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SUSTAINING STEM/STEAM ON A COMMUNITY COLLEGE CAMPUS



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Abstract

College campuses launch Science, Technology, Engineering, Math (STEM) or Science, Technology, Engineering, Art, Math (STEAM) programs often neglect to establish a sustainability plan. STEM/STEAM events tend to be random acts or stand-alone events lacking intentionality, integration, and collaborative connections across the STEM/STEAM disciplines, faculty, and students. To establish, implement, enhance, and sustain efforts in STEM/STEAM programming on a college campus; Housatonic Community College identified six necessary core components. 1. Developed STEAM/STEM Taskforce (Passionate/Key Faculty, Staff and Students). 2. Administration buy-in and support (Embed in Mission or Vision statement). 3. Inventory of all stand-alone events and programs (Calendar of Events that fit within STEAM). 4. Funding and/or leverage current resources (Identify all funding sources, donations, in-kinds). 5. STEM/STEAM Training or certification (Professional Development for faculty, staff, and students). 6. Maintain and establish key stakeholders (community engagement, K-12, employers, and legislators). STEM/STEAM initiatives, goals and objectives require innovation, forward thinking and collaboration. Adequate staffing, administrative support, funding, equipment, training, and key stakeholders are necessary to strategically sustain a robust STEM/STEAM campus. The term STEM and STEAM will be used interchangeably. Institutions may recognize one over the other, however, the core components can be leveraged for either institutional type.

Introduction

Housatonic Community College (HCC) wants to properly prepare students for the economic future by educating and producing a strong foundation in STEM/STEAM. Students at Housatonic Community College can choose from over 60 Associate Degree or certificate options under the Science, Technology, Engineering, Art and Math disciplines. Education is being called upon to prepare responsible citizens to meet the complex challenges we are currently facing as a means of addressing the rising economic, social, or environmental challenges.¹ Housatonic Community College (HCC) wants to help meet the complex challenges and began to intentionally focus on strategically building and strengthening STEM/STEAM initiatives, programming, and funding since late 2015. HCC is now recognized a leader in STEM Education in the State of Connecticut. In such a short time frame, HCC was able to leverage resources, connect with STEM partners and build critical STEM pipelines with K-12 schools, the community, private and public 4-year institutions and the STEM workforce industry in the Greater Bridgeport, Connecticut region.

Job opportunities in STEAM disciplines are consistently on the rise and are projected to grow through 2024.² To succeed in the STEAM fields, students must be equipped with the necessary skill set required in addressing the ever-transforming workforce. Students must possess career readiness competencies in strong communication, creativity and critical thinking coupled with solid technical and soft skills as defined by National Association for Colleges and Employers (NACE).³ In order to best serve our student population, faculty must have a continued enriching professional development plan allowing them to access educational units and trainings in effective teaching practices, STEM integration, equity and inclusion across the STEM/STEAM studies.

Building a campus or STEM community that is focused on improved STEM teaching and learning can improve the learning experience of students. Such a community can extend the capacity to evaluate programs and assess learning on campus through the coordination of campus activities. In addition, an inclusive community can attract and support student populations, including those underrepresented in the sciences.⁴ HCC is committed to raising the bar in STEM education through enhanced programming, research opportunities, study abroad, faculty and student professional development, instructional pedagogy, and real-life hands-on applications. HCC wants to provide the essential skills and tools necessary in preparing students for the STEM workforce or transfer to a four-year institution.

For continued and aggressive momentum in STEM and STEAM, HCC has created a sustainability plan founded on six core components essential to sustaining STEM/STEAM on a college campus. The six core components will be outlined and discussed in this submission. In 2015, the STEAM Team Taskforce identified key priorities and objectives. The timeline depicts how each objective was met and when. Accomplishing these achievable goals over the past 5 years, revealed both direct and indirect impact and advancement in our students, faculty, and the overall college.

Six Core Components in sustaining STEAM on a college campus

The six core components are a culmination of best practices in STEM education, and were constructed as low scale, low-cost approaches in establishing and sustaining STEM on a college campus. HCC is nested in Bridgeport, Connecticut, an urban setting that is struck with high poverty rates, high crime rates and suffers significantly from the economic and educational disparities within the Fairfield County region of Connecticut. The six core components are founded on limited resources and funding but more importantly on the upward passion and mobility to thrive. The six core components are listed below and will be discussed in detail throughout this paper:

1. Developed STEAM/STEM Taskforce (Passionate/Key Faculty, Staff and Students)
2. Administration buy-in and support (Embed in Mission or Vision statement)

3. Inventory of all stand-alone events and programs (Calendar of Events that fit within STEAM)
4. Funding and/or leverage current resources (Identify all funding sources, donations, in-kinds)
5. STEM training or certification (Professional Development for faculty, staff, and students)
6. Maintain and establish key stakeholders (Community/STEM Ecosystem, K-12, legislators)

Core Component 1: Developed STEAM/STEM Taskforce (Passionate/Key Faculty, Staff and Students-internal stakeholders)

One of the most critical aspects in sustaining STEM or any student success program on a college campus is having the support and buy-in from students, faculty, and staff. Every effort to improve student success must include their voices and intensive engagement.⁵ This prompted HCC to first develop a taskforce comprised of students, faculty and staff who are like minded whereas these members are genuinely passionate about STEM and STEAM. This core team or taskforce is organically interested in the potential growth of STEM/STEAM programming at the campus. These members should have shown a willingness and readiness in moving the needle in STEM education. The taskforce is fundamental in the planning and piloting of all STEM initiatives on campus. Ultimately, the taskforce of internal stakeholders is charged to create, adapt, and scale up specific practices that can advance STEM education and the STEM workforce.⁶ HCC started by identifying all full-time STEM faculty and those that expressed an interest in STEM. The taskforce consists of eleven members: seven, three staff and one administration. The taskforce meets weekly for one-hour since 2015. The team was charged with key duties in launching STEM on the campus. Some of the charges transitioned and expanded into the other core components within this paper.

- Building a timeline of events that require low-to-no cost with high victory wins in offerings
- Identify all random acts of STEM, which are stand-alone events that lacked connections and intentionality.
- Identify key stakeholders both internal and external partners within the community.
- Take inventory of STEM/STEAM academic programs and equipment throughout the college campus

Core Component 2: Administration buy-in and support (Embed in Mission or Vision statement)

Leveraging administrative support and buy-in from the campus leadership team is fundamental in sustaining STEM on a community college campus. Research on how to best structure a STEM campus, the necessary infrastructure required, and the funding needs must be presented to the leadership board, college foundation boards and any other executive functioning boards that need to weigh in and endorse the STEM campus planning. Discussions related to pipeline programming, partnerships, events should exist in the presentations. Leadership should be aware of the budget neutral approaches that can exist in the establishment of STEM on a campus as well as the proposed budget for the expansion and long-term commitment of retaining STEM on campus. HCC was able to start with a budget neutral approach by adding STEAM to the mission and vision statement for the community college. This approach allowed the campus to approach and present to external philanthropist, legislation, and STEM employers. The STEAM taskforce was provided the opportunity to present at open houses and student orientations regarding the programs that organically fit under the STEAM umbrella. Excitement around STEAM on campus, was critical in building a band wagon approach.

Mission: Housatonic Community College, through a collaborative, learner-centered, technology-rich and stimulating educational environment, empowers all individuals to develop to their full potential as lifelong learners. As a knowledgeable and dedicated faculty and staff, we inspire students to contribute responsibly to our dynamic regional and global society.⁷

Vision: By 2021, Housatonic Community College, empowered by resources and public support, will be a regional leader in higher education, workforce development, and community engagement with cutting-edge programs in science, technology, engineering, arts, mathematics, and other disciplines that address the ever-changing needs of students, employers, and society.⁷

Core Component 3: Inventory of all stand-alone events and programs (Calendar of Events that fit within STEAM)

In addition, the taskforce was charged with:

1. building a calendar of STEM events
2. taking inventory of all underutilized equipment and models
3. Generating a list of all academic programs that fit under the STEM/STEAM umbrella. These three aspects became fundamental in the building and strengthening of STEM on campus. All three were low stake approaches, no cost associated and ultimately became one of the most impactful approaches in the establishment of the STEM Center of Excellence.

All random acts of STEAM, meaning all STEM/STEAM events that were once stand-alone events, lacking connection and intentionality were reviewed and added to the running log of events. The intention was to regroup, rebrand and redistribute these events as STEAM events. This calendar of events morphed into an elaborate, comprehensive, rich platform of opportunities open to college students, K-12 community, employers and more. discussion and focus on STEAM across the academic year as well as the celebration of STEM/STEAM during National STEM Day in November. This re-focus allowed HCC to offer Research Days, STEAM College Transfer events, STEM employer engagement events, STEAM summer camps, STEAM Saturday Academies, Women in Manufacturing Boot Camps, Edible Campus Gardening and Earth Day projects, Hack-o-thon, Girls and Coding, Sidewalk Art Festival, sponsored Minds in Motions, STEAM Study Abroad, and the evolution of the now well-recognized Annual STEAM Fest at HCC.

HCC developed unique partnerships in the community and was able to sponsor and support the below youth STEAM programs on campus. These programs were independently funded, staffed, and organized by individual organizations. The HCC campus provided the facility and space for the enrichment programs during the summer and weekends during normal operating business hours. There was no accrued cost to the campus. HCC was able to leverage these collaborative connections with the community, display the HCC logo on all enrichment programs and utilize these partners in future grant proposal requests.

Youth STEAM Enrichment Programs housed at HCC:

- Bridgeport Organization for Youth Sports, Inc., STEAM Camp (2016)
- ACCESS for Education, STEAM Summer Enrichment Program (2017, 2019)
- Amazing Girl Science, Norwalk, CT. (2018, 2019, 2020)
- Bridgeport Public Schools Manufacturing Enrichment Program (2019)
- Dept of Transportation Summer Enrichment, 2020 (cancelled due to Covid-19 Pandemic)

An inventory of all academic programs, course offerings related to STEAM areas. This comprehensive list of program and course offerings were placed under the STEAM umbrella and helped launch the STEAM website for HCC. The identified list also set the tone for new future course and program offerings in STEM/STEAM based on the STEM/STEAM projected employment demands. Since the launch of STEAM at HCC in 2015, the below degree or course offerings in both credit and non-credit areas were approved.

New course and program offerings at HCC:

- Pre-Nutrition Degree
- Surgical Technology Degree
- Industrial Design Degree
- Manufacturing Technician Degree

- Forensic Science with Laboratory course (Biology and Criminal Justice Majors)
- Art of Chemistry (course)
- Astronomy (course)
- Organic Chemistry (course)
- Human Biology (non-STEM major course)
- Sterile Processing Technician (non-credit, program)
- Comp TIA ++ (non-credit, program)
- STEM Pathway Training Professional Development Course (non-credit course)
- Introduction to Gardening Course (non-credit course)
- Introduction to Herbalism Course (non-credit course)

STEAM Center of Excellence:

The newly developed STEM Center nested in the Academic Support Tutoring Center, provides a think-tank supportive to STEM Education. This hub is used by STEM faculty and STEM students for tutoring, office hours, project-based learning, research planning, small symposiums, and STEM trainings. It was established by the STEAM taskforce and first comprised of the underutilized equipment including laptops, calculators, microscopes, anatomy models and reference books. This idea of providing a location for STEM Excellence was gained at a STEM Conference attended by the Academic Dean. After researching and reviewing STEM Centers of Excellence across the world, it was noted a necessary component in supporting and enhancing STEM Education. One of the best practices in developing the center, is strategically nesting it within the tutoring corridors. It draws attention and is not lost in a campus, while minimizing confusion in students on when and how to use the space. Many college campuses, organizations and institutions are incorporating such centers of excellences into their mission and vision statements. STEM Centers of Excellence are becoming the most highly noted means of connecting STEM students to resources, opportunities, programs, the community, and employers. STEM Centers foster an environment for interactive, intellect, empowering and upward mobility in STEM academics. It promotes a student and academic service for inquiry, collaborative and integrated based learning for STEM students and STEM faculty. This is a pivotal time for STEM focused institutions to invest in the development of a STEM Center of Excellence and seek the various funding opportunities available in establishing the center.^{8,9}

Core Component 4: Funding, Technical Support, In-kinds

Any project with the intent to exist for a long duration requires a sustainability plan that outlines funding. The sustainability plan is required for forward-thinking and long-term success. Its relevant benefits and overall impact should be shared with donors, community funders and displayed in grant proposals. To sustain a project or plan, in this case, sustaining STEM on a

college campus, the sustainability plan requires a plan or approach in financial stability. Both internal and external sources of financial support are required for on-going sustainability. ¹⁰

In-kinds, collaboratives, grant writing groups, presentations to community stakeholders and reallocation of internal budgets should be reviewed and rest on core components one through three. This has strategically allowed HCC to receive direct funding for STEM/STEAM enrichment programs and activities, technical support for program development and funding for faculty and student professional development and training. On-going funding has also been secured for the STEM Center of Excellence and for the annual STEAM Fest. It is critical to have open communication with leadership, skilled grant writers, including the faculty who are passionate and knowledgeable about the disciplines in STEM/STEAM. HCC innovatively submitted a proposal to a local biotechnology pharmaceutical who was closing. This allowed HCC to seize laboratory supplies, laptops, and state of the art equipment including pipettes, balances, and vortexes to support the science labs and the development of the forensic coursework. Since the infancy of STEAM at HCC, HCC has been able to secure in-kind, funding, and technical support equaling \$400,000. This includes support from Jobs for the Future, Yale Post Doctorate Teachers, Helmsley Charitable Trust, Sikorsky Lockheed Martin, Pitney Bowes, National Institute for Women in Trades, Technology and Science (IWITTS) and recently submitted two large grant proposals to the National Science Foundation. In 2019, HCC partnered in a proposal with the United Way of Fairfield Coastal and were awarded the designation of co-lead in the Bridgeport STEM Ecosystem, which is fundamental to core component six, community stakeholders. John Mishler outlined a three-level strategy for small to mid-sized colleges and universities who want to transition their focus toward external funding, those included the preparation of a mission statement, long-range strategic plan, and goal setting. Within the three components a critical aspect was enhancing infrastructure at the institutional and department level. ¹² These components were fundamental to HCC.

Core Component 5: STEM training or certification (Professional Development for faculty, staff, and students):

HCC seeks to help strengthen educators and engage students early on in educational pathways in the STEM fields. HCC offers early college credit to high school students, stackable certificate, and associate degrees to college students and work to strengthen transfer articulations to help transfer and graduate students make seamless transfers into baccalaureate programs.

HCC provides faculty, staff and students training and professional development opportunities that help transform the typical lecture experience into a STEAM enriched coursework through effective pedagogical approaches including inquiry, project-based and hands-on practical applications. Innovative and effective 21st century classrooms with a shift from traditional lecture style has allowed faculty to provide more critical, creative, and technical

skills required to meet the industry demands while growing soft skills that are necessary for employment.

In August 2019, Housatonic Community College was named the first Pathway Provider of Carnegie STEM Education in Connecticut. As a trained Pathway Provider, HCC has conducted the Carnegie STEM Excellence Pathway three-part strategic-planning process designed to aid schools, districts, and organizations in improving STEM education.¹¹ Since this designation, HCC has successfully trained the Greater Bridgeport Ecosystem members, HCC faculty and teachers in the K-12 schools. The training pathway has been leveraged as a revenue generating model and used in grant funding efforts. In 2020, HCC received its first mini-STEM grant under the GANAS NSF Semillas to offer Carnegie training to faculty and the community partners. STEM faculty and students must be given opportunities to participate in STEM education conferences, convenings, and seminars to help build knowledge, and to learn of best practices in STEM education. STEM leaders and administrators must be actively engaged in attendance at STEM leadership conferences that will help continue to develop the campus vision, network, and establish critical partnerships and opportunities to bring back and infuse on campus. HCC had the opportunity to participate in Women in STEAM conferences, STEM Annual Convenings under the STEM Ecosystem, Annual STEM Alliance Leadership, and Carnegie STEM trainings. Student participation is encouraged and supported in these events. HCC has also been able to strengthen its STEAM Study abroad opportunities allowing STEAM students and faculty members to embark in continental and abroad experiences thereby expanding the classroom beyond four walls. Student and faculty have the chance to embrace culture, diversity while reviewing solutions to world-wide problems in ecology.

Core Component 6: Maintain and establish key stakeholders (Community/STEM Ecosystem, K-12, legislators)

The STEM workforce is a generalized term used to describe professionals and occupations within Science, Technology, Engineering, Mathematics and may include health professions as well. Key stakeholders help implement and support the innovative steps in enhancing STEM education, student development, and training.¹³

In 2019, HCC was named co-lead in the Greater Bridgeport STEM Ecosystem under the STEM Learning Ecosystem Community of Practice. The mission of the Greater Bridgeport STEM Ecosystem lead by the United Way of Coastal Fairfield is to recognize the importance of strong STEM competencies across generations and the role STEM skills play in promoting a vibrant local economy. The ecosystem requires the interconnections between the community, businesses, and the education systems. Within the Greater Bridgeport Ecosystem, local nonprofits, universities, science museums, zoos, the regional business council, STEM employers, and the Bridgeport School District K-12 all participate work to engage and strategize to develop

a shared vision in STEM literacy for all, strengthening the local STEM workforce pipeline, and promoting intergenerational STEM learning opportunities.

The ecosystem focuses on developing local students' social emotional, technical, creative, logical, critical thinking skills, and exposure of STEM concepts beginning in elementary school.¹⁴ Through collaborative efforts, partners can leverage resources across sectors, including educational enrichment programs for youth and trainings for educators. Partners are already providing an array of programs including academic enrichment, youth development, college prep, camps, job training and re-training including technical and trades skills training, and professional development for educators. The STEM ecosystem aims to build connections across the various activities to best amplify the overall impact for youth, families, and the community. The Bridgeport Ecosystem is supported by the Teaching Institute for Excellence in STEM (TIES).

Conclusion

Housatonic Community College strives to be a benchmark institution and leader in STEM Education. HCC wants to innovatively transform the student experience, increase faculty, and staff STEM awareness through professional development and provide a career-ready pipeline to the STEM workforce. Over the past five years, HCC strategically identified six critical core components as necessary functions required in sustaining STEM/STEAM on a college campus. Most of what was reviewed, unpacked, and discussed are not new approaches. HCC intentionally focused all efforts on pulling together random acts of STEAM and took a collective direction in how to best offer and sustain STEAM on campus. HCC learned that being intentional and practicing intentionality drove the creation of programs, practices, and policies that are tailored to address student demands.¹⁵ How to address student, faculty and community needs requires a more strategic approach and delivery. HCC considered the attributes, strengths and how to cultivate and leverage what is already in the campus' possession and less of an approach in fixing the problem which was little to no resources. With a positive outlook and strategic approach, HCC has been able to establish, implement and sustain STEM education on a community college campus by observing six core components.

1. Developed STEAM/STEM Taskforce (Passionate/Key Faculty, Staff and Students)
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6. Maintain and establish key stakeholders (Community/STEM Ecosystem, K-12, legislators).

These six intentional approaches were critical in the design and implementation of programming and processes that impact and improve student academic success and career preparation. Plans for continued sustainability of STEAM at HCC rest at the seam of the continued work of the STEAM Taskforce. Faculty and staff dedication, passion and willingness are the driving force for continued efforts. Development of new programming, enhancement of current coursework is critical in strengthening the STEM/STEAM pipelines. Innovative thinking in identifying and leveraging resources across multiple programs/initiatives on campus and with community partnerships is the pivotal adhesion necessary for forward mobility and growth. The evolution of the STEM Center of Excellence, and other key campus recognitions such as Carnegie STEM Pathway, STEM Ecosystem co-leads and STEM National Honors Society HCC Chapter are critical in long-term stability and provides a stronger case when seeking philanthropic and grant support. Lastly, it is imperative to develop new and advance partnerships with key STEAM stakeholders including community leaders, STEM employer, K-12 school districts, 4-year private and public universities, and non-for-profit grassroots and well-established organizations.

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