Exploring SC's STEM Ecosystem to Identify Grand Challenges

WHO WE ARE

A Brief History
South Carolina's Coalition for Mathematics & Science (SCCMS) is an alliance of partnering organizations and initiatives working together everywhere that STEM matters in our state. Together, we address STEM education challenges through partnerships, advocacy and public engagement.

The Coalition was formalized in 2004, with the guidance of BMW Manufacturing Co., Duke Energy (formerly Carolina Power & Light), DuPont, Michelin North America, and the SC Department of Education and a planning grant funded by the National Alliance of State Science and Mathematics Coalitions (NASSMC), the National Aeronautics and Space Administration (NASA), and the US Department of Education. Its precursors, South Carolina's Coalition for Science and Math Education and SC Leadership and Assistance for Science Education Reform provided a solid body of experience in bringing together key thought and action leaders around common issues in STEM before STEM was a movement.

Purpose, Vision, Values and Mission
SCCMS is a purpose driven organization. We seek to inspire learning and leadership in STEM education in schools, out-of-school time, business and industry and community.

We envision all South Carolinians as exemplars of world-class STEM knowledge, skills, and life/career characteristics that enable successful careers and engaged citizenship.

We value serving those in need, creating synergies, thinking strategically, acting on opportunity, and reaching for the impossible.

We fulfill our purpose by identifying and addressing Grand Challenges in STEM Education through partnerships, advocacy, and public engagement.

Things we do
As a managing organization, SCCMS has actively engaged partners for the purpose of offering aligned STEM efforts across the full South Carolina STEM Ecosystem by:

- providing instructional support for educators through S^2TEM Centers SC and the Next Steps Institute;
- promoting out-of-school learning experiences through Science on the Move and DIG (Dreams Imagination and Gift);
- collaborating with business and industry through the Upstate STEM Collaborative and LowCountry STEM Collaborative;
- creating experiences for ALL through statewide STE(A)M festivals - iMAGINE Upstate, Charleston STEMFest, iMAGINE Midlands and 4H Engineering Challenge; and
- provided information and resources virtually through STEMLinx, STEM Insights and Pinterest Boards.

HOW WE GOT TO GRAND CHALLENGES

The identification of "grand challenges" and the pursuit of solutions for them is not a new thing. There are "grand challenges" in engineering, social work, global development, and STEM teaching (https://100kin10.org) just to name a few. Why take this approach? The Bill and Melinda Gates Foundation explains it this way, "These initiatives use challenges to focus attention and effort on specific problems, and they can be traced back to the mathematician David Hilbert, who over a century ago defined a set of unsolved problems to spark progress in the field of mathematics."

While it is easy to know everyone who plays in the South Carolina STEM ecosystem due to our state's relatively small size, annual STEM Summits and other Coalition activities have brought together scores of organizations and hundreds of key leaders to inform, inspire and connect, these actions have not, however, engaged them to act as one. The idea of aligning our efforts throughout the STEM ecosystem in SC using a grand challenges approach came to fruition following a presentation by Talia Milgrom-Elcott, Co-founder and Executive Director of 100Kin10 at the 2017 STEMxchange.

The 100Kin10 Challenge Tree for STEM Education offers an exploration of root causes and possible actions to address the critical shortage of STEM teachers. This is well and good as teachers are "keystone species" in the STEM ecosystem. Teachers do not, however, thrive in isolation. Save the Redwoods, for example, states its mission is "to protect and restore redwood forests and connect people with their peace and beauty so these wonders of the natural world flourish." One cannot be rooted in the care of trees without considering the fullness of the forest.

We proposed to look at grand challenges from a wider lens than STEM teaching. We set out to ask questions about the broader ecosystem of STEM learning in South Carolina that included out-of-school time learning, the Arts, and learners of all ages. Our end in mind was to identify five ecosystem-wide grand challenges within our state that we might master within five years' time if we act together in ways that maximize our individual and organizational strengths and resources.

How do we know this matters and that these challenges will serve as seeds of future partnering/collaboration? As previously noted, it is easy to know who is who in STEM in our state. Therefore, we created a simple survey and asked 62 of our known STEM colleagues *to identify their interest* in a grand challenges conference. Of 33 respondents, not one declined interest and 24 responded "Most definitely" as to their desire to participate. Additionally, survey respondents identified 19 colleagues whom they felt would be interested as well.

Why 100Kin10?

Our goal for involving 100Kin10 as our outside facilitator was to ensure that all key stakeholders across our state were aware that we were not putting our own agenda forward within the grand challenges dialogue/discussion. External facilitation by an organization expert in grand challenges ensured that participants were seen as equals and that, indeed, the identified challenges represented the collective thoughts of those participating. Just as important, 100Kin10 has a relevant body of experience in the design and delivery of protocols essential to identifying both grand challenges and root causes.

To be clear, the "solutions" relevant to the STEMx network that were called for in the challenge grant are not simply the actions to be directed toward the identified grand challenges in South Carolina. We set out to translate grand challenges work accomplished by 100Kin10 to an environment that is both broader, in terms of STEM challenge possibilities beyond teachers and teaching, and, narrower, in terms of geography as a state rather than a national inquiry. We see this process as especially relevant to states in the early stages of organizing a network and for states like ours with no sanctioned STEM strategic plan and/or with a network that is a loose federation of actors in need of a narrower set of rallying points to maximize their impact.

PREPARING FOR THE GRAND CHALLENGES SUMMIT

Our team worked very closely with Grace Doramus, Director of Strategic Initiatives at 100Kin10 to plan the summit and to follow up afterward as we continue to move forward with finalizing and implementing our grand challenges. The objectives of our partnership are:

1. Develop a comprehensive map of the grand challenges in STEM education for South Carolina, building on 100Kin1o's national grand challenges maps and research.

2. Identify ~5 priority challenges to guide South Carolina's STEM effort for ~five years.

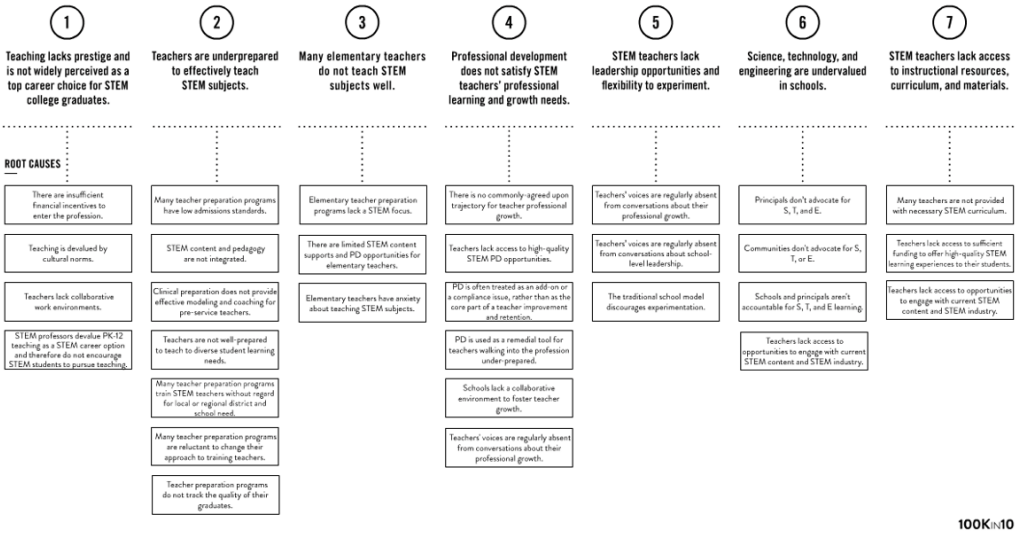
3. Define a method for mapping a STEM education ecosystem and identifying priority areas in a single state, to be used by other STEMx members or in other regional settings

Together, 100Kin10 and the SCCMS Team developed an overarching, three-step approach for applying the 100Kin10 grand challenges to the local setting.

1. Use pre-work (e.g. interviews, surveys, small workshops) to localize the existing map and data. Prior to the convening, our team collected interview data from stakeholders that represented multiple categories of STEM including arts community leaders, STEM and non-STEM teachers, STEM and non-STEM students, school administrators, school district leadership, business/industry representatives, policy makers, out-of-school learning community, technical college faculty, special educators, and State Department of Education staff. Information collected from the interviews was compiled and used to develop our state's version of the Grand Challenges Map. This process was made possible by using the 100Kin10 guide "Revising the Grand Challenges Map with Stakeholder Interviews". Using this guide, we were able to identify additional catalysts to add to the grand challenges map.

   While the two maps below have many similarities, we were purposeful in making the map our "own" such that it fit the needs in our state. Using the interview data, we identified *Super Themes* that were used to organize the 100Kin10 Themes for Grand Challenges. The Challenges are color coded according to the Super Theme. We also replaced language used such as using "educators" in place of "teachers". Our goal was to focus on educators across the spectrum from preschool to secondary to out-of-school learning. Within the maps, we identified the additional catalysts that came forth through interview data.

THE CHALLENGE TREE



100KIN10

THE SYSTEM MAP

GRAND CHALLENGES IN SC STEM SUMMIT 2017

Value & Perception

HOW MIGHT WE RAISE THE PRESTIGE OF THE STEM EDUCATING PROFESSION?

Educating lacks financial incentives.

Educating is devalued by cultural norms.

Educators lack collaborative work environments.

STEM professors often devalue PK-12 educating and do not encourage STEM students to pursue the profession.

SEE CHALLENGES

Value & Perception

HOW MIGHT WE EMPOWER STEM EDUCATORS WITH LEADERSHIP AND AUTONOMY?

Educators' voices are regularly absent from conversations about their professional growth.

Many schools lack opportunities for educator leadership.

The traditional school model discourages experimentation.

SEE CHALLENGES

Value & Perception

HOW MIGHT WE ENSURE SCIENCE, TECHNOLOGY, AND ENGINEERING ARE VALUED IN SCHOOLS?

Principals often do not advocate for science, technology, and engineering.

Communities often do not advocate for science, technology, or engineering.

Schools and principals often are not accountable for science, technology, and engineering learning.

Few educators have opportunities to engage with current STEM content and industry.

SEE CHALLENGES

Educators' Continuous Learning

HOW MIGHT WE ENSURE EDUCATORS ENTER THE CLASSROOM WELL-PREPARED TO TEACH STEM?

Prep programs often have low admissions standards.

STEM content and pedagogy are not integrated.

Pre-service educators often lack effective coaching.

Educators often lack preparation for diverse learning needs.

Many educator preparation programs do not account for local or regional needs.

Many educator preparation programs are reluctant to change their approach.

Educators' Continuous Learning

HOW MIGHT WE ENSURE VALUABLE PROFESSIONAL DEVELOPMENT AND GROWTH FOR STEM EDUCATORS?

There is no commonly-agreed upon trajectory for educator professional growth.

Educators often lack access to quality STEM professional development.

Professional development is often treated as a compliance issue.

Schools often lack a collaborative environment to foster educator growth.

Educators' voices are regularly absent from conversations about their professional growth.

SEE CHALLENGES

Elementary Educators

HOW MIGHT WE EFFECTIVELY PREPARE AND SUPPORT ELEMENTARY EDUCATORS TO TEACH STEM?

Few elementary educator preparation programs have a STEM focus.

Elementary educators often lack access to STEM professional development.

Many elementary educators have anxiety about educating STEM subjects.

SEE CHALLENGES

Instructional Resources

HOW MIGHT WE ENSURE EDUCATORS HAVE ACCESS TO QUALITY STEM INSTRUCTIONAL MATERIALS?

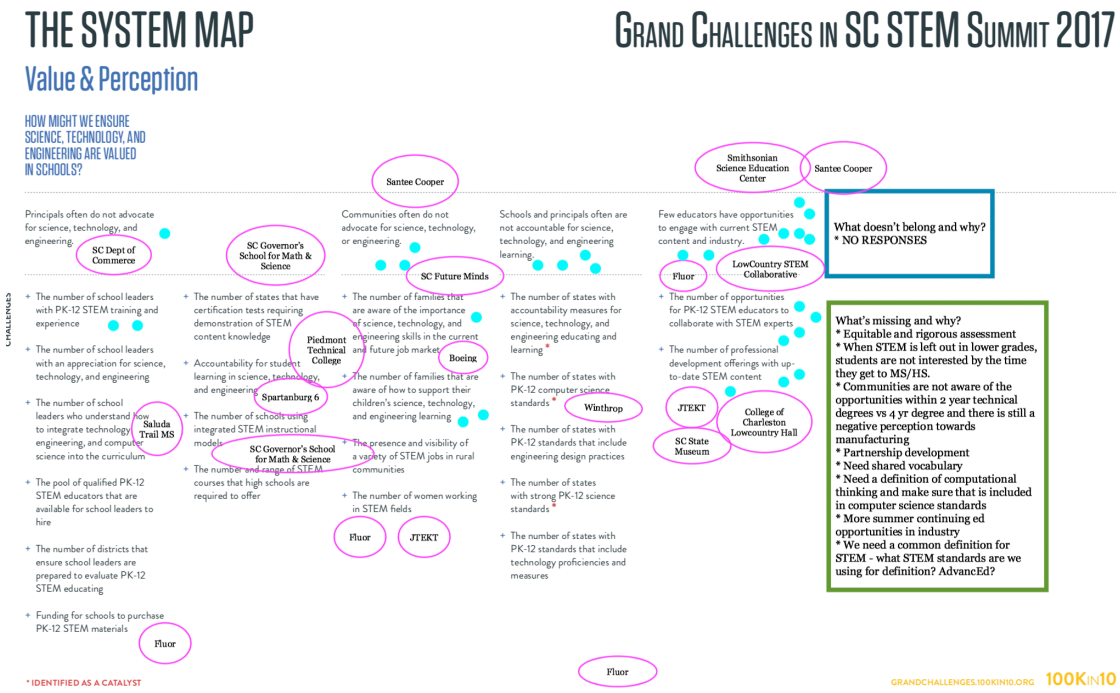
Many educators lack access to quality STEM curriculum.

Educators lack funding to provide quality STEM instructional experiences.

Few educators have opportunities to engage with current STEM content and industry experiences.

SEE CHALLENGES

2. Host the Summit convening to finalize the map and develop a "heat map" of existing STEM work in the state. This heat map would show us who was already addressing STEM challenges throughout our state, as well as provide ideas as to where we might gather recommendations and ideas for the priority areas, create buy-in for the challenges identified, and prepare attendees to take action. (See heat map below from data collected at the Summit. The blue dots represent votes for challenges in which to focus, the names within circles show where resources already exist and the boxes on the side represent initial thoughts on the map.)



3. Develop final set of state priorities based on recommendations received at the convening. See Grand Challenges section below.

This three-step approach was designed to emphasize informing a new audience about the existing challenge maps while minimizing the need to collect and analyze large amounts of local data. This approach does not fully "regionalize" the maps and also relies on additional effort following the convening to solidify priorities for the targeted geographic area; in our case, the state of South Carolina.

THE DAY OF THE GRAND CHALLENGES SUMMIT

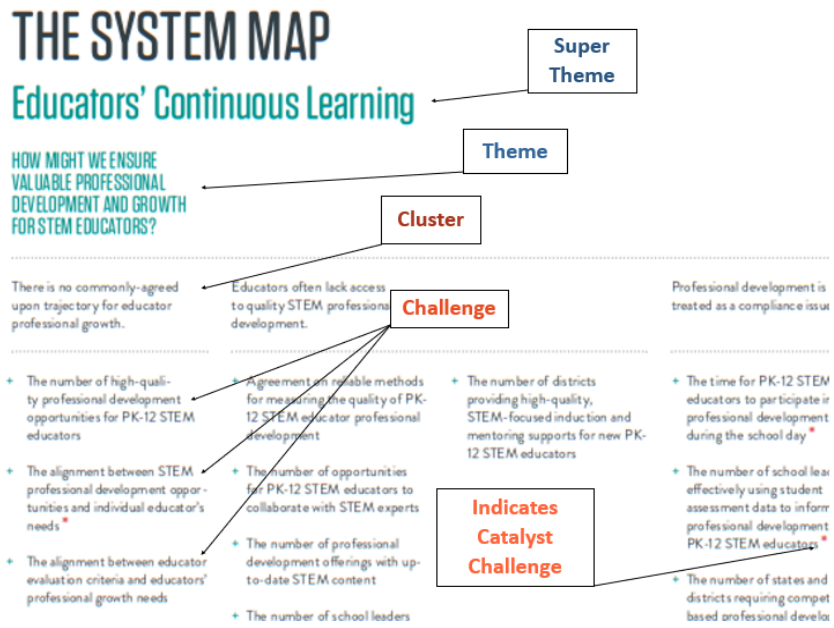
Roles:

- SC STEMx Team led on convening logistics, invitations/registration, pre-work implementation, grand challenges maps localization, and convening follow-up and next steps. This team also provided facilitators for the day-of the convening, as well as other staff support.
- The 100Kin10 team led on agenda planning, recommendations and guidelines for grand challenges map and data localization, pre-work design, and meeting facilitation. This team also consulted and provided support for convening follow-up and next steps.

Attendees were known thought and action leaders with interest in STEM. They came from across the entire state, from urban and rural regions, and from all walks of life including business/industry, the Arts, out-of-school learning places, government, classrooms and more. Participants were nominated by SCCMS and by regional leaders from the statewide S^{2}TEM Centers SC network, managed by SCCMS. Additionally, an invitation was extended to representatives of STEMx member states.

Unlike prior SC STEM Summits, the focus of thought and action was intended to come from the participants themselves rather than by by external speakers, panelists or other presenters. As such, our team devised a set of protocols to engage the participants in networking, exploring the vastness of the [STEM Challenge Tree System Map], and then taking a deep dive into a sub set of challenges of each participants' choice.

Dialog promoted by the protocols was centered on research conducted by 100Kin10 to identify root causes and possible actions to address the critical shortage of STEM teachers. Particularly effective was the use a set of *South Carolina Super Themes* identified through analysis of pre-convening interviews.

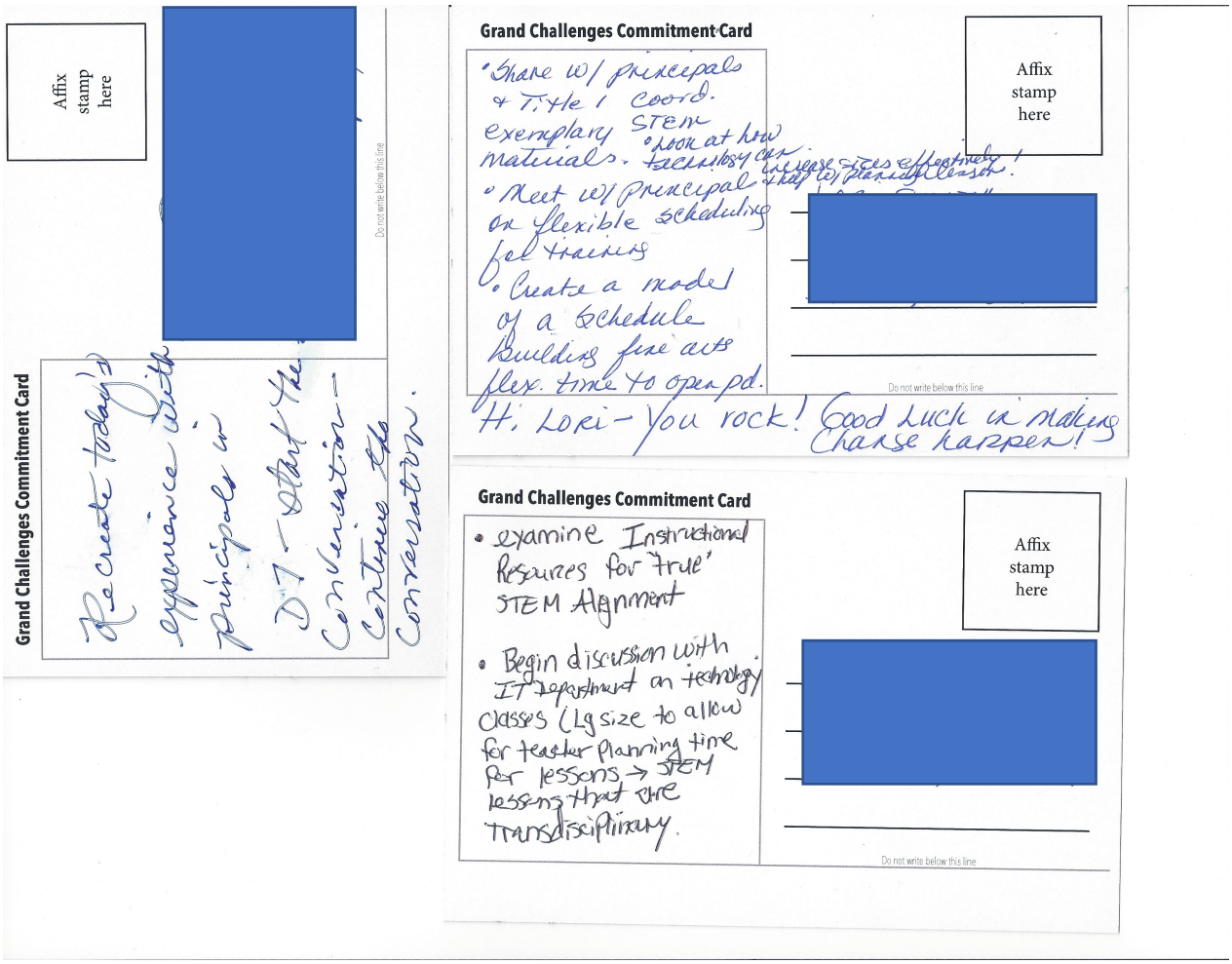


Themes

Super Theme	Theme
Value & Perception	How might we raise the prestige of the STEM educator profession?
	How might we empower STEM educators with leadership and autonomy?
	How might we ensure science, technology, and engineering are valued in schools?
Educators' Continuous Learning	How might we ensure educators enter the classroom well-prepared to teach STEM?
	How might we ensure valuable professional development and growth for STEM educators?
Elementary Educators	How might we effectively prepare and support elementary educators to teach STEM?
Instructional Resources	How might we ensure educators have access to quality instructional resources?

Participants engaged in small group dialogue around each Super Theme to inform their selection of one to explore further in a Deep Dive protocol. The Super Themes were not only effective in categorizing data gathered through our pre-conference interviews but also as a quick visual. As participants separated into Super Theme groups according to their expertise, interest, etc., their choices gave us an immediate data point with the largest group being Value & Perception, followed by Educators' Continuous Learning, then Instructional Resources, and finally Elementary Education. We found this choice pattern to be a trend as we continued to use the Challenge Maps for other statewide meetings and conferences to continue collecting data.

The Deep Dive into the Super Themes for our groups was key to the day. It was then that our participants explored challenges within the Super Theme and discussed causes and possible solutions. Having an expert facilitation team from the S^2TEM Centers SC network helped greatly to ensure that dialog and discussion stayed on point and yielded the results we were after. At the end of the Deep Dive Discussion time, each group shared their three top ideas with the full audience of participants. At the end of the convening participants reported that they were encouraged, excited, hopeful, and committed. (See sample commitment postcards completed and mailed back to each participant as a reminder 2 months post Summit.)


Affix stamp here
Grand Challenges Commitment Card
Do not write below this line
Grand Challenges Commitment Card
• Share w/ principals & Title I coord. exemplary STEM materials. • look at how technology can increase STEs effectiveness & how to plan lessons.
• Meet w/ Principal on flexible scheduling for training
• Create a model of a schedule building fine arts flex. time to open pd.
Affix stamp here
Do not write below this line
Hi, Lori - You rock! Good luck in making change happen!
Grand Challenges Commitment Card
• examine Instructional Resources for true STEM Alignment
• Begin discussion with IT Department on technology classes (Lg size to allow for teacher planning time for lessons → STEM lessons that are transdisciplinary.
Affix stamp here
Do not write below this line

MAIN TAKEAWAYS FROM THE CONVENING

First and foremost, the meeting validated our contention that STEM leaders would rally around the strategy of identifying a few catalytic challenges to move STEM teaching and learning forward. As we had expected, the task of reviewing over 100 challenges and whittling them down to a mere five was simply too daunting for a single day. That said, we were many steps closer at the end of the convening and Grand Challenge Summit participants made personal commitments to broaden their networks in the SC STEM community and to share what they have learned with their colleagues.

We would still need to continue sharing the grand challenges map throughout the state with other groups of STEM stakeholders to continue collecting data. We compiled all of the collected data and created a draft form of the SC Grand Challenges to be released at our first STEM Education Day at the State Capitol (March 7, 2018). The draft grand challenges remained for public review/comment through the end of April. See drafts below.

Grand Challenges in SC STEM

Value & Perception of STEM

- *STEM Community Engagement*
  - Engage individuals and organizations in advocating for quality STEM education
  - Build awareness of the value of STEM education and career opportunities across the community
- *STEM Leadership and Educator Roles*
  - Expand educators' STEM content knowledge and career awareness through professional learning experiences that engage SC's STEM business/industry experts
  - Build leadership capacity of STEM educators, including school & district administrators, both in schools and across the community
- *STEM Educator Incentives*
  - Recruit and retain STEM educators through financial and other incentives

NEXT STEPS FOR GRAND CHALLENGES IN SC STEM

Identifying the five Grand Challenges in SC STEM is just our beginning for the next five years. We are moving forward in several ways. First, a grand challenges task force is being formed. SCCMS staff members have been assigned to lead teams focused on each of the five grand challenges. Teams will consist of a variety of stakeholders in STEM (similar to the interviews and the Summit). Each grand challenge team will develop goals, action steps, resources, success stories, information and questions. This information will be added to the grand challenges website and updated as teams meet and have more information to share.

An unexpected, yet not surprising, outcome of our grand challenge work and data collection is that we have shown the need and desire for our state to come together toward the purpose of creating a common definition of STEM education, and to denote a common language for STEM teaching and learning. It remains challenging in SC to collect STEM student and STEM teacher data without an accepted and agreed upon definition of STEM. With the assistance of our colleagues at the Department of Commerce and other business/industry partners, we anticipate we will reach a common understanding and definition prior to the beginning of the next fiscal year.

We have only just begun to tell our story; the grand challenges identification process will be presented as a 10 hour, learning pathway at the upcoming Next Steps Institute for STEM Learning and Leadership in Colorado Springs in October of 2018.

Terms Glossary

Term	**Definition**
Super Theme	Related themes are grouped into super themes.
Theme	Related clusters of challenges are grouped into a theme.
Cluster	Related individual challenges are grouped into a common cluster.
Challenge	Individual root cause issue in the system.
Catalyst challenge	Individual root cause that was identified as having greater influence over the system through the national analysis or through South Carolina specific research.