

The University of Vermont

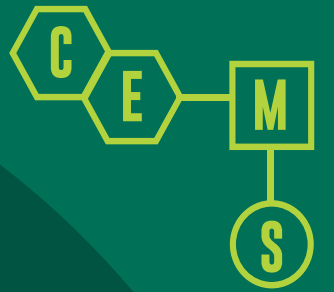
**COLLEGE OF ENGINEERING
AND MATHEMATICAL SCIENCES**

109 VOTEY HALL, UNIVERSITY OF VERMONT
33 COLCHESTER AVENUE, BURLINGTON VT 05405

(802) 656-3392
info@cems.uvm.edu
www.uvm.edu/cems

COLLEGE OF ENGINEERING AND MATHEMATICAL SCIENCES

STRATEGIC PLAN 2019



CEMS ON THE MOVE



THE UNIVERSITY OF VERMONT
COLLEGE OF ENGINEERING &
MATHEMATICAL SCIENCES



COLLEGE OF ENGINEERING AND MATHEMATICAL SCIENCES (CEMS) STRATEGIC PLAN

PURPOSE

We live in a world that is volatile, complicated, and full of promise. We face innumerable interconnected challenges from cancer to clean water, climate change to sustainable energy. While technical skills are crucial for a complex future, such skills alone do not suffice.

Our rigorous STEM curriculum stands on its own, but this is only part of the equation. Our curriculum also embraces real world engineering skills, sustainable practices, communication skills, leadership, equity, and cultural awareness. Our graduates strive to apply technology to improve people's lives.

Our world-class research embraces the largest of challenges and seeks sustainable solutions. As a community of scholars, we welcome exposure to diverse ideas, backgrounds, and opinion, for we know this is the pathway to the largest impact.

This is the UVM College of Engineering and Mathematical Sciences difference. Now is the time take bold steps.

VISION AND MISSION

A Vision of Responsible and Equitable Development and Implementation of Technology

UVM's College of Engineering and Mathematical Sciences will create a more sustainable and equitable future through its excellence in education and research focused on solving the complex problems facing our world.

The College's graduates will be recognized for their acumen in a discipline, communication skills, commitment to a better world, lifelong learning, creativity, and empathetic leadership.

The Mission of CEMS @ UVM

UVM's College of Engineering and Mathematical Sciences is an open and conscientious intellectual community focused on excellence, and committed to its public responsibilities as part of a comprehensive land-grant institution. The College's mission is to:

- Prepare the next generation of technical and societal leaders who thrive in a world that is volatile, complex, and full of promise, and who are committed to a sustainable and equitable world, lifelong learning, and empathetic leadership.
- Advance knowledge in fields that align with our commitment to a more sustainable future.
- Provide leadership and develop partnerships across Vermont with K-12 STEM educators, companies, and municipalities.



UVM CEMS engineering students Josh Goodrich, Katie Stokes and Alex Troche demonstrate one of two new prosthetic hands they designed for the Victoria Hand Project, a group that works with amputees in developing nations. Photo: Josh Brown

THE CEMS COMMUNITY

CEMS sits within the University of Vermont, a land-grant university with a distinctive landscape. Nestled between Lake Champlain, agricultural land and the Green Mountains, UVM is part of the vibrant and open culture of Burlington, Vt. This creates a unique opportunity for the students of CEMS to do field-based research, work with local companies, and participate in community based projects around the state. We are the ideal size for students to have easy access to faculty and at the same time access impactful opportunities. The student/faculty culture is highly interactive; both faculty and students treasure the shared intellectual environment.

The combination of engineering, mathematics, statistics, and computer science in today's world of the internet of things and big data is a distinction we embrace. Our proximity to the Larner College of Medicine, the Rubenstein School of Environment and Natural Resources, the Grossman School of Business, and the other colleges at UVM offers powerful partnerships for research and education. We celebrate UVM's commitment to the environment, sustainability, and social justice.

As a community of scholars we embrace UVM's Our Common Ground and add to it our commitment to an open and welcoming atmosphere that celebrates diversity and treats everyone with courteous goodwill. We acknowledge our errors and work towards solutions. We strive towards excellence in teaching, research and service. We celebrate each other's success and work to enable innovation in all its manifestations.

OVERARCHING GOALS

Transform Undergraduate and Graduate Education: CEMS has a long tradition of embracing high quality education and faculty/student interactions. We will design a curriculum that provides acumen in each discipline, skills in empathetic leadership, sustainability, equity, data dexterity, communication, innovation and confidence in solving open-ended problems as part of a team. We will build synchronous and asynchronous courses focused on active learning and projects, and create the academic support systems that promote the success of all.

A College Culture that Is Open and Affirming for All: We desire a CEMS faculty, student, and staff culture that is ever respectful, and always welcoming. We strive to achieve parity in retention and graduation rates for all identity groups and academic backgrounds.

Expand Research Impact: UVM and CEMS have focused areas of research excellence, and an emerging comfort with transdisciplinary research both within UVM and with external partners. We will significantly increase research spending, the number of graduate students, engagement of undergraduates in research, and our external reputation in focused areas of excellence.

Advance Faculty and Staff Excellence: Our faculty and staff are the backbone and engine of the College. We will aggressively promote career development and success.

Embrace Our Role as Part of the Public Trust: We embrace our responsibility to contribute to the economic development of the state. We will help K-12 educators achieve excellent STEM knowledge, and build opportunities for Vermont K-12 students to explore their interest in the STEM disciplines. We will build partnerships with Vermont industry and communities.

TRANSFORM UNDERGRADUATE AND GRADUATE EDUCATION

Building on our long tradition of excellent undergraduate education, we will give students the tools to design socially and culturally conscious technical solutions to critical challenges. **It is time to build the curriculum of the future and create the CEMS distinction.**

Desired Outcomes:

- An externally recognized, forward-thinking curriculum that attracts students of exceptional potential recognized for their distinct attributes that make them highly sought after upon graduation.
- A culture of pedagogical innovation that leads to continuous improvement in our content and delivery of a high-quality education.
- B.S., M.S. and Ph.D. graduates prepared to be technical leaders with a sustainable and equitable mindset.

STRATEGIES:

Create an innovative CEMS curriculum that balances deep rigor in each discipline and a keen ability to apply those fundamentals to create a more sustainable and equitable world.

- Create a set of core undergraduate and graduate courses for all CEMS students that ensures our students are effective communicators, have awareness of the cultural and social justice implications of their work, and have a strong grounding in STEM fundamentals, data dexterity, ethical decision making, leadership, social justice, communication, and professional skills.
- Infuse active learning across the curriculum.
- Further develop project-based classes in each discipline that emphasize the application of fundamental knowledge to relevant societal and open-ended problems.
- Leverage external partnerships to create an M.S. and Ph.D. co-op program with both industry and national laboratories.
- Encourage and/or create co-curricular opportunities in entrepreneurship, intellectual property, finance, and other similar topics.

Build a culture of pedagogical innovation and assessment that improves student education and attracts faculty committed to our teacher-scholar model of excellence in research and education.

- Create a beta classroom for testing of new technologies before implementation in courses.
- Create a faculty teaching and learning collaboratory that shares best practices, runs workshops, and inspires pedagogical innovation across the college.
- Hold a CEMS annual pedagogical workshop for professional development of faculty teaching skills (e.g. active learning, project-based learning, and incorporating technology).
- Create an Institute for Instructional Innovation in CEMS.

01



The UVM XHAB team senior design project worked on a NASA project preparing for a mission that will send rovers to the poles of the moon to mine for water ice. In March 2018, students traveled to NASA Ames in Mountain View, California to present their progress. Here, they are standing in the biggest wind tunnel in the world. From left to right: senior Catherine Simpson; Ryan Vaughan and Paul Banicevic, systems engineers at NASA Ames; and seniors Liz Barrett, Thomas Durivage, Adam Potasiewicz, and Liam McAuliffe.

A COLLEGE THAT IS OPEN AND AFFIRMING FOR ALL

CEMS is committed to cultivating a welcoming atmosphere for all faculty, staff, and students. We believe diversity and inclusion are critical components to solving the world’s grand challenges.

Desired Outcomes:

- Parity in retention and graduation rates regardless of a students’ background or identity.
- A retention rate of 90% and 6-year graduation rate of 80%.
- 40% women and 10% underrepresented minority students in the first-year class by 2025.
- A student, faculty, and staff culture that embraces diversity, inclusion, respect, and collaboration.

STRATEGIES:

Become a leader in STEM education of women and underrepresented groups particularly with respect to retention and post-graduation success.

- Improve CEMS outreach to attract a more diverse cohort of Vermont students (including more focused dual enrollment programs).
- Create a student/faculty task force to identify improved mentoring practices.
- Develop and fund a summer program for recruitment of students from underrepresented groups.
- Foster relationships with international universities to increase the number of international students in CEMS and to provide opportunities for CEMS students to study abroad.

Develop a faculty/student/staff advising model that increases student retention and enhances their competitiveness for full-time jobs or graduate school.

- Include assessment of advising/mentoring in the annual evaluation of faculty.
- Provide biennial training of faculty and staff in advising.
- Modernize the Student Services Facility to increase access and interaction.



Elyon Eyimife, Julia Syzmanski, Zach Roussel, Chika Ikpechukwu and Dia Brown of the UVM Chapter of the National Society of Black Engineers.



02



Photo: Andy Duback

EXPAND RESEARCH IMPACT

UVM and CEMS have pockets of research excellence, and an emerging comfort with transdisciplinary research both within UVM and with external partners. It is time to significantly increase research spending, the number of graduate students, and the external reputation in focused areas of excellence.

Desired Outcomes:

- Increase research spending from multi-investigator, interdisciplinary groups of faculty both internal to UVM and with external partners.
- Increased leverage of our unique combination of engineering, mathematics, statistics, and computer science for large grants.
- Increase the number of high impact publications.
- Increase the average research spending per faculty member by 20% over the next four years.
- Increase the number of patents, licenses, and start-up companies.
- Increase the number of externally funded Ph.D. students to 60 by 2022.
- Increase the number of master's degree students pursuing our interdisciplinary degrees and certificates.

STRATEGIES:

Incentivize interdisciplinary research and educational research.

- Cultivate industrial and academic partnerships that align with our research expertise, improve our ability to compete for impactful research grants, and result in internships and jobs for our students.

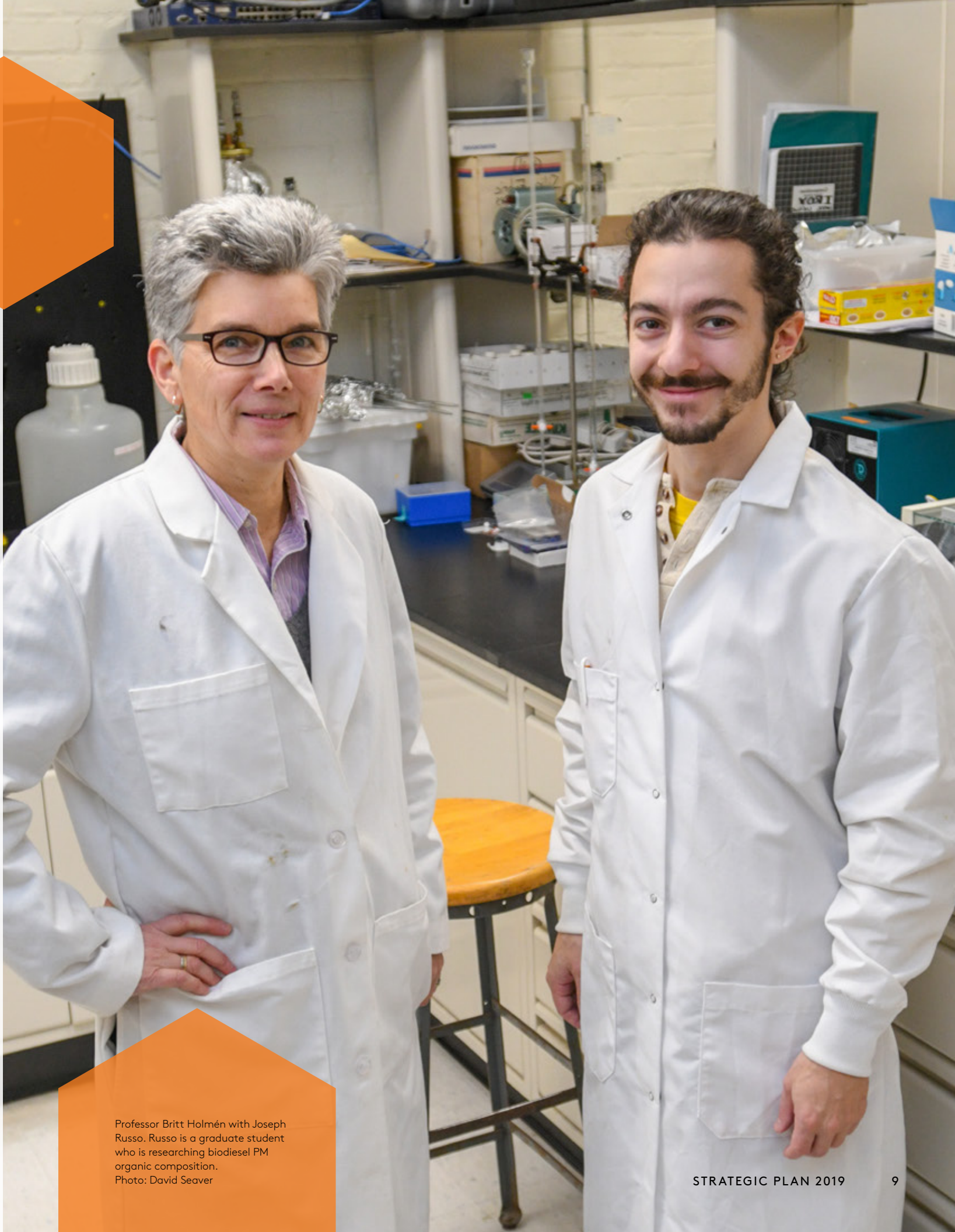
Recruit high quality graduate students.

- Put at least two existing M.S. degrees online by 2022.
- Build our relationships with international universities to create a pipeline of international graduate students.

Enable and support our current centers and encourage the creation of new centers of teaching and research excellence.

- Develop a strategic agenda for the next step in growth for our current centers (Transportation Research Center, Complex Systems Center, and the interdisciplinary group in Cybersecurity).
- With the College of Nursing and Health Sciences, the Larner College of Medicine, and the Grossman School of Business, create a Center for Biomedical Innovation that supports both curricular and research and development projects with industry in the field of biomedical devices.
- Support emerging interdisciplinary research groups as they seek center status with the University.

03



Professor Britt Holmén with Joseph Russo. Russo is a graduate student who is researching biodiesel PM organic composition. Photo: David Seaver

ADVANCE FACULTY EXCELLENCE

Faculty are the engine for inquiry, education, and discovery in the College. The quality of the educational experience, research, and mentoring rest on their shoulders. CEMS cultivates faculty excellence.

Desired Outcomes:

- Faculty fully committed to excellence in education, research, and service.
- Faculty externally recognized for their achievements in education and research.
- New endowed chairs and professorships for fully promoted faculty and Green and Gold junior faculty professorships (at least one per department).
- 10% faculty from underrepresented minority groups by 2025.

STRATEGIES:

- Provide faculty start-ups that appropriately launch faculty research and elevate expectations for scholarly contributions to achieve tenure.
- Work with the UVM Foundation to create endowed faculty positions.
- Aggressively nominate faculty for external awards.
- Proactively nominate faculty for appropriate leadership positions in their professional societies.
- Encourage faculty and staff to take leadership roles in national/international professional societies through annual evaluation and support of faculty who assume positions of national leadership in their societies, or editorships of journals.

UVM CEMS faculty gather for a group photo in advance of the 2019 CEMS graduation ceremony.



04



Eric Hernandez, a UVM CEMS professor and internationally-known scholar whose research is at the forefront of structural engineering, was invested as the first Gregory N. Sweeny Green and Gold Professor of Civil Engineering in 2018.

ADVANCE STAFF EXCELLENCE

05

Staff are foundational to the success of the college. They support students, classrooms, laboratories, research, faculty, partnerships, and more. We will only succeed with high-quality staff.

Desired Outcomes:

- Staff fully committed to excellence in their field and in support of students and faculty.
- External recognition for CEMS staff excellence.
- A high-quality diverse staff empowered to help improve and grow the College.
- A faculty/staff culture of mutual respect and support.

STRATEGIES:

- Support annual professional development opportunities.
- Develop a staff mentoring program.
- Aggressively nominate professional staff for external awards.
- Proactively nominate professional staff for appropriate leadership positions in their professional societies.

A contingent of 19 UVM students traveled to Grace Hopper 2018 with Samantha Williams, CEMS Graduate Coordinator, Lauren Petrie, CEMS Career Readiness Coordinator and Lisa Dion, Lecturer of Computer Science.



UVM CEMS Lab Manager Courtney Giles received UVM's Lab Safety Partnership Award in 2018 and 2019.



EMBRACE CEMS ROLE AS PART OF THE PUBLIC TRUST

The University of Vermont is a land-grant public institution with an important responsibility to contribute to the economic development of the state. Critical to that role are K-12 educators with excellent STEM knowledge, and opportunities for the students of the state to explore their interest in the STEM disciplines. We are currently working with a variety of programs to support K-12 students including: MATHCOUNTS, FIRST Robotics, Girls Who Code, the Vermont High School Math Contest, and the Aiken Challenge.

Desired Outcome:

- A better prepared cadre of Vermont students applying to Universities in the STEM disciplines.
- Improved accessibility for Vermont students to pursue a STEM education.
- Opportunities for continuing education for STEM professionals across Vermont.

STRATEGIES:

A focus on raising scholarship dollars for Vermont students to pursue a UVM degree in STEM education.

Hire a part-time educational outreach coordinator to develop opportunities for K-12 educators in the state to increase their STEM skills.

- Create a certificate for teachers in computer science/cybersecurity/engineering solutions/ climate change.
- Provide summer workshops for K-12 educators to gain new knowledge in a variety of STEM fields.
- Coordinate our work with organizations like FIRST Robotics, MATHCOUNTS, and the Aiken Challenge that enable students in grades K-12 to develop their engineering, coding, and mathematics skills.
- Partner with the Vermont Society of Professional Engineers and the Professional Chapter of the Society of Women Engineers to increase the reach of the current programs throughout the state.
- Develop a funding model that encourages faculty and graduate student participation in creating summer programs.

Develop online courses and certificates in key emerging disciplines and encourage participation across the state.

Coordinate the industrial outreach approaches for the senior design courses, the engineering management program, and the career readiness office to increase interaction with industry in the state.



Vermont's FIRST Robotics Competition

06



UVM CEMS Computer Science Student Nikki Allen '19 taught girls to code on Friday afternoons.



CEMS ON THE MOVE

The Alternative Energy Racing Organization (AERO) is a CEMS student-run club that designs and builds electric and hybrid vehicles to compete at Formula Hybrid, an international collegiate competition.