UC DAVIS CENTER FOR INTEGRATED COMPUTING AND STEM EDUCATION (C–STEM)

Research and Outreach

Transforming computing and STEM education through integrated learning.

UCDAVIS
C–STEM Center

c-stem.ucdavis.edu

ABOUT C−STEM

The UC Davis C-STEM Center aims to transform computing, science, technology, engineering and mathematics (C-STEM) education in both formal and informal in K-14 programs through integrated learning, guided by two key objectives:

- Close the achievement gap by broadening participation of students traditionally underrepresented in computing and STEM related careers and post-secondary study.
- Develop students' 21st century problem-solving skills to tackle real world concerns through integrated computing and STEM education.

Through cutting edge research with funding from the National Science Foundation, the C-STEM Center, in collaboration with our industry partners, has developed innovative educational computing and robotics technologies for K-14 hands-on learning. By working with K-14 educators, the C-STEM Center integrates computer programming and robotics into teaching STEM subjects by creating project-based computing and robotics activities, integrated curriculum, and hands-on personalized and collaborative learning strategies aligned with Common Core State Standards and CTE Standards. This integration helps students make meaningful connections between regular STEM topics and their relevance to real life applications as well as help develop students' critical thinking and problem-solving skills while preparing all students to be career and college ready.

C-STEM joins a distinguished group of programs with UC A-G Program Status. Schools can easily add the A-G approved rigorous C-STEM curriculum to their own school's A-G course lists to satisfy the UC/CSU admission requirements. C-STEM is also a UC Approved Educational Preparation Program for Undergraduate Admission for all UC campuses, meaning that participation in the C-STEM program is recognized in the UC admissions process as achievements that have explicitly prepared students for college and career.

The C-STEM Center and our partners organize annual curriculum-based RoboPlay Competitions in various regions to further engage students in project-based team activities and to showcase their accomplishments and creativity in not only math and engineering, but also in writing, art, music and film production. The C-STEM Center provides unique professional development for STEM educators who have no prior computer programming or robotics experience to implement C-STEM curriculum in both formal and informal programs. Working together, we can transform K-14 education and inspire students to pursue computing and STEM related careers and post-secondary study.

Harry H. Cheng
C-STEM Center Director and Professor

EXPLORING MATHEMATICS WITH COMPUTING AND ROBOTICS

(This course is designed for 5th to 6th grades. This curriculum will be available for pilot in Fall, 2015).

This course explores mathematical concepts in the Common Core State Standards- Mathematics through practical applications with hands-on and fun computing and robotics activities. Students write C/C++ computer programs to control a single robot and multiple robots. Through both personalized and collaborative group computing and robotics activities, students learn and reinforce the algebraic thinking with arithmetic operations in whole and decimal numbers, fractions, measurement, variables, data conversion, lines, angles, ratios, and proportions. The hands-on computing and experiments help students make meaningful connections between abstract math concepts and their relevance to real-life applications, as well as help develop students' critical thinking and problem-solving skills.

"The C-STEM curriculum allows students to practice their math skills outside of the traditional classroom learning... This is an excellent combination of technology, problem solving, and a chance to strengthen logical thinking."

- Megan Schoellhamer, Math Teacher, Bridgeway Island Elementary School

MATH 7 WITH COMPUTING

This course, based on the Common Core Math 7 standards, uses computing to develop and expand students' understanding of Math 7 topics. Students analyze real life situations, identify given information, formulate mathematical steps to find a solution, and analyze the results for accuracy, all within the context of computer programming. The logical process of computer programming allows students to organize their approach to problem solving and efficiently analyze and correct their work. Topics covered include evaluating expressions, one variable equations and inequalities, rates, proportions, percents, probability, similarity, plotting points and linear equations, and identifying slopes and intercepts. Optional group computing activities allow students to collaborate on critical thinking activities based on algebraic topics while developing their ability to effectively communicate, listen, share responsibility and respectfully address the suggestions of others. Optional robotics extension activities allow students to reenact physically derived mathematical problems through robotics technologies to visualize situations, associate graphs with physical phenomenon, predict and identify key features of the graphs with the specific physical situations, and solve physical problems through algebraic means.

Teaching resources contain optional robotics activities.

MATH 8 WITH COMPUTING

This course, based on the Common Core Math 8 standards, uses computing to develop and expand students' understanding of Math 8 topics. Students analyze real life situations, identify given information, formulate mathematical steps to find a solution, and analyze the results for accuracy, all within the context of computer programming. The logical process of computer programming allows students to organize their approach to problem solving and efficiently analyze and correct their work. Topics covered include evaluating expressions, one variable equations and inequalities, rates, proportions, probability, scientific notation, statistics, plotting points, linear equations in slope-intercept form, systems of linear equations, radical expressions and equations, similarity, and geometric transformations, including translations and reflections. Optional group computing activities allow students to collaborate on critical thinking activities based on algebraic topics while developing their ability to effectively communicate, listen, share responsibility and respectfully address the suggestions of others. Optional robotics extension activities allow students to reenact physically derived mathematical problems through robotics technologies to visualize situations, associate graphs with physical phenomenon, predict and identify key features of the graphs with the specific physical situations, and solve physical problems through algebraic means.

Teaching resources contain optional robotics activities.

"What I like about Ch programming is learning how a computer works, how to manipulate the Linkbot using Ch, and learning from my mistakes while writing a program."

COMPUTER PROGRAMMING WITH CH

This course introduces students to the fundamentals of computer programming with an emphasis on applications of math concepts using the user friendly C/C++ interpreter Ch. Students start with basics of how a computer works and then explore programming in Ch to solve real life problems. Students write computer programs with graphical plotting and animation in an integrated development environment (IDE). Through computer programming based problem solving and engaging activities, such as generating random numbers for applications in math and gaming, students develop critical and computational thinking skills. Each section includes objectives, pre-requisites, applicable Common Core Language, Reading and CTE ICT standards, terminology, text with examples and applications, and exercises.

Teaching resources contain optional robotics activities.

ROBOTICS AND FILM PRODUCTION

This course introduces students to the working principles of robotics with applications for film production using robotics. Students will explore fun applications, such as robotic soccer and robotic drawing by controlling a single robot out of the box, and continue on to multiple robot applications aided by a graphical user interface and computer programming using the C/C++ interpreter Ch. Students write robotics programs to perform various tasks with applications for the RoboPlay competition. With robots, students explore their creativity in writing, art, music, choreography, design, video editing and film production. This course emphasizes hands-on robotics activities to explore applications of robotics to gain effective communication and team work skills.

This course can be implemented as a stand-alone robotics course or as a supplement to a Physical Science or Engineering course.

COMPUTER-AIDED DESIGN IN AUTODESK INVENTOR AND 3D PRINTING (SUPPLEMENTARY)

This curriculum introduces computer-aided design with Autodesk Inventor to create accessories and parts for the Linkbot using a 3D printer. The curriculum can be used stand alone. It is also appropriate for use in conjunction with the C-STEM Computing with Robotics or PLTW Design & Modeling course.

COMPUTER-AIDED DESIGN IN SOLIDWORKS AND 3D PRINTING (SUPPLEMENTARY)

This curriculum introduces computer-aided design with SolidWorks to create accessories and parts for the Linkbot using a 3D printer. The curriculum can be used stand alone. It is also appropriate for use in conjunction with the C-STEM Robotics and Film Production course.

AFTERSCHOOL PROGRAMS ON COMPUTING AND ROBOTICS

The C-STEM Computer Programming and Robotics curriculum can be used in an after school setting.

"Before this program, I didn't know anything about robotics. Now, I feel confident about programming. I would like to learn more."

"If I hadn't have taken this program, I would never have been interested in computer science."

C-STEM UC A-G PROGRAM STATUS

A-G courses fulfill subject requirements for freshman admission to the University of California and California State University systems. A-G courses are seven general subject areas labeled "A" through "G." The University of California Office of the President (UCOP) has established articulation agreements with, and granted program status to, selected programs and organizations to accept their courses to meet the "A-G" subject area requirements. These programs have standardized curriculum that is available to schools in California. Schools can easily add the program's previously approved courses to their own school's "A-G" course lists without going through the traditional approval process with UCOP.

C-STEM joins a distinguished group of programs with UC A-G Program Status. All C-STEM high school courses are A-G approved. Schools can readily and easily add the C-STEM Center's "A-G approved" courses to their own school's A-G course lists. Each C-STEM curriculum is focused on the disciplinary knowledge with computer programming and robotics as tools to enhance student learning.

ALGEBRA 1 WITH COMPUTING

This course guides students through topics in Algebra 1 in Common Core State Standards for Mathematics while simultaneously teaching students programming and computational thinking. Students use programming in C/C++ interpreter Ch to reinforce and extend their knowledge of mathematical concepts by analyzing real life situations, identifying given information, formulating steps that a computer program could calculate to find a solution, analyzing the results for accuracy, and revising/modifying the programming solutions as necessary. Topics covered include solving one-variable equations with multiple steps, solving and plotting absolute value equations and inequalities, linear equations, systems of linear equations and inequalities, polynomial functions, exponential and radical functions, and step and piece-wise functions, evaluating, multiplying, and factoring polynomial functions, solving quadratic equations with applications, probability, statistical data analysis and visualization, and arithmetic and geometric sequences. Group computing projects allow students to collaborate on critical thinking activities based on algebraic topics while developing their teamwork and communication skills.

*Approved with C Math credit. Teaching resources contain optional robotics activities.*

"I feel satisfaction whenever my program runs perfectly. Almost like a pat-on-the-back for success."

"I like it because it lets us do something different from the math and science textbooks."

ALGEBRA 1 WITH COMPUTING AND ROBOTICS

The course guides students through topics in Algebra 1 in Common Core State Standards for Mathematics while simultaneously teaching students programming and computational thinking. Students use programming in C/C++ interpreter Ch to reinforce and extend their knowledge of mathematical concepts by analyzing real life situations, identifying given information, formulating steps that a computer program could calculate to find a solution, analyzing the results for accuracy, and revising/modifying the programming solutions as necessary. Topics covered include solving one-variable equations with multiple steps, solving and plotting absolute value equations and inequalities, linear equations, systems of linear equations and inequalities, polynomial functions, exponential and radical functions, and step and piecewise functions, evaluating, multiplying, and factoring polynomial functions, solving quadratic equations with applications, probability, statistical data analysis and visualization, and arithmetic and geometric sequences. Robotics activities allow students to reenact physically derived mathematical problems through robotics technologies to visualize situations, associate linear and quadratic graphs with physical phenomenon, predict and identify key features of the graphs with robotic systems, and solve robotics problems through mathematical modeling and programming.

*Approved with C Math credit. Teaching resources contain robotics activities.
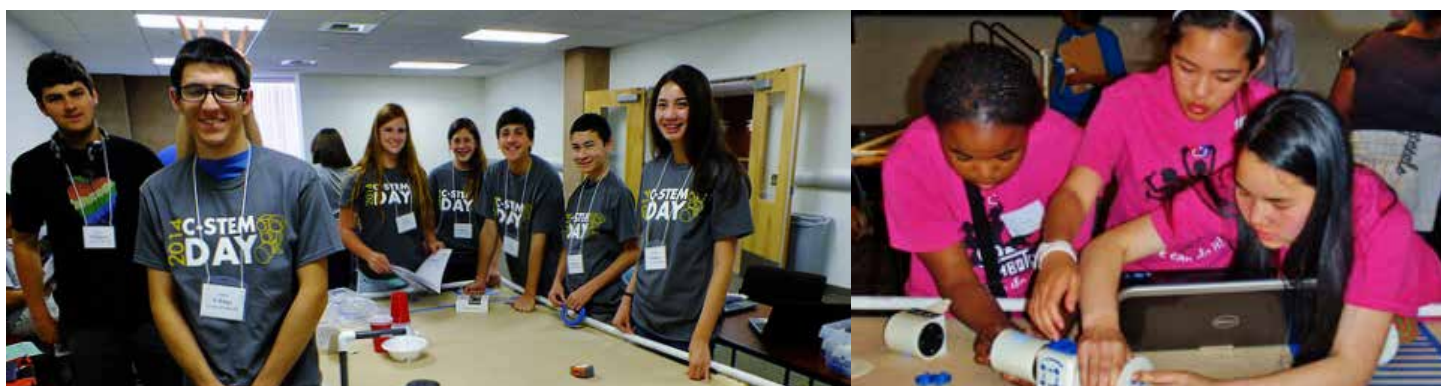
INTEGRATED MATHEMATICS 1 WITH COMPUTING

The course guides students through topics in Integrated Mathematics 1 in Common Core State Standards for Mathematics while simultaneously teaching students programming and computational thinking. Students use programming in C/C++ interpreter Ch to reinforce and extend their knowledge of mathematical concepts by analyzing real life situations, identifying given information, formulating steps that a computer program could calculate to find a solution, analyzing the results for accuracy, and revising/modifying the programming solutions as necessary. Topics covered include solving one-variable equations with multiple steps, solving and plotting absolute value equations and inequalities, linear equations, systems of linear equations and inequalities, polynomial functions, exponential and radical functions, evaluating, multiplying, and factoring polynomial functions, probability, statistical data analysis and visualization, arithmetic and geometric sequences, and geometric transformations, including translations, rotations, reflections and dilations. Group computing projects allow students to collaborate on critical thinking activities based on mathematics topics while developing their teamwork and communication skills.

*Approved with C Math credit. Teaching resources contain optional robotics activities.

INTEGRATED MATHEMATICS 1 WITH COMPUTING AND ROBOTICS

The course guides students through topics in Integrated Mathematics 1 in Common Core State Standards for Mathematics while simultaneously teaching students programming and computational thinking. Students use programming in C/C++ interpreter Ch to reinforce and extend their knowledge of mathematical concepts by analyzing real life situations, identifying given information, formulating steps that a computer program could calculate to find a solution, analyzing the results for accuracy, and revising/modifying the programming solutions as necessary. Topics covered include solving one-variable equations with multiple steps, solving and plotting absolute value equations and inequalities, linear equations, systems of linear equations and inequalities, polynomial functions, exponential and radical functions, evaluating, multiplying, and factoring polynomial functions, probability, statistical data analysis and visualization, arithmetic and geometric sequences, and geometric transformations, including translations, rotations, reflections and dilations. Robotics activities allow students to reenact physically derived mathematical problems through robotics technologies to visualize situations, associate linear and exponential graphs with physical phenomenon, predict and identify key features of the graphs with robotic systems, and solve robotics problems through mathematical modeling and programming.

Approved with C Math credit. Teaching resources contain robotics activities.

"I like working with my classmates and I find programming really fun and exciting. We all have something in common."

COMPUTER PROGRAMMING FOR SOLVING APPLIED PROBLEMS

This course provides students with the fundamental knowledge of computer programming for solving applied problems in C. Students learn how a computer works and structured programming in C for software development. The topics include programming constructs, data types and declaration of variables, expressions and operators, selection statements, repetition, flowcharts for algorithm development, functions for modular programming, arrays for statistical data analysis, plotting for visualizing data (using scatter plot, dot plot, bar graph, histogram, Box-and-Whisker plot, etc.), linear regression and curve fitting, pointers and dynamic memory allocation, processing data files, animation, robotics applications, and applications in math and science. The emphasis of the course is to introduce the students to software development concepts. This course also focuses on algorithm development and computer programming for solving applied problems in science, technology, engineering and math (STEM), such as solving problems in Algebra and robotics. Considerable attention is devoted to program design, task decomposition, testing, debugging, and software reuse. Students write computer programs with graphical plotting in an integrated development environment. Through problem-based projects, students develop critical thinking, problem solving, computational thinking, effective communication, and teamwork skills.

Approved with G elective credit. Teaching resources contain robotics activities.

COMPUTING WITH ROBOTICS

This course introduces students to the working principles and foundational knowledge of robotics. Students learn to control a single robot and multiple robots by graphical user interface, pose teaching, and computer programs in C/C++. Students write robotics programs to perform various tasks based on the sensory information of robots. Robots are used as platforms to engage students in both personalized and collaborative learning computing, science, technology, engineering, and math concepts. This course emphasizes hands-on robotics activities with a concentration on mathematical modeling and computer programming for solving problems in math and science. As term projects, students will participate in regio-nal and statewide C-STEM RoboPlay Video and/or RoboPlay Challenge Competitions, which not only enhance their learning of robotics, math, and engineering, but also allow them to explore their creativity in writing, art, music, choreography, design, video editing, and film production. Through these project-based team activities, students develop critical thinking, problem solving, effective communication, and teamwork skills.

Approved with G elective credit.
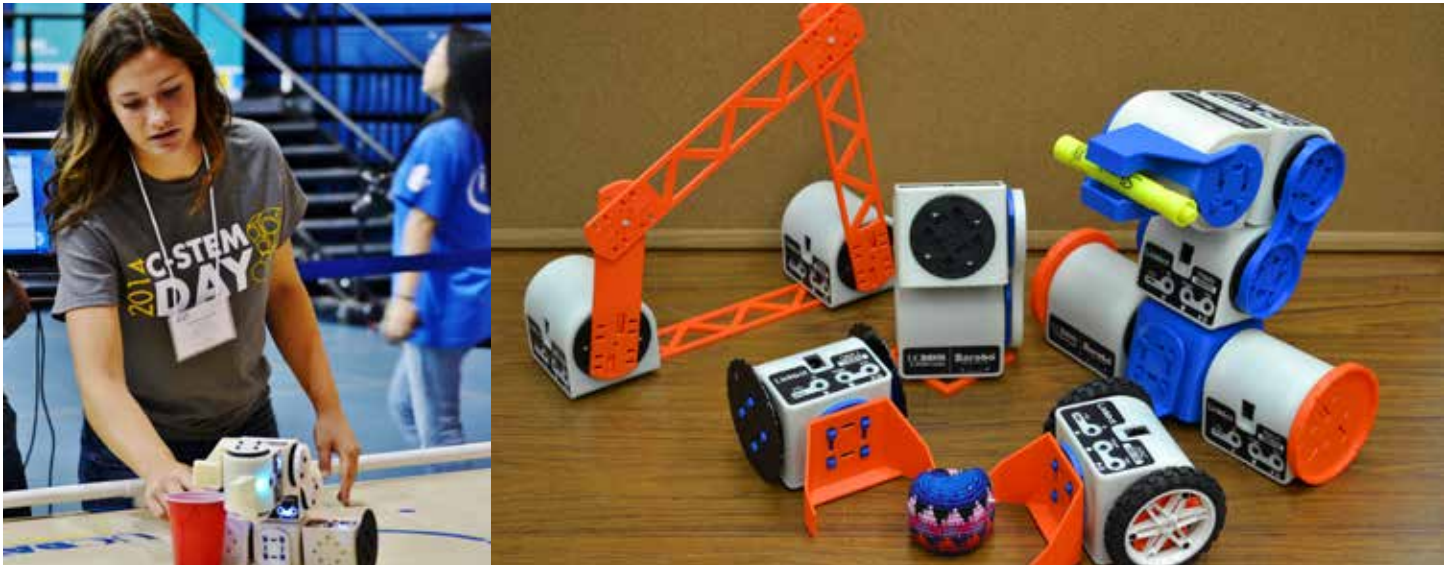
COMPUTER-AIDED DESIGN IN AUTODESK INVENTOR AND 3D PRINTING (SUPPLEMENTARY)

This curriculum introduces computer-aided design with Autodesk Inventor to create accessories and parts for the Linkbot using a 3D printer. The curriculum can be used stand alone. It is also appropriate for use in conjunction with the C-STEM Computing with Robotics, PLTW Introduction to Engineering Design, or PLTW Principle of Engineering course.

COMPUTER-AIDED DESIGN IN SOLIDWORKS AND 3D PRINTING (SUPPLEMENTARY)

This curriculum introduces computer-aided design with SolidWorks to create accessories and parts for the Linkbot using a 3D printer. The curriculum can be used stand alone. It is also appropriate for use in conjunction with the C-STEM Computing with Robotics.

INTRODUCTION TO COMPUTER PROGRAMMING FOR ENGINEERING APPLICATIONS (A UC DAVIS ENGINEERING COURSE)

This course introduces students to structured programming in C. Many algorithms for computer-aided problem solving are developed throughout the course to solve practical problems in engineering and science. The topics include number systems with internal representations of binary, octal, decimal, and hexadecimal numbers as well as binary two's complementary representation; limitations and numerical accuracy of different data types; 32-bit and 64-bit programming models; unary, binary, and ternary operators; selection statements for making decisions; iterative statements for repetitions; modular program-ming and code reuse; storage classes; arrays for data processing; pointers; dynamical memory allocation and deallocation; ASCII Code; characters and strings; structures and enumerations; top-down and bottom-up design of large-scale software project; file processing; and computational arrays for matrices and linear algebra for engineering applications.

"I like how I learned something that could one day be a big part of my future career."

COURSES FOR PILOTING IN 2015-2016

- Algebra 2 with Computing
- Algebra 2 with Computing and Robotics
- Integrated Mathematics 2 with Computing
- Integrated Mathematics 2 with Computing and Robotics

COURSES FOR ADOPTION IN 2016-2017

- Computer Programming with C for Mathematics
- Computer Programming with C for Arduino
- AP Computer Science Principles
- Integrated Mathematics 3 with Computing
- Integrated Mathematics 3 with Computing and Robotics

C-STEM YOUTH SUMMER CAMPS

C-STEM Youth Summer Camps emphasize logical and computational thinking with hands-on fun and exci-ting computing activities for campers to explore real-world applications of computer programming and mathematics. Campers gain problem solving, effective communication, and teamwork skills. These self-sustained summer camps are held on school campuses and colleges through our partners. Detailed descriptions for each camp can be found on the C-STEM website.

COMPUTER PROGRAMMING AND ROBOTICS

One-week camp for elementary school students from grades 4 to 6.

EXPLORING MATHEMATICS WITH ROBOTICS

One-week camp for elementary school students from grades 5 to 6.

COMPUTER PROGRAMMING WITH STEM APPLICATIONS

One-week camp for middle school students from grades 6 to 8.

ROBOTICS AND DIGITAL MEDIA

One-week camp for middle school students from grades 6 to 8.

COMPUTER PROGRAMMING WITH ROBOTICS

One-week camp for middle school students from grades 6 to 8.

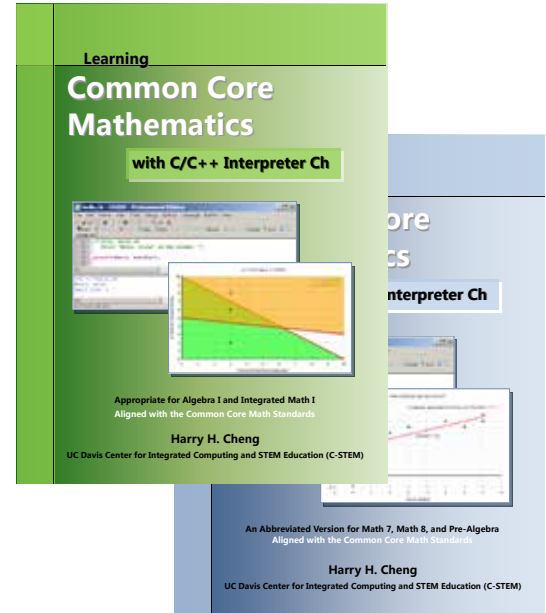## GIRLS IN ROBOTICS LEADERSHIP (GIRL)

One-week camp for middle school female students from grades 7 to 8.

"I probably would have never known how to program computer without this program and now I'm more confident about programming computers."

STUDENT TEXTBOOKS

- FOR SUPPLEMENT OR STANDALONE COURSES
- EACH SECTION INCLUDES:
    - Objective
    - Prerequisites
    - Common Core Math standards
    - CTE ICT Standards
    - Terminology
    - Exercises differentiated by levels of knowledge
    - Worked Examples and Applications

Learning
Common Core Mathematics
with C/C++ Interpreter Ch

Appropriate for Algebra I and Integrated Math I
Aligned with the Common Core Math Standards

Harry H. Cheng
UC Davis Center for Integrated Computing and STEM Education (C-STEM)

An Abbreviated Version for Math 7, Math 8, and Pre-Algebra
Aligned with the Common Core Math Standards

Harry H. Cheng
UC Davis Center for Integrated Computing and STEM Education (C-STEM)

TEACHER RESOURCES

- COURSE PLANNERS FOR EACH OF THE APPROPRIATE CLASSES
- EACH SECTION INCLUDES:
    - Lesson Plan
    - Pre and Post Formative Assessments
    - Powerpoint Lesson
    - Video Lesson
    - Extra Practice Utility Programs
    - Optional Group Computing Activities
    - Optional Robotics Activities

- **Math 7 with Computing**
- **Math 8 with Computing**
- **Algebra 1 with Computing**
- **Algebra 1 with Computing and Robotics**
- **Integrated Math 1 with Computing**
- **Integrated Math 1 with Computing and Robotics**

C–STEM PROFESSIONAL DEVELOPMENT

C-STEM provides unique professional development at UC Davis and on-site for teachers without any prior computing and robotics experience to offer C-STEM curriculum as stand-alone courses or integrate them into the existing STEM courses and after school programs. Currently, the C-STEM Center offers three types of professional development, each geared towards implementing different C-STEM curricula. C-STEM also provides tailored on-site professional developments.

"Oh my gosh! I barely can contain myself….soooo fun!!! So challenging and so rewarding at the same time!!!"

— Jessica Fernandez
Math Teacher
Glen Edwards Middle School

C-STEM 2-DAY ACADEMY ON INTEGRATED COMPUTING AND STEM EDUCATION

The C-STEM 2-Day Academy on Integrated Computing and STEM Education in various regions will provide K-14 teachers with hands-on experience on how to use freely available C-STEM Studio and RoboBlockly, as well as C-STEM integrated curriculum with interactive computing, programming, and robotics that aligns with the Common Core Math and ICT Sector standards to develop students' 21st century problem-solving skills and better prepare students for college and careers.

C-STEM 1-WEEK INSTITUTE ON INTEGRATED COMPUTING AND STEM EDUCATION

The intensive C-STEM 1-Week Institute on Integrated Computing and STEM Education is designed to provide professional development for K-14 teachers on the principles of robotics and computing and how to integrate them into STEM classes. Teachers learn computer programming, computational thinking, and problem-solving with coding using freely available C-STEM Studio and RoboBlockly. Teachers will learn specific teaching pedagogy and classroom implementation strategies for integrating computing and robotics activities into math, science and engineering curricula, as well as how to support the Common Core State Standards (CCSS) and Next Generation Science Standards (NGSS) using the C-STEM integrated curriculum with interactive computing, programming, and robotics. Teachers also learn how to teach and reinforce mathematical concepts through practical applications with hands-on computing and robotics activities. These activities reinforce logical reasoning and critical thinking skills through computing activities in which students write functions, visualize, process, save and plot experimental and hypothetical data. Teachers will get the first-hand experience of C-STEM RoboPlay Competition and learn to advise their students to participate in this level-playing field robot competition.

TRAIN-THE-TRAINER PROGRAM

The C-STEM Train-the-Trainer Program allows district and county office of education personnel as well as college and university faculty of C-STEM Affiliates to become certified C-STEM Trainers who can hold C-STEM certified trainings in their geographic area.

C-STEM Trainer Requirements: A C-STEM trainer must meet the following criteria

1. Have attended a two-week C-STEM Summer Institute on Computing and STEM Education
2. Meet one of the qualifications below:

    a. Have more than one-year teaching experience on C, C++, or Java in a middle school, high school, or college.

    b. Have taken C, C++, or Java course in a college with a passing letter grade and more than 3-years teaching experience in math and CTE subjects in a middle school, high school, or college.

    c. Have taught one or more of the year-long C-STEM curricula in its entirety for more than two years in a middle school, high school, or college.

    d. Coaching and mentoring experience is a plus.

To attend the C-STEM Train-the-Trainer Institute and hold a certified C-STEM training, C-STEM trainers must collaborate jointly with a C-STEM Affiliate organization.

C–STEM DAY

The C-STEM Day is organized to build public awareness and advocate for Integrated Computing and STEM education. The C-STEM Center and our partners organize curriculum-based RoboPlay Competitions in various regions on the annual C-STEM Day in May to further engage students in project-based team activities and to show-case their accomplishments and creativity in not only math and engineering, but also in writing, art, music and film production. Various C-STEM awards and scholarships are presented at the awards ceremonies to outstanding students to recognize their achievement and inspire them to pursue computing and STEM related careers and post-secondary study.

"Speaking I feel for all of us who were "first timers" at Orange County site, the day was amazing. We saw teams "bounce back" after disappointing starts, leaders "take command" as the clock ticked, students and their teacher jumping in unison at a score, and some very competent teams that almost always knew exactly what to do. Obviously, technical skills in programming the bots was the official contest, and I think it teaches very well basic engineering values of achieving goals with precision and accuracy, under time constraint, and sometimes against unpredictable obstacles. The Judge Awards, in my opinion, are a superb complement to the technical scoring. We all know that "soft skills" are important in business, so recognizing those attributes gives stronger context to the competition. Finally, the video competition certainly added an artistic dimension, entering the realm of C-STEM."

- Chris Harrington, Head Judge for RoboPlay Challenge Competition at UC Irvine, a former Vice President for Toshiba American Information Systems.

ANNUAL C-STEM AWARDS

- Award of Acheivement (for middle-school students
- Girl's Leadership Award (for middle-school girls
- Award of Excellence (for high-school students
- Scholarship of $500 (for upcoming college students)

- Curriculum Based Competition
- Challenge revealed day of competition
- 3 - 5 Middle School or High School students per team

C-STEM ROBOPLAY
CHALLENGE COMPETITION

The RoboPlay Challenge Competition is designed for students to showcase their real-world problem solving skills in a competitive environment. This competition simulates an unexpected problem occurring at a remote location such as a space station or planetary habitat, where a robotic solution must be quickly developed and deployed, using only existing resources. The competition challenges students to creatively use modular robots and accessories to complete various tasks. The competition arena and specific challenge will be kept secret until the day of the competition. Using their math, programming, and problem solving skills, students try to most efficiently get the highest score for each task.

AWARD CATEGORIES

- Best Storyline
- Best Choreography
- Most Interesting Task
- Best Custom Designed Part
- Best Overall Video

C-STEM ROBOPLAY
VIDEO COMPETITION

RoboPlay Video Competition is designed for students to learn robotics while having fun and exploring their creativity in writing, art, music, choreography, design, video editing and film production and at the same time seamlessly learning C-STEM subjects. The necessary robot coordination to match the movement of multiple modules to music requires not only teamwork in designing a well-organized visual performance, but also the math and programming skills to produce the desired actions. The competitions enable students with different interests to explore the basic concepts of C-STEM in conjunc-tion with their artistic and music talents.

- C-STEM Teacher of the Year Award
- C-STEM School of the Year
- C-STEM Service Award

C-STEM ANNUAL CONFERENCE ON INTEGRATED COMPUTING AND STEM EDUCATION

The annual C–STEM conference provides a forum for K–14 STEM teachers, researchers, educators, policy makers and industrial partners to share their experiences, best practices, and ideas, and thereby influence the future direction of integrated computing and STEM education.

Outstanding STEM teachers are recognized with the C–STEM Teacher of the Year Award for their dedica-tion and achievement on integrated computing and STEM education. Schools who provide all students with computer programming experience in formal education are recognized with the C–STEM School of the Year Award. The C-STEM Service Award recognizes volunteers for their unusual dedicated voluntary service to the C-STEM program by outstanding performance, demonstrated effective leadership, prolonged and committed service, devotion, enthusiasm and faithfulness.

INTEGRATED COMPUTING AND STEM EDUCATION
FOR BOTH FORMAL AND INFORMAL K–14 PROGRAMS

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California Department of **EDUCATION**

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