101	C	**Create a "loan forgiveness" program for student teachers who pursue STEM related teaching certifications**	
BB102	C	Support Regents' actions to require all school districts to reapply for teacher certifications as a way to push more teachers into STEM certifications	
BB103	A	Institute policies that support teacher mobility between school districts (to protect benefits), current system creates disincentives for teachers to transfer to where they are needed	
16		***CREATE COLLABORATIVE PROGRAMS FOR TEACHERS AND STEM CAREER PROFESSIONALS TO WORK JOINTLY ON STEM COURSE DEVELOPMENT AND INSTRUCTION***	**(4)**
BB104	R	Teachers can benefit from collaborating with career professionals; create opportunities for teachers to partner with career professionals for up to six months to co-design projects, identify common interests and build relationships	
BB105	R	Create summer programs for teachers to work with career professionals, then follow with a fall program where students become involved in hands on learning	
BB106	R	Utilize social networking media to develop professional discussion groups that can contribute to ideas and potential project development	
BB107	R	Create opportunities for career professionals and college students to co-teach STEM courses; higher education should reach out to work with high school students	
17		***CHANGE STANDARD TEACHER EVALUATIONS TO INCORPORATE STEM EDUCATION GOALS***	**(3)**
BB108	R	Eliminate tenure and start "grading" teachers, they are dying for meaningful feedback, e.g., observation and written feedback is rarely done; design differential pay structure based on grading scale; not everyone is motivated by salary alone, create ways to recognize excellence in teaching that elevates quality teaching practices	
BB109	C	**Track teacher performance through student performance and provide feedback to colleges of education**	

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BB110	A	Restructure the teacher evaluation process to provide mechanisms to put teachers on the right track; eliminate current principal-teacher private evaluation and create project-based, team approach to teacher evaluations that is more transparent and that recognizes and promotes excellence in teaching	
18		***CHANGE STEM TEACHER COMPENSATION AND WORK WITH UNIONS TO ADDRESS CHANGES TO SUPPORT STEM EDUCATION GOALS***	**(5)**
BB111	Y	Must engage unions to have a productive dialogue about what needs to change	
BB112	N	Support differential pay for excellence in teaching; restructure collective bargaining contracts to support rewards and pay scales that compete with private industry; develop a 5-yr bonus structure, require 3 years in STEM teaching	
BB113	C	Work with the unions in order to advance the retraining process	
BB114	A	Institute policies that support teacher mobility between school districts (to protect benefits), current system creates disincentives for teachers to transfer to where they are needed	
BB115	A	Engage unions early in the process to better understand their issues and interests; coordinate labor involvement to expand current local scale engagement to state level	
19		***DEVELOP TEACHER TRAINING PROGRAMS FOR SECOND CAREER STEM PROFESSIONALS***	**(7)**
BB116	B	Develop a cadre of tech teachers among retired professionals (training can be completed in one year)	
BB117	R	Create mechanisms for career professionals to enter the teaching profession including mechanisms such as tax credits for businesses that "lend" industry professionals to fill the shortage of STEM teachers	
BB118	Y	The best approach to attract content experts to the classroom may be to offer career professionals cooperative engagements with schools so they can maintain their status in the business world, and still contribute in the classroom; **recruit and select teachers for shared jobs and job appointments**	
BB119	N	Open up teacher certifications to career professionals to meet urgent needs for STEM teachers and that will also involve industry in education; consider the New Jersey program as a model	
BB120	N	Promote the *"Transition to Teaching"* Program to more businesses as an effective way to meet the teacher shortage in STEM fields for all grade levels	
BB121	N	Work with the *Science Academy* to encourage its members to consider second careers in education (6K Academy members) to pursue a short term plan to meet the need for STEM instruction	
BB122	C	Develop policy to allow career professionals to begin a second career at retirement as STEM instructors and teacher coaches	
20		***DEVELOP STEM CURRICULUM, INSTRUCTION AND ASSESSMENTS***	**(35)**
BB123	B	Develop more "non-Regents' directed courses" which do not speak to the exam but to STEM content	
BB124	B	Change the infrastructure of curriculum and instruction to allow for introduction of "best practices"	
BB125	R	Provide teachers with a framework to develop collaborative relations with other teachers, transforming the concept of teaching practices; develop skill set to promote team dynamics and project based instruction; utilize strong teachers as lead to collaborate with weak teachers, and new teachers; utilize the *BOCES* PD model	
BB126	R	There is a disconnect between elementary and middle school curriculum; give elementary school teachers clearer understanding of middle school curriculum to help them prepare students for later grades and material to be covered	
BB127	S	Create teacher teams to integrate English/social studies with math and science	
BB128	S	**There is a mobile art bus, why not set up a mobile science bus?**	
BB129	Y	Vertically align high school and college curriculum	
BB130	N	**Current emphasis on Regents' exams and meeting benchmarks does not support innovation; create policies that give schools and teachers freedom to develop innovation in the classroom**	
BB131	N	Work with English teachers to improve literacy targeted to science literature (students cannot read science textbooks)	
BB132	N	Align K-12 math and science curriculum with higher education requirements, e.g., *Project Lead the Way* students cannot meet physics requirements for college engineering programs	

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BB133	N	Marry instructional resources with curriculum to benefit from hundreds of programs available for older grades, e.g., PBS science series, *"Elegant Universe,"* that can expose students to advanced scientific theories in visual ways, and bring scientists like Brian Green to rural schools	
BB134	C	State standards should address all content areas through an interdisciplinary framework for curriculum design; provide an adequate timeframe for new curriculum development with exemptions on exams for 3-5 years; provide adequate funding for curriculum expertise and design	
BB135	C	**The term "teacher" is archaic and does not reflect the new role of teachers as learning facilitators or counselors who should function as team leaders in collaborative learning teams that follow the industry model; teachers do not have experience working in teams or how to use other teachers as experts in collaborative team teaching, and lack the knowledge necessary to teach children how to be effective team members**	
BB136	C	Students won't invest in learning if they don't see the relevance, they need tangibility; as students move through the system, they lose interest and ability to think creatively	
BB137	C	Consider how students today like to learn through texting, social networking, smart boards, staying connected, this is their process and needs to be part of their school life; throw away the textbooks and give students computers, let them use their cell phones because this is their culture; they are multitaskers and "physiologically different" from adults	
BB138	C	Students naturally form partnerships for informal learning and should be given the opportunity to build on that as an effective strategy to develop team learning skills	
BB139	A	Build mechanisms to support PBL, starting with elementary school where it is easier to implement PBL, to higher levels where it is more complicated	
BB140	A	STEM instruction will require different teaching and measuring methods to capture creativity; STEM must be built into the curriculum in order to assure that the program is sustained	
BB141	A	Utilize team teaching (higher education model); need to address scheduling issues if team teaching is to be implemented	
BB142	A	There are no schools in New York State using an open source learning approach	
BB143	A	Develop clearly defined criteria for assessing PBL including what content and skills a student must master, and what constitutes project completion and level of achievement	
BB144	A	Schools that have effectively implemented cross disciplinary instruction are not recognized by NYS; currently held administrative goals and values for teaching in the classroom are our of synch with cross disciplinary instruction	
BB145	L	Reinstate state waiver to allow exploration of new approaches to assessment	
BB146	B	Unpack innovation in the classroom in order to assess; shift focus from assessment of teaching to assessment of learning	
BB147	B	Students should be assessed more often – don't wait for the state test to assess; progressive schools assess students more frequently to capture different aspects of learning	
BB148	B	Assessments should include measurement of both process and outcomes	
BB149	R	Waive the exams for one year and design new methods to determine value as a teacher, value as a learner	
BB150	R	Track students throughout their academic career	
BB151	N	In the school environment, assessment is about measuring what you have learned; in the corporate environment assessment is a constant aspect of gauging productivity to determine what skills are needed to solve a problem, what is expected for effective team work and how to add value to the team, and producing good outcomes	
BB152	C	**Change graduation requirements to include a digital "personal portfolio" that supports education requirements based upon knowledge achieved; assess a student's competency, not credits earned; require a defined graduation product**	
BB153	C	Expand assessment of schools beyond test results, identify measures of connection to real world, e.g., partnerships with business and industry	

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BB154	C	**Change assessments in ways that provide important data to the state that ties in with the national crisis in education and that directly informs state STEM program development**	
BB155	C	**Develop student assessments that also provide good feedback to teacher education and pre-service programs**	
BB156	A	Develop clearly defined criteria for assessing PBL including what content and skills a student must master, and what constitutes project completion and level of achievement	
BB157	A	Identify newly emerging and existing data to support assessment of STEM education goals	
21		***CHANGE EDUCATION REQUIREMENTS***	**(1)**
BB158	C	Students should pursue an individual path of achievement through the framework of "learning portfolios"; redefine graduation requirements to incorporate personal digital portfolios; students should be focused on STEM proficiency as their primary objective for graduation; define the 21st century student characteristics and all the skills necessary to function in the 21st century	
22		***BUILD BROAD NETWORK ENGAGEMENT***	**(9)**
BB159	N	Utilize information being developed through the *Tech Valley High* research-based program to demonstrate success of collaboration and involvement of partners in design and implementation of STEM education	
BB160	C	**Initiate local level action through the formation of a professional learning community across all school districts to bring teachers, principals, administrators and other essential stakeholders into the conversation; utilize social networking to expand the process to the whole community, including parents, who are as important to educate about STEM as school administrators**	
BB161	C	The framework for change should address unique differences that will occur at the district level that are necessary to meet local priorities, including aligning STEM programs with local resources	
BB162	C	**The term "teacher" is archaic and does not reflect the new role of teachers as learning facilitators or counselors who should function as team leaders in collaborative learning teams that follow the industry model; teachers do not have experience working in teams or how to use other teachers as experts in collaborative team teaching, and lack the knowledge necessary to teach children how to be effective team members**	
BB163	C	Utilize social networking tools as a way to connect more broadly with stakeholders to collaborate, discuss, seek help with problems, and strengthen ties between education and business and industry; use social networking tools to communicate about specific issues and relevance of STEM education, e.g., global warming; connect with career professionals from business and industry who can act as mentors and collaborate with students and teachers to develop a global perspective on real world issues	
BB164	C	Consider NYS programs, *BOCES* and *MST Connect* as examples of programs that have achieved consensus through action, gaining parent and community support	
BB165	A	Engage parents early in learning about PBL and benefits for children; target dysfunctional families; find ways to reach parents whose lifestyles may limit their ability to be involved with the school (time constraints, language barriers); develop a collaborative approach to engaging parents in common goals for the benefit of their children; shift cultural attitudes of parents from athletic focus to academics	
BB166	A	Clearly define goals for all stakeholders to establish common ideas about building a strong vibrant education community and workforce; it is especially important to link these two goals in order to engage teachers who are resistant to the concept of workforce development, but who would support building community; the underlying message is that without a strong workforce there is no community	
BB167	A	Identify a local level lead entity to advance STEM education reform, cannot be done by school districts	
23		***CREATE NEW TYPES OF PARTERNSHIPS WITH BUSINESS/INDUSTRY***	**(11)**
BB168	R	Address liability issues that constrain students and teachers from entering the workplace	
BB169	R	Regents' standards for high school graduates should relate to career readiness and competitiveness in a global market; work with business and industry to develop curriculum and standards that meet state needs	
BB170	R	**Focus on developing regional mandates that bring industry and education together to develop STEM programs; identify a strong leader that can make the right things happen and get the essential people committed**	

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BB171	R	Partner with business to develop paid summer internships and target students who haven't made it through academics and are drop outs or ready to drop out; develop a program collaboratively with business where students investigate real problems, they report back to business, and participate in an authentic process allowing students to contribute to developing curriculum, standards and leadership	
BB172	R	*BOCES* training facilities allow student access for ages 16-18; work with *BOCES* to identify other situations that students can access for STEM training (liability issues)	
BB173	R	*BOCES* provides a model of earning credits for alternative learning experiences; consider the *New Vision Program* for high school seniors as well as the *Franklin High School Program* linked to the *Rochester General Hospital* for examples of ways students can earn credit in alternative programs	
BB174	S	NYS can utilize university jointly run PBS television station to provide access to media for STEM support	
BB175	Y	Business must engage with reforming education because they are the ones who will benefit; work more broadly with STEM businesses to develop resources for education; business needs to understand and support PD for teachers as an important component for implementation of the STEM initiative; develop an internship/externship program sponsored by business	
BB176	C	Industry must take responsibility for communicating to teachers, students and parents about the new reality of business and industry, and to convey specific skills that are needed, as well as innovative and creative aspects involved in manufacturing today; work with regional industries to reframe outdated perceptions about heavy manufacturing as a "bad" place to work, e.g., consequences of not doing well in school; work with parents to change perceptions and stigma about certain types of jobs (welder, plumbers), what it means to be an engineer, and math skills essential to tech careers	
BB177	A	Work with the Department of Labor to bring industry to the table at the state level to actively engage in STEM education development	
BB178	A	Follow *Tech Valley High* model in bringing business and unions early to the planning and design process	
24		***BUILD STEM AWARENESS IN THE COMMUNITY***	**(4)**
BB179	R	Target Latino and African American students, they don't know what STEM careers look like and what direction to pursue; these students are facing a 50% unemployment rate	
BB180	C	Address the digital divide in order to use social networking tools to achieve inclusiveness; leverage interest in technology using social networking tools focused on popular uses easily embraced that will extend technology use to become part of the formal learning culture	
BB181	A	Utilize media to create student interests in tech careers (follow CSI model); students are interested in careers that they see a future in; students need to understand career skills required to succeed, e.g., CSI programs have high drop out rates; students currently lack adequate information in making college and career decisions	
BB182	A	**STEM is not the focus but is the underpinning for everyone to prepare for success in a career, in college, and as a citizen**	
25		***REDIRECT EXISTING FUNDING/FORM NEW TYPES OF FUNDING PARTNERHIPS/IDENTIFY NEW INCENTIVES TO SUPPORT STEM PROGRAM DEVELOPMENT***	**(6)**
BB183	B	State level aid leads to short-term gains only, must add a long-term pathway that also includes a system of incentives or changes will not be implemented	
BB184	R	Create statewide programs that offer tax incentives or grants to businesses that establish internships or apprenticeships for students before graduation; a *monster.com* study shows that compared to other similar cities, Rochester has the fewest internships available to college students	
BB185	R	Approach STEM program funding from community base in order to allow schools to focus on local priorities and needs; find ways to: 1) gain strong state support, and 2) create systematic regional connections to learn from each other	
BB186	Y	*Fordham University* offers a successful program for schools in grant writing targeted to local, regional and national grant programs	

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BB187	C	**Introduce tax incentives to gain support of business and taxpayers and motivate constituents to fund STEM education;** long term benefits of tax breaks are generally positive, but short-term impacts may be detrimental to the educational system and may require that schools are funded through different mechanisms	
BB188	A	Prioritize funding for teacher training	

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1		***CROSS CUTTING ACTIONS***	**(20)**
CC1	L	Teacher training should be conducted in partnership with business to allow professionals to work "in service" with teachers ("create continuing education credits"); work with higher education to build teacher skills to teach "real science and real math" before they enter the classroom; higher education should focus on "innovation in teaching" ("change the higher education model")	
CC2	R	**Create a STEM advocate/coordinator for every school who reports to the Principal, with key responsibilities including: 1) coordinating required 175 hrs of professional development (PD) for all teachers; 2) network building linking the school with universities, business and the informal learning community; 3) meet with other STEM advocates and coordinate regionally; 4) identify community resources that match up with school needs; 5) coordinate afterschool programs; 6) work with school guidance counselors; 7) coordinate student internships to ensure meaningful experience (not just standing at the copier); 8) coordinate STEM workshops as needed;** consider the Hillside scholarship education liaison as a model for STEM School Coordinators	
CC3	R	Approach STEM program funding from community base in order to allow schools to focus on local priorities and needs; find ways to: 1) gain strong state support, and 2) create systematic regional connections to learn from each other	
CC4	R	Initiate a stakeholder-based STEM program development process across diverse interests in the community; focus on program development for younger students and get them engaged out in the community where everyone can see achievements and attract parents and students to new programs	
CC5	R	Change the way collaborative projects are packaged to include access to tech labs, transportation, e.g., bus tokens, in order to develop research-based projects that expose students to their world; work collaboratively with universities and businesses to ground student projects in areas that are essential to business, and that also provide a student centered context; set up partnerships as 3-year commitments with year-end quality checks	
CC6	R	Create opportunities for career professionals and college students to co-teach STEM courses; higher education should reach out to work with high school students	
CC7	C	NYS should develop three key areas of policy to implement effective change: extend the school calendar to year-round, implement problem based learning (PBL), and develop high quality professional development (PD) for teachers, including new STEM requirements for pre-service training; policy should consider what education should look like in 5 or 10 years; state STEM policies should provide guidance on transitioning to PBL; throw out the text books	
CC8	C	Focus on teacher PD to break away from the 1880s model of teaching; provide adequate funding for PD; restructure the school day to allow adequate time for teacher innovation and creativity; new policies must include mandates and timeframes that will assure sustainability of the STEM initiative and therefore, garner investment by teachers; teachers have a role to play in pressuring the state to sustain STEM programming through legislative action; **legislators need to respond to that pressure to assure that STEM education is adequately supported and sustained through permanent restructuring of the system**	
CC9	C	**Create pilot schools where individual regional goals are defined by business and community partners; provide adequate connections for students and parents to use opportunities to engage in alternative routes to learning; it is essential that the product of the pilot program be defined by co-development and collaboration among stakeholders; build on the process to enlighten the community about what STEM is and what is possible through advertising to communicate information and to expand stakeholder interest at the local level**	
CC10	C	Use demonstration schools to show other communities what is possible and concrete steps to implementation; develop ties to the community to leverage support and funding, as well as linkages to museums and other learning resources in the community in order to implement STEM education more broadly through strong stakeholder advocacy	
CC11	C	Work with stakeholders to redefine what the school room looks like both subject wise and time wise; formulate strategies framed by nonrestrictive parameters	

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CC12	C	Create explicit links with business and industry that are interactive and constant that support co-development of curriculum with teachers and students; identify incentives that link to the need for a better hiring pool and ways business can invest in education to make that happen; bring teachers and career professionals together to co-teach and work collaboratively on a regular basis to achieve program goals through exchange, participation and delivery; involve students in this process to demonstrate the power of collaborative action and the role of local stakeholders in implementing change	
CC13	C	Throw out the curriculum and develop new curriculum that provides interdisciplinary problem based learning (PBL) that is individualized, and that incorporates apprenticeships for both students and teachers; new curriculum should accommodate changes in knowledge over time; **delivering integrated curriculum will require extending instruction periods**	
CC14	C	**Develop a pilot school staffed by teachers in PB training by industry, and also traditional teachers who can convey how it works and can convey ideas, teach and collaborate with business to co-develop curriculum; use the pilot school to provide a demonstration classroom for training that can feed to local schools in the district; work with business expertise in training and instruction**	
CC15	C	**Extend teaching contracts from 10 months to 11 months to include 1 month of PD annually; change the school work day to look more like the business work day; work with unions to develop compensation to match new contract conditions**	
CC16	C	Develop curriculum by September, 2010 that is project based, and that will be immediately linked to a network across all 21 school districts; superintendents must be on board to target the message to teachers to get their involvement	
CC17	C	Develop a 48-week school year based on teacher rotation, where students are enrolled in 4 sessions/year with the potential for 5-6 sessions if needed; costs savings of $900K could accrue from reduced staff (from 300 to 200); the program would allow more time for teacher training and also support a 30% pay increase for teachers, and more effective use of facilities; students could advance through grades at their own pace not tied to age; high school students could work when not in school session through work study program; call the program, “consolidation of services”	
CC18	C	Consider the Ohio model of STEM education where the state initiated legislative action to eliminate restrictions, and instituted a radical process to work on program development with committed people, creative outside the box thinking, and collaboration across different stakeholders; teachers are not pressured to meet seat time requirements, and are supported by superintendents and principals to explore innovative approaches to learning	
CC19	C	Consider Finland’s achievement as the #1 education system in the world in curriculum and assessment, where teachers mentor students in completing student-designed projects, and teachers coach each other	
CC20	A	Consider model program in Boston for shift to year-round program; incorporated STEM/PBL through creation of 4 interdisciplinary courses (and two separate humanities courses); program support required cutting operations and maintenance budget, negotiating furloughs with teachers, caps on line item expenses, and cutting under-enrolled programs	
2		***CREATE NEW SCHOOL PROGRAMS UTILIZING BEST PROGRAMS AND MODELS FOR STEM EDUCATION***	**(21)**
CC21	B	There needs to be standards for School Board members that measures their proficiency in areas related to STEM	
CC22	R	Fund those schools and teachers who are willing to implement problem based learning; start an independent school to initiate the transition through a six-week pilot program; evaluation could require a control group to compare outcomes (control groups are controversial)	
CC23	R	Identify potential program components that can be mapped out and launched, then work backwards to build a comprehensive approach; utilizing existing resources will give students the opportunity to experience different ways to learn, e.g., the Wegman 4th grade program	
CC24	R	*BOCES* training facilities allow student access for ages 16-18; work with *BOCES* to identify other situations that students can access for STEM training (liability issues)	

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CC25	R	*BOCES* provides a model of earning credits for alternative learning experiences; consider the *New Vision Program* for high school seniors as well as the *Franklin High School Program* linked to the *Rochester General Hospital* for examples of ways students can earn credit in alternative programs	
CC26	R	The *Youth Apprenticeship Program* of Rochester requires students to complete capstone projects that link school with community	
CC27	R	School 58, the *World of Inquiry* K-6 School in Rochester produces scores in the 90s in math through expeditionary learning, where 90% of students are poverty level (determined by free and reduced lunch program participants); elementary school students "defend" their performance with presentation of portfolios; program practices are being expanded to K-12	
CC28	R	In 1995 a college workshop program for chemistry teachers to learn to work together was initiated with good results, later it was expanded to the biology department by request where it has also been effective; take this program to the lower grades and show what can be achieved	
CC29	S	See the *JPMC High School* apprenticeship program; develop a six-week, job-related internship, to start as early as age 13; consider student pay; develop mentor teams to avoid time constraints/burden on a single working professional; draws from interested adults, e.g., *Big Brothers, Big Sisters*	
CC30	S	**There is a mobile art bus, why not set up a mobile science bus?**	
CC31	S	Consider potential of portfolio schools that are exempt from Regent's rules (to initiate new programs)	
CC32	Y	Programs that do not meet Regents' standards are not valued, e.g., *BOCES,* and should be considered for their potential to demonstrate innovative solutions for teachers and students	
CC33	Y	Community colleges are the best kept secret: graduation rate is low because not all students are there for a degree, but to benefit from certificate programs or to advance their job skills through specific courses	
CC34	N	**Develop innovation zones supported by coordinated state and private sector funding**	
CC35	N	Select four schools for a pilot program and create a STEM report card to assess program outcomes in ways that provide feedback to principals and teachers on what is working and what is not	
CC36	N	Utilize the *Tech Valley High (TVH)* Program as a model for teachers to see problem based learning in the classroom; develop teacher training that builds on *TVH* program approach	
CC37	C	**New York State should fund pilot STEM schools and provide regulatory waivers for experimental program development;** scaling pilot programs to expand statewide will be a challenge that must be addressed at the state level	
CC38	C	Develop a pilot STEM program to gain taxpayer support (an individual school or an individual school district with one designated school at each level, including elementary, middle and high school) to demonstrate system benefits and outcomes that can be achieved	
CC39	C	Take immediate steps to make changes based on the success of *Tech Valley High* model of *High Tech High,* and *BOCES* as a system within a system, pushing the envelope; follow their model as an example of developing a local solution	
CC40	A	**Follow charter school models to foster innovation and creativity in meeting student needs**	
CC41	A	**Develop new strategies for public schools that fix the problems and build on what has been learned through the charter school process;** utilize the TVH experience to shift away from top down, highly structured, highly regulated environment to restructure the school and approach to teacher certification	
3		***INITIATE STEM PROGRAM AND CAREER DEVELOPMENT WITH YOUNG STUDENTS***	**(2)**
CC42	R	Initiate program development at the earliest levels beginning with kindergarten; starting with high school is not the solution	
CC43	C	Students must be introduced to career development at an early stage so that they have time to explore their interests with an understanding of the career options they have ahead of them, and an idea of the importance of gaining important skills in their ongoing pursuit of knowledge; students must develop the understanding that they can do anything and have many options; prepare them for the world of 2050, not 1950	
4		***ADDRESS ACCESS TO TECHNOLOGY RESOURCES***	**(9)**
CC44	Y	Use the internet to address differences in resources between urban areas, where there are more resources, and rural areas where there are fewer resources	

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CC45	Y	Stop taking technology away from students, instead develop policies to guide student learning with tech tools; students focus on tech because it isn't allowed in school	
CC46	Y	Computer availability at the school is an issue; this is especially important in Hispanic communities	
CC47	Y	Consider changes that build upon creating "virtual" schools, collaborative schools, and virtual classrooms; develop online virtual instruction that can open up opportunities for students and teachers; Yonkers is already offering online instruction; courses can be blended, i.e., in-class instruction, online and distance learning	
CC48	Y	Consider the example of the Michigan Governor who initiated a program to provide fiber optic connections for all schools, especially in rural areas where students have fewer resources based on his experience growing up in northern rural Michigan; the program also provided laptops to all teachers; how to impart this kind of insight and motivation in all decision makers?	
CC49	N	Rethink use of *distance learning* as a way to reach "best and brightest" in STEM fields increasing access for all students to best minds and most creative thinkers	
CC50	N	Utilize distance learning (DL) in high school and higher education to expand access to science instruction; selectively institute distance learning in schools where DL can be effective, and utilize instructors to support classroom instruction in schools where DL cannot be easily employed	
CC51	C	Develop new policies on technology across the 21 school districts that fosters appropriate use of technology for students, and that teaches them how to explore and learn through technology; consider strategies to scale up BOCES example of teaching students appropriate uses of technology; work with adults in the professional learning community to model appropriate uses of technology for students	
CC52	A	Develop online access to education, including distance learning	
5		***CHANGE THE STRUCTURE OF THE SCHOOL DAY/YEAR TO SUPPORT STEM EDUCATION GOALS***	**(3)**
CC53	R	Change the structure of the school day to expand beyond a 45-minute segment; extend the school day to provide students with different learning experiences, not more of the same	
CC54	C	**The school year is outdated and no longer meets student needs**, and ties school funding cycles to a timeframe that constrains state supported educational services	
CC55	C	**Change the school year to improve the connection between the teaching world and the real world;** lengthen the school day to 8 hours, and start later (brain scientists recommend the latter) to keep students later so that they are not going home in the middle of the day when their parents are at work; pay teachers for an 8 hour day; consider benefits of extending the school day for rural students who have transportation challenges with before-school and after-school programs	
6		***BUILD STEM PROGRAMS THAT UTILIZE SUCCESSFUL BUSINESS MODELS***	**(6)**
CC56	S	Use Facebook to support STEM partnerships with business; **consider EBAY model to provide access to STEM related activities across the region, e.g., student project that involved three school classes from around the world monitoring a boat with GPS;** <u>utilize Facebook, STEM SAR and EBay model to network everything people are doing and have access to</u>	
CC57	S	Utilize "reverse mentors" (Lockheed) where new "kids" who know how to use tech teach older people; do this with students and teachers, where students teach the teachers how to use tech	
CC58	S	<u>Utilize the workplace model (for STEM development) where teams work as a group so that no one individual is solely responsible for making things happen;</u> in the real world, collaboration tools are most effective way to get things done, no longer rely on one person to solve problems	
CC59	N	In the school environment, assessment is about measuring what you have learned; in the corporate environment assessment is a constant aspect of gauging productivity to determine what skills are needed to solve a problem, what is expected for effective team work and how to add value to the team, and producing good outcomes	
CC60	A	Business and industry are built on access to information, schools are not	
CC61	A	Build on business model to foster entrepreneurial approach to program development that includes adapting to new conditions, changing workforce thru retraining, and successful problem solving vs. going out of business, failing to adjust and survive	

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7		***CREATE K-20 PROGRAM CONNECTIONS***	**(1)**
CC62	N	Higher education should engage with K-12 students to inform them of program requirements to pursue post secondary education in math, science, engineering	
8		***DEVELOP PARTNERSHIPS WITH COMMUNITY-BASED INFORMAL LEARNING PROGRAMS***	**(13)**
CC63	R	Start project based learning through informal education programs in order to move ahead without delays; eventually successful programs can merge into school programs	
CC64	R	Give students opportunities to engage in being scientists and exploring and learning, not through more schooling but through different types of learning experiences, do school differently; portray science so young children see it as something they want to do; students should see science as messy and tentative and understand that it is a range of things	
CC65	R	Tech camps for middle school students are important because this is when the "I" develops further	
CC66	R	*MCC* tech camps are effectively marketed to students through linking the camp with student interests, e.g., bicycles, offering them a fun, applied, embedded learning experience	
CC67	R	The City of Rochester has double the museum facilities of many communities in the U.S., which could be utilized to support informal learning program development	
CC68	S	**Utilize existing summer science camps for teachers and students to incorporate field trips to labs and other STEM related places; open new partnerships with municipalities and other civil society venues for summer labs**	
CC69	S	**Modernize organizations like *Big Brothers, Big Sisters* to develop engagement in STEM mentoring, internships**	
CC70	Y	Increase mentoring opportunities for students through professionals organizations that can inspire students, e.g., the *National Society of Black Engineers* (NSBE)	
CC71	Y	**Ensure the involvement of all students by incorporating before and after school programs, and field experiences that are supplemented by in-school instruction and support for students and teachers**	
CC72	Y	The Yonkers area has access to the "science barge" and should be linked to every school to provide all youth with an opportunity to visit the program; funding for buses can be provided by private support and can be offered in both spring and fall	
CC73	N	Marry instructional resources with curriculum to benefit from hundreds of programs available for older grades, e.g., PBS science series, "Elegant Universe," that can expose students to advanced scientific theories in visual ways, and bring scientists like Brian Green to rural schools	
CC74	C	Develop formal partnerships with informal learning institutions	
CC75	A	Work with nonprofits (informal education) to focus on PBL afterschool programs; current state legislative support for informal education is not likely to succeed as this is best developed at the local level, not top down	
9		***INCREASE STUDENT AWARENESS OF VOCATIONAL EDUCATION STEM CAREER PATHWAYS***	**(3)**
CC76	R	Change the perception of apprenticeships as alternative paths to career development, to that of a "front burner" option along with traditional education	
CC77	R	Identify careers that don't require a college degree and develop/offer courses to support skill development, e.g., cad-based instruction offered in high school drafting courses that prepares a student to become a cad designer, or aviation mechanics training for careers as certified mechanical inspectors, both make good salaries	
CC78	C	**Students should see viability of pursuing successful STEM career paths through trade schools as well as through college;** need to address student perceptions about trade schools, e.g., referring to BOCES students as "botards"; not all students can afford to go to college and are not aware of career choices through vocational training, e.g., plumbers, welders, that do not need a college degree	
10		***DEVELOP STEM PROGRAMS TO ADDRESS UNDERSERVED STUDENT NEEDS***	**(4)**
CC79	R	Target Latino and African American students, they don't know what STEM careers look like and what direction to pursue; these students are facing a 50% unemployment rate	

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CC80	R	Partner with the city as a potential funder of STEM programs that target out-of-school youth including pregnant and parenting young adults as a direct means of getting specific target populations into programs that will benefit the community through tax dollars at work	
CC81	R	If parents cannot engage in supportive ways with their child, then there needs to be other mechanisms to provide guidance and encouragement for kids "in the pipeline"; the leaky pipeline is about kids that do not have support at home	
CC82	C	Create mentoring programs and social networking tools to conduct outreach to schools to connect with minority students	
11		***CREATE PROGRAMS TO ENGAGE STEM CAREER PROFESSIONALS AS ROLE MODELS***	**(1)**
CC202	B	Identify local engineers to act as mentors and role models	
12		***ADDRESS BROAD SOCIAL ISSUES***	**-**
13		***REQUIRE TEACHERS TO COMPLETE STEM PROFESSIONAL DEVELOPMENT***	**(21)**
CC83	B	Elementary school teachers lack competence in math and science and are not ready for STEM (fear math); need to strengthen math/science instruction in k-6 (by 6th grade students have been exposed to 6 teachers who do not love math	
CC84	B	Centralize teacher PD by developing a resource network; Buffalo State teacher training is inconsistent in approaches and creates confusion for students; math and science teaching should be based on common approach	
CC85	B	PD should reflect a vision of what we want for students	
CC86	L	Teacher internships should be structured to occur both in and outside of the classroom, and should be content and lab-based, and should open up the teacher's experience and knowledge of the real world context of learning; expand teacher's views to encompass real world relationships and issues	
CC87	R	Utilize the existing mandate for 175 hours of PD to engage teachers in work outside the classroom, e.g., a teacher who spent one year working at Kodak returned to the classroom as a different person, providing great counseling to the student as a result of that business experience; allow K-12 teachers six months' immersion in industry, and pay teachers a stipend	
CC88	R	Design PD to create a vision of STEM, to give teachers an idea of what to work toward in the future similar to the way business works, where the team leader makes sure everyone has a vision for the future of the company	
CC89	R	Design PD to consider cultural differences in teaching styles that include two-way student teacher learning where the student is encouraged to point our errors by the teacher, versus the more traditional approach; teachers who lack confidence are sometimes uncomfortable when students ask questions, but this is not real learning; the best teachers learn from their students, but this is not part of their training; giving up control means teachers have to face not knowing everything and overcome their fear of not having all the answers	
CC90	R	Provide teachers with a framework to develop collaborative relations with other teachers, transforming the concept of teaching practices; develop skill set to promote team dynamics and project based instruction; utilize strong teachers as lead to collaborate with weak teachers, and new teachers; utilize the *BOCES* PD model	
CC91	R	Teachers enthusiasm for STEM would increase with increased support and leadership of principals	
CC92	C	Early support for school principals will be esential to developing efective approaches to integrate math and science, and to lead teachers in STEM implementation more broadly	
CC93	S	Develop an elementary school teacher boot camp to increase confidence and strengths in math and science	
CC94	Y	School districts can direct mandated professional development (175 hrs/5 years) to focus on STEM	
CC95	Y	Use the mandated 175 hours of PD to focus on STEM; restructure to incorporate stem content instruction	
CC96	N	Bring in content experts to conduct teacher training (not educators); rethink teacher training content to include training in use of sophisticated technology for STEM delivery in order for students to see applied uses of technology for learning	

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CC97	N	Develop program opportunities for teachers to gain training and experience in STEM education within a process that returns them to their home school (e.g. Beacon Institute)	
CC98	N	Teachers need opportunities to practice applied learning in a "low stakes environment" before being evaluated through formal assessment	
CC99	N	Consider *Beacon Institute* as a model for teacher training and professional development of current teachers to gain STEM skills through summer courses and other opportunities, returning to their home schools to apply new skills to teaching	
CC100	N	NYC *Hall of Science* (HOS) coordinates clinical work between college students and HOS staff providing practical experience for students; program offers 500 hours of teaching practice coordinated with school courses; scale this across the state with other museums	
VV101	C	Develop STEM career training for guidance counselors so they are able to "effectively enlighten students about what the world is like" and to adequately prepare students for their lives after graduation	
CC102	C	**STEM education requires huge changes in PD to provide adequate resources and training to effectively prepare teachers for STEM instruction; provide in-service and pre-service training so that all teachers are STEM trained when they enter the classroom and motivated to pursue ongoing STEM curriculum development; focus PD on developing skills in math and science**	
CC103	C	Teachers must have opportunities to leave the classroom to experience the world of business and industry to understand what is happening and what has changed; most teachers have been in school since age 5 and have never been a part of business and industry and need to learn through first hand experience and need support in translating that experience to the classroom, creating a lesson plan and integrating new knowledge into the curriculum, otherwise they will stick to the textbook; sensitivity should be incorporated into PD intended to build real world experience for teachers who resent being told they do not understand the world they live in	
14		***CREATE STEM TEACHER TRAINING/PRE-SERVICE PROGRAMS TO PREPARE NEW TEACHERS FOR STEM INSTRUCTION***	**(7)**
CC104	B	Change pre-service teacher training to accommodate interdisciplinary training, including math/science/technology; should be conducted by a panel across higher ed departments	
CC105	L	Provide structure and support for younger (new) teachers to break away from established practice and traditional teaching methods of experienced, tenured teachers; younger teachers are more likely to have more tech skills and could help fill the generational gap [digital divide] and lead the way in innovation in teaching	
CC106	R	Create mandates that require teacher training to include business/industry apprenticeships, internships or other forms of involvement to gain experience outside the classroom	
CC107	N	New teachers are trained in classroom management and do not have real teaching experience when they enter the classroom; provide adequate time for new teachers to develop curriculum, identify classroom resources, and to understand different learning modes and to experience the excitement of learning in order to be able to convey that to their students; new teachers typically have lowest improvement in test scores, and teacher retention is low (80% of teachers are gone in first four years, 52% of teaching fellows leave during first four years)	
CC108	C	Work with the unions in order to advance the retraining process	
CC109	N	Create teacher training residency programs that give teachers time to learn how to teach, how to interact with the school and to develop peer relations; train teachers in building relations with business and industry, and to utilize learning resources in the community, e.g., build peer relations with staff at the American Museum of Natural History	
CC110	N	NYC has a teacher residency program (pay is $10k/year for 3 years) that could be leveraged across the state; identify new sources to fund expanding the residency program	
15		***CREATE TEACHER STEM CERTIFICATION PROGRAMS***	**(1)**
CC111	R	Provide scholarships for student teachers to get STEM certified; create research internships for teachers and student teachers (graduate students); graduate research assistants should be trained in teaching and how to communicate with students; provide a stipend/grant to fund teacher training for research assistants	

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16		***CREATE COLLABORATIVE PROGRAMS FOR TEACHERS AND STEM CAREER PROFESSIONALS TO WORK JOINTLY ON STEM COURSE DEVELOPMENT AND INSTRUCTION***	**(3)**
CC112	R	Teachers can benefit from collaborating with career professionals; create opportunities for teachers to partner with career professionals for up to six months to co-design projects, identify common interests and build relationships	
CC113	R	Create summer programs for teachers to work with career professionals, then follow with a fall program where students become involved in hands on learning	
CC114	R	Develop a summer exchange program for teachers and career professionals linked to tax incentives for participating businesses, and provide sabbatical leave to support teachers	
17		***CHANGE STANDARD TEACHER EVALUATIONS TO INCORPORATE STEM EDUCATION GOALS***	**(3)**
CC115	R	Eliminate tenure and start "grading" teachers, they are dying for meaningful feedback, e.g., observation and written feedback is rarely done; design differential pay structure based on grading scale; not everyone is motivated by salary alone, create ways to recognize excellence in teaching that elevates quality teaching practices	
CC116	C	**Track teacher performance through student performance and provide feedback to colleges of education [good model for state and natl]**	
CC117	A	Restructure the teacher evaluation process to provide mechanisms to put teachers on the right track; eliminate current principal-teacher private evaluation and create project-based, team approach to teacher evaluations that is more transparent and that recognizes and promotes excellence in teaching	
18		***CHANGE STEM TEACHER COMPENSATION AND WORK WITH UNIONS TO ADDRESS CHANGES TO SUPPORT STEM EDUCATION GOALS***	**(3)**
CC118	N	Support differential pay for excellence in teaching; restructure collective bargaining contracts to support rewards and pay scales that compete with private industry; develop a 5-yr bonus structure, require 3 years in STEM teaching	
CC119	C	**Create a "loan forgiveness" program for student teachers who pursue STEM related teaching certifications**	
CC120	A	Institute policies that support teacher mobility between school districts (to protect benefits), current system creates disincentives for teachers to transfer to where they are needed	
19		***DEVELOP TEACHER TRAINING PROGRAMS FOR SECOND CAREER STEM PROFESSIONALS***	**(5)**
CC121	R	Create mechanisms for career professionals to enter the teaching profession including mechanisms such as tax credits for businesses that "lend" industry professionals to fill the shortage of STEM teachers	
CC122	Y	The best approach to attract content experts to the classroom may be to offer career professionals cooperative engagements with schools so they can maintain their status in the business world, and still contribute in the classroom; **recruit and select teachers for shared jobs and job appointments**	
CC123	N	Open up teacher certifications to career professionals to meet urgent needs for STEM teachers and that will also involve industry in education; consider the New Jersey program as a model	
CC124	N	Work with the *Science Academy* to encourage its members to consider second careers in education (6K Academy members) to pursue a short term plan to meet the need for STEM instruction	
CC125	C	Develop policy to allow career professionals to begin a second career at retirement as STEM instructors and teacher coaches	
20		***DEVELOP STEM CURRICULUM, INSTRUCTION, AND ASSESSMENTS***	**(40)**
CC126	B	Urban SDs are focused on skills/drill teaching to reach performance goals focused on math and science that have not worked; need to shift focus to k-4, integrated hands-on learning that could significantly improve performance outcomes	
CC127	B	Buffalo public school statistics show a graduation rate of 90% for students in computer/tech education programs, when overall graduation rate for BPS is 50%; demonstrates value of tech education in engaging students in ways that they can connect their interests with their education	
CC128	R	There is a disconnect between elementary and middle school curriculum; give elementary school teachers clearer understanding of middle school curriculum to help them prepare students for later grades and material to be covered	

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CC129	R	Create programs that "cross-fertilize" faculty from higher education and from K-12 through planned sabbaticals that allow teachers to trade places for a period of time	
CC130	R	Give students a framework for learning that is problem oriented, and linked to real needs in industry and business; students should feel ownership of their learning experience that makes the difference between 'have to stay in school' and 'want to stay in school'; teachers should explore ways to encourage student enthusiasm for learning	
CC131	R	Change the culture of math instruction so that student expectations are not about being shown what to do, and instead there is a different approach that engages students in an alternative kind of learning experience; engage parents in shifting expectations about math instruction	
CC132	R	Create a student peer to peer teaching/learning model to increase student performance (used in a chemistry class by one teacher with a 15-20% increase in outcomes); allow students to investigate a problem in a social context where students are on their own to pursue solutions with their friends	
CC133	R	Form student clusters structured by interests designed by the teacher who know students best then promote learning	
CC134	R	Align high school and college science curriculum; incorporate hands on learning in the science curriculum across high school and college	
CC135	R	College level science instruction occurs in real settings working like real scientists in labs, with hierarchies (professor, post-doctoral researchers, doctoral students and lab techs) working together following ideas, not following a syllabus; build this approach from both ends beginning with Pre-K through college	
CC136	R	Change classroom experience for young children who lose interest in learning by the 3rd grade; create STEM curriculum for Pre-K level; expose pre-k students to science through play and then start science learning in later grades; start students early in networked learning (Pre-K), to experience learning from their peers and others, and breakdown barriers at an early stage of development	
CC137	S	Create teacher teams to integrate English/social studies with math and science	
CC138	S	**Integrate all content areas in order to raise math and science requirements on the same plane with reading**	
CC139	Y	Hands on instruction will force schools to invest in providing lab facilities for students	
CC140	Y	Contextualize writing about science as reading proficiency in science	
CC141	Y	Block scheduling is essential to restructuring for STEM education	
CC142	N	Administrators must restructure the school day for teachers to allow time for collaboration and peer group development, planning and resource sharing; larger NYC schools are being split up into smaller schools, leaving teachers in cohorts of 2 versus cohorts of 20 to share resources and ideas	
CC143	N	Work with English teachers to improve literacy targeted to science literature (students cannot read science textbooks)	
CC144	N	Transform siloed instruction to integrated approach for middle and high school (elementary school is more integrated); need to change the structure to support a different curriculum, currently it is too constricted to allow for innovative instruction	
CC145	N	Align K-12 math and science curriculum with higher education requirements, e.g., Project Lead the Way students cannot meet physics requirements for college engineering programs	
CC146	C	State standards should address all content areas through an interdisciplinary framework for curriculum design; provide an adequate timeframe for new curriculum development with exemptions on exams for 3-5 years; provide adequate funding for curriculum expertise and design	
CC147	C	**The term "teacher" is archaic and does not reflect the new role of teachers as learning facilitators or counselors who should function as team leaders in collaborative learning teams that follow the industry model; teachers do not have experience working in teams or how to use other teachers as experts in collaborative team teaching, and lack the knowledge necessary to teach children how to be effective team members**	
CC148	C	Students won't invest in learning if they don't see the relevance, they need tangibility; as students move through the system, they lose interest and ability to think creatively	

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CC149	C	Consider how students today like to learn through texting, social networking, smart boards, staying connected, this is their process and needs to be part of their school life; throw away the textbooks and give students computers, let them use their cell phones because this is their culture; they are multitaskers and "physiologically different" from adults	
CC150	C	Students naturally form partnerships for informal learning and should be given the opportunity to build on that as an effective strategy to develop team learning skills	
CC151	C	Require all students to form "learning teams" to work collaboratively on individual skills and content focus (graduate school model) where students can learn from each other's strengths	
CC152	A	Students need to develop skills in self-direction, leadership, team work, communication; students today can't write or speak in complete sentences; students need soft skills in order to succeed, they can be taught to perform a job	
CC153	A	Students need tech skills to be augmented by ethics and understanding of team-based demographics of problem solving where everyone must pull their weight	
CC154	A	STEM instruction will require different teaching and measuring methods to capture creativity; STEM must be built into the curriculum in order to assure that the program is sustained	
CC155	L	Reinstate state waiver to allow exploration of new approaches to assessment	
CC156	L	Utilize established research to design assessments that shows that grades go up and behavior problems go down with PBL	
CC157	R	Waive the exams for one year and design new methods to determine value as a teacher, value as a learner	
CC158	R	Develop an exam based upon (35) integrative questions in which there are no definite answers to experiments for students to assess by the end of the term; allow students to utilize internet sources and discuss questions with each other; the process is not competitive but instead engages students in collaborative research and study throughout the term, not just at the end of the term	
CC159	R	Develop a biocultural assessment to get beyond traditional approach based on one single curriculum (lack of attention to diversity)	
CC160	R	Track students throughout their academic career	
CC161	S	**Develop student digital portfolio with student projects throughout academic career; creates continuum and interdisciplinary framework**	
CC162	C	Expand assessment of schools beyond test results, identify measures of connection to real world, e.g., partnerships with business and industry	
CC163	C	**Change assessments in ways that provide important data to the state that ties in with the national crisis in education and that directly informs state STEM program development**	
CC164	C	**Develop student assessments that also provide good feedback to teacher education and pre-service programs**	
CC165	A	Motivate students with weekly "pay checks" in lieu of grades for one year to connect students with workforce reality (pay checks are created on a scale of achievement, not dollars)	
21		***CHANGE EDUCATION REQUIREMENTS***	**(3)**
CC166	R	Extend high school credit for community service to include work with STEM related businesses and organizations	
CC167	C	**Redefine graduation requirements to include a digital "personal portfolio" that supports education requirements based upon knowledge achieved; assess a student's competency, not credits earned; require a defined graduation product**	
CC168	C	Students should pursue an individual path of achievement through the framework of "learning portfolios"; **redefine graduation requirements to incorporate personal digital portfolios;** students should be focused on STEM proficiency as their primary objective for graduation; define the 21st century student characteristics and all the skills necessary to function in the 21st century	
22		***BUILD BROAD NETWORK ENGAGEMENT***	**(19)**
CC169	B	Form a "*collaboratorium"* to partner outside the schools to include people with soft skills, culturals (libraries, museums), adjuncts from other fields	

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CC170	L	Students should be involved in setting goals that are meaningful and lead to sense of achievement	
CC171	R	Improve outreach to parents to extend communication beyond bad news, e.g., "your child needs to do better," to include positive progress that will encourage parents to connect with the school	
CC172	R	Augment the national referendum with a local regional mandate where it is easier to get stakeholders together, to reach agreement; "connect the dots" and take advantage of the existing resources	
CC173	R	Utilize social networking media to develop professional discussion groups that can contribute to ideas and potential project development	
CC174	S	Others should be involved with scalability and sustainability issues beyond teachers, they should not be solely responsible; build stakeholder process to assure that all who need to be are at the table in early stages of planning; hold 1-2 day events for business to form a collaborative to support partnership development; build community collaboration	
CC175	S	Develop a clearinghouse of STEM information for teachers and students to know which companies want to help/engage in the classroom (students use wikis, adults don't); create a regional planning calendar to track activities across school districts	
CC176	S	Use the annual *GEAR UP* parent conference in the spring to embed ideas on science fair opportunities with parents who need to engage and support community involvement; see *POTTERS FOR PEACE,* where artists and scientists came together to study water supply challenges; rename science fairs, "problem fairs," to emphasize multidisciplinary, multiple stakeholder process, including all ages, incentives, problem banks, industry/business partners, real life connections with STEM professions, and opportunities to create experiences that change life trajectories; **showcase student projects through competition**	
CC177	Y	Students know what they need and should be involved in the process of developing a new approach to education; without student involvement, we don't know what students think of the STEM initiative, they must be engaged in the dialogue, they are the ones most affected by the changes to be made	
CC178	N	Utilize information being developed through the *Tech Valley High* research-based program to demonstrate success of collaboration and involvement of partners in design and implementation of STEM education	
CC179	C	**Focus on policy that enables schools to make changes at the local level and that includes all key stakeholders including students and parents; policy should support community driven processes that are flexible in order to meet ongoing local needs that will change over time**	
CC180	C	Superintendents must take the lead in the districts, to set priorities, take risks, and establish the tone for each school; superintendents should be prepared to "step on toes" to implement needed changes, and to assure everyone is taking steps toward essential changes that must occur; early support for principals to lead teachers in STEM implementation is essential	
CC181	C	**Initiate local level action through the formation of a professional learning community across all school districts to bring teachers, principals, administrators and other essential stakeholders into the conversation; utilize social networking to expand the process to the whole community, including parents, who are as important to educate about STEM as school administrators**	
CC182	C	Address the digital divide in order to use social networking tools to achieve inclusiveness; leverage interest in technology using social networking tools focused on popular uses easily embraced that will extend technology use to become part of the formal learning culture	
CC183	C	Initiate support in the community through parents who are currently involved with tutoring and teaching remedial reading, as well as through the PTA	
CC184	C	Consider New York State programs, *BOCES* and *MST Connect* as examples of programs that have achieved consensus through action, gaining parent and community support	
CC185	A	Clearly define goals for all stakeholders to establish common ideas about building a strong vibrant education community and workforce; it is especially important to link these two goals in order to engage teachers who are resistant to the concept of workforce development, but who would support building community; the underlying message is that without a strong workforce there is no community	
CC186	A	Engage unions early in the process to better understand their issues and interests; coordinate labor involvement to expand current local scale engagement to state level	
CC187	A	Identify a local level lead entity to advance STEM education reform, cannot be done by school districts	

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23		***CREATE NEW TYPES OF PARTERNSHIPS WITH BUSINESS/INDUSTRY***	**(14)**
CC188	B	Neither higher education nor business are interested in lower level science education, they need to rethink importance of cultivating early interest in science and math	
CC189	L	Address legal liability issue of students in the workplace at state level	
CC190	R	Work with small businesses to gain their input on strategies for success and build on their expertise in thinking through problems and diverse challenges; small business has a real interest in improving the quality of future employees and can give input to structuring program goals	
CC191	R	Partner with business to develop paid summer internships and target students who haven't made it through academics and are drop outs or ready to drop out; develop a program collaboratively with business where students investigate real problems, they report back to business, and participate in an authentic process allowing students to contribute to developing curriculum, standards and leadership	
CC192	R	**Develop business input on curriculum and standards in order to serve the long term needs of business as well as society, and that also reflects important global challenges and real world issues that should be integrated into the curriculum; disseminate effective curriculum to other schools**	
CC193	S	Create new partnerships between K-12 teachers, students and business to build new collaborations for PBL before students reach the university	
CC194	S	College level internships are beneficial to students and to business as a two-way street to know individual students (who may be potential hires); develop apprenticeships to include training to become professional practitioners; develop program for former students in STEM professions to return to speak to the school about the real world	
CC195	S	NYS can utilize university jointly run PBS television station to provide access to media for STEM support	
CC196	S	**Use the *Cornell Cooperative Extension Program* to set up a STEM clearinghouse as a "donor choice model" open for businesses and teachers to connect school needs with business resources; could also be used by business to promote jobs/positions aimed at students; develop the infrastructure to support partnership building, matching businesses and schools by county/city, identify internships, and coordination to assure good outcomes**	
CC197	S	**Solicit problems that need solutions from different professional fields and create a student think tank, vet the problem through local scientists and others, and scale to age level of the student group**	
CC198	N	Promote the *Transition to Teaching* Program to more businesses as an effective way to meet the teacher shortage in STEM fields for all grade levels	
CC199	C	Industry must take responsibility for communicating to teachers, students and parents about the new reality of business and industry, and to convey specific skills that are needed, as well as innovative and creative aspects involved in manufacturing today; work with regional industries to reframe outdated perceptions about heavy manufacturing as a "bad" place to work, e.g., consequences of not doing well in school; work with parents to change perceptions and stigma about certain types of jobs (welder, plumbers), what it means to be an engineer, and math skills essential to tech careers	
CC200	C	Utilize social networking tools as a way to connect more broadly with stakeholders to collaborate, discuss, seek help with problems, and strengthen ties between education and business and industry; use social networking tools to communicate about specific issues and relevance of STEM education, e.g., global warming; connect with career professionals from business and industry who can act as mentors and collaborate with students and teachers to develop a global perspective on real world issues	
CC201	A	Follow *Tech Valley High School* model in bringing business and unions early to the planning and design process	
24		***BUILD STEM AWARENESS IN THE COMMUNITY***	**(5)**
CC203	B	Coordinate across the various community activities that relate to science and math, e.g., *Body Worlds,* upcoming exhibit on Darwin jointly developed by UB and the library; these can help to change people's perspective on science	
CC204	R	Educate parents about technology so that they consider it "cool," and influence their child's view of technology	

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CC205	S	**Use media to encourage students and conduct community outreach, e.g., start a science page in the local newspaper;** utilize media to increase interest in science fairs, academic tech bowl competitions	
CC206	A	Identify opportunities to bring the community together to understand STEM and value of increasing science literacy; expand community awareness to support scientific basis for problem solving	
CC207	A	**STEM is not the focus but is the underpinning for everyone to prepare for success in a career, in college, and as a citizen**	
25		***REDIRECT EXISTING FUNDING/FORM NEW TYPES OF FUNDING PARTNERSHIPS/IDENTIFY NEW INCENTIVES TO SUPPORT STEM PROGRAM DEVELOPMENT***	**(1)**
CC208	R	Utilize private/philanthropic funding sources to initiate STEM PD in the short term, and seek funds from the state and federal government to sustain PD programs including the Department of Labor, U.S. Department of Education, and NSF program grants.	