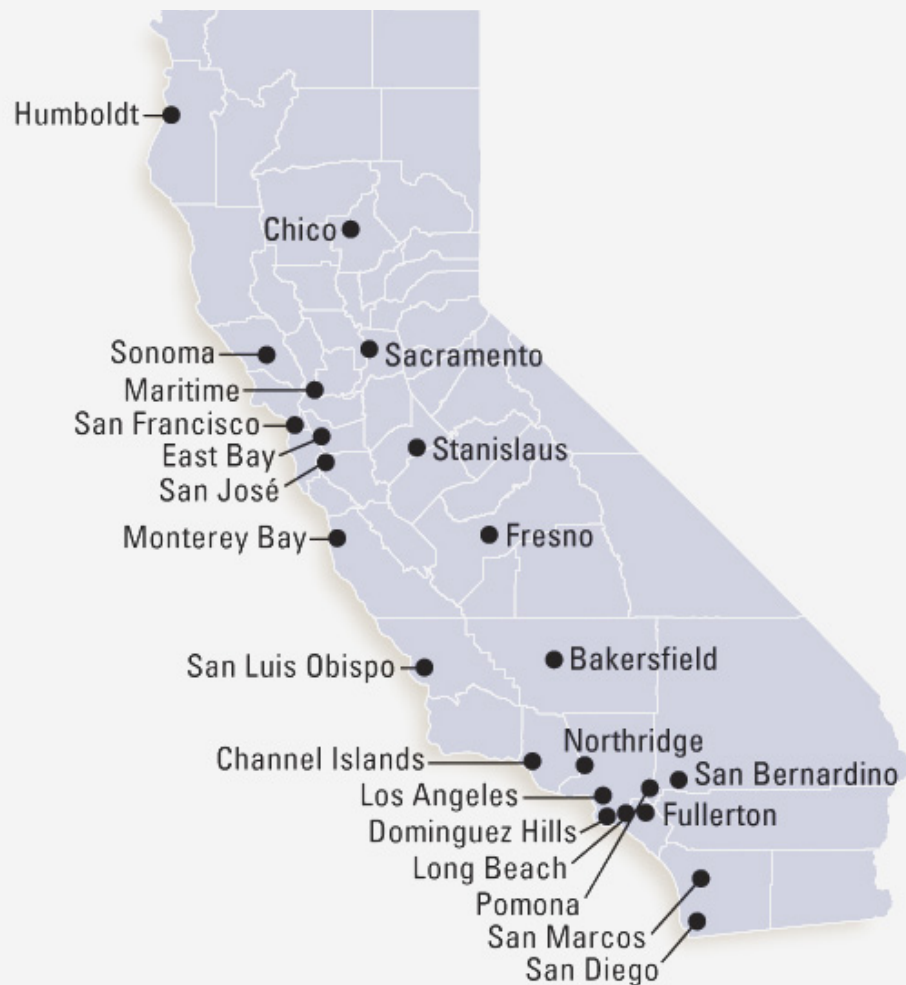


Innovative and Effective Approaches for STEM Teacher Preparation

**STEAM Symposium
October 28, 2018**

<http://bit.ly/InnovSTEMTchrPrep>



Presenters for Innovative and Effective Approaches for STEM Teacher Preparation

Presenters

- Carol Fry Bohlin, *CSU Fresno*, carolb@csufresno.edu
- Babette Benken, *CSU Long Beach*, babette.benken@csulb.edu
- Al Schademan, *CSU Chico*, aschademan@csuchico.edu
- Stamatis Vokos, *Cal Poly San Luis Obispo*, svokos@calpoly.edu
- Megan Sulsberger, *CSU Monterey Bay*, msulsberger@csumb.edu
- Deidre Sessoms, *CSU Sacramento*, dsessoms@skymail.csus.edu

Moderator: Joan Bissell, *CSU Chancellor's Office*, jbissell@calstate.edu

Introduction: Innovative Approaches Enhancing STEM Teacher Preparation

Joan Bissell
Director, Educator Preparation and Public School Programs
CSU Chancellor's Office
jbissell@calstate.edu

Innovative Federal Partnerships of CSU Campuses in Preparing STEM Teachers

- Programs with Federal Science Agencies Enhancing Teacher Knowledge
 - Future STEM teacher lab experiences in leading edge research
 - Workshops for future teachers on advances in space science
 - Field research studying earth science and extreme environments

Strategies Used by CSU Campuses in Preparing STEM Teachers in Engineering

- Activities providing teaching experiences addressing engineering design
 - Introducing providing teaching experiences addressing engineering design
 - Co-teaching STEM in school settings with Digital Fabrication Labs
 - Working with students in Project Lead the Way activities

Ways CSU STEM Teacher Candidates Learn Working with Families and Communities

- Roles expanding learning opportunities for families in STEM
 - Assisting with Family Math and Family Science events in English and Spanish
 - Working with students and families in community science centers
 - Collaborating with science museums, state and national park facilities

Approaches Increasing STEM Learning Opportunities for K-12 Students

- Strengthening teacher candidate preparation through roles in informal science
 - Providing after school program STEM opportunities (Boys and Girls Clubs, etc.)
 - Contributing to week-end STEM programs for K-12 students
 - Helping to lead STEM summer camps and programs

Opportunities for Increasing Interest in STEM Among All Students

- Preparing teachers to address STEM through sports in schools and communities
 - Utilizing STEM learning activities developed for Olympics
 - Demonstrating science, math, engineering in sports
 - Partnership with Chevron in STEM Zone at sports and science events

Partnerships, Programs, and Practices for Preparing Powerful PreK-12 STEM Educators

Carol Fry Bohlin
California State University, Fresno
carolb@csufresno.edu

Mathematics and Science Teacher Initiative (MSTI)

Remember your favorite teacher?

TEACH and someone will remember YOU!



Teaching is a highly rewarding and fulfilling career! It offers an opportunity to make a meaningful difference in the lives of children and young adults.

The [Kremen School of Education and Human Development](#) has outstanding teacher preparation programs. You will learn cutting edge teaching methods that will prepare you to make learning exciting and challenging for your students. The program's outstanding and experienced faculty, supervisors, and master teachers will become your mentors as you move from university student to classroom teacher.

Do you have a passion for math or science?

You can share that excitement with the next generation by being a teacher! The demand for fully-credentialed mathematics and science teachers is significant and is expected to increase dramatically as more teachers retire.

The [College of Science and Mathematics](#) and the [Kremen School of Education and Human Development](#) offer excellent preparation and support for prospective mathematics and science teachers! For more information about earning your initial teaching credential at Fresno State, call the [Center for Advising and Student Services](#): (559) 278-0300 or visit Kremen Education Room 100.

Great Opportunities:

- Do you need to take a CSET subtest in mathematics or science for an initial or additional credential? MSTI offers FREE online, interactive courses and workshops that review the subject matter content included on these exams. All workshops are taught by talented instructors, many of whom are faculty members at Fresno State. See the "CSET Workshops/Forms" area on this webpage for more information!



CSET Workshops // Forms

- MSTI Fall 2018 Workshops
- MSTI Summer 2018 Workshops
- CTC Credential Application
- CTC & CSET Reimbursement
- Workshop Archive

Travel Information

- MSTI Travel Application

CSET Information

- Mathematics
- Science
- CSET Math Prep SJSU
- CSET Math Prep-UCI
- CSET Prep-TTP

MSTI Partnerships and Activities

Fresno State Credential Programs

Fresno State Mathematics and Science Departments

- Biology
- Chemistry
- Computer Science
- Earth and Environmental Sciences
- Mathematics
- Physics

Credential Pathways

- Mathematics
- Science
- Supplementary Authorizations
- Subject Matter Authorizations
- Credential Application
- Commission on Teacher Credentialing Multiple Subject and Single Subject Pedagogy Information

Additional Resources

Fresno Unified Teacher Residency Program

TEACH Grants

MSTI-Fresno: <http://bit.ly/MSTI-Fresno>

Twitter: @STEM_Fresno

Director: Dr. Carol Fry Bohlin • (559) 278-0237

MSTI Supports Prospective Mathematics and Science Teachers Throughout California

- Sponsors free online, interactive, and archived classes/workshops taught by talented faculty to review content on Single Subject math and science CSETs
- Reimbursement of CSET and credential (CTC) fees
- MSTI website contains details and resources.

MSTI Sponsors Mathematics Teaching Scholars (MTS)

- Part of new 4-year integrated bachelor of science in math + Single Subject Teaching Credential program
- Educators invited to nominate students for program; students invited to information session.
- MTS (20/year) receive \$2000 in support from MSTI
- <http://bit.ly/MathTeachingScholars>
- <http://bit.ly/MathScholarsFlyer1>

Incentives for Future PreK-8 Teachers to Take Additional STEM Courses

Liberal Studies (LS) STEM and Mathematics Concentrations

- LS majors receive a **\$200 stipend** for each of three elective courses per concentration.
- Students are encouraged to take designated courses to also satisfy requirement for an **Introductory Supplementary Authorization or Subject Matter Authorization** in Math or Science.

We're exploring a **Supplementary Authorization in Computer Science.**



Early Connection to the Profession for Future PreK-12 Math and Science Teachers

- Membership in professional organizations (CMC, CSTA, NCTM, NSTA)
- Travel support to attend math, science, tech, and STEAM conferences
- Opportunities to serve as co-instructors for math, STEM, and technology summer/weekend academies and to teach in STEM afterschool programs
- Paid early field experiences in math/science classrooms



Fresno Teacher Residency Program

Partnership between Kremen School of Education and Fresno Unified School District since 2013

- Funding: S. D. Bechtel, Jr. Foundation and ED Teacher Quality Partnership (TQP) Grant Program
- Multiple Subject credential candidates encouraged to also earn either an FLM or FLGS credential
- Currently have over 100 Teacher Residents in the M.A.Ed. + credential program (> a dozen cohorts 2014-19)



Fresno Teacher Residency Program

Program Supports

- Cohort Model
- Co-Teaching
- Financial Incentive
- Culture of Collaboration

Highlights

- Teaching Credential with Fresno State
- District Professional Learning
- Year Long Credential Residency
- Teaching Position in Fresno Unified

Program Options

	7-12	7-12
Credential	Multiple Subject	Single Subject
Emphasis	Elementary, Math, Science	Math, Science, English
Master's Degree	Included	Included

Apply Today!

1. <https://www.fresnou.edu/dept/hr>
2. Complete the Fresno Unified Certificated online application
 - a. Attach the following:
 - i. Resume
 - ii. 2 Letters of Support
 - iii. Transcripts
3. Complete the Teacher Insight Survey: The survey will be emailed upon completion of the application.
4. Apply for Teacher Residency

Contacts

traci.taylor@fresnouunified.org
jeanna.perry@fresnouunified.org

Fresno Unified School District
FRESNO STATE
Member of Arts in Education
CURRICULUM AND INSTRUCTION
AND/OR THE ADVANCE STUDY
IN EDUCATIONAL TECHNOLOGY
CERTIFICATE



<http://bit.ly/FTRP2018>

Outreach Events and Courses Provide Teaching Experience and Support the STEM Pipeline



For Immediate Release:
March 23, 2017

Contact: Amber Taylor
703-201-4893
ataylor@tomorrow.org

More than 200 Students Gather to Investigate Careers in Education

Winners of Three State-Level Student Competitions Announced During Conference for High School Students

Fresno – More than 200 students from 11 area high schools are attending



OFFICE OF COMMUNITY BASED LEARNING • MATHEMATICS AND SCIENCE TEACHER INITIATIVE • NASA AEROSPACE ACADEMY



YOUTH TECHNOLOGY INSTITUTE

PROGRAM DESCRIPTION

The Tech Academy is taught using the latest technology, software, and equipment. Learners will participate in two 90-minute classes each day.

Each class is limited to 20 students to maximize individual attention and to allow adequate time for practice. Learners will develop skills in science, technology, engineering, and mathematics as they explore and problem solve with hands-on activities.

“Now Enrolling...
...All Future Techs!”



Tentative Fall Courses

1st – 3rd

- Beginning Engineering Design Challenges
- Dash Robotics

4th – 8th

- Video Production
- Beginning Lego Robotics
- Adventures in Aviation and Flight

When 9/22, 9/29, 10/6, 10/20 & 10/27

(Must be available to attend all 5 program days)

Time 9:00 a.m. to 12:30 p.m.

Where Fresno State – Kremen School of Education

Who Students 1st - 8th grade

Fee \$150 (Registration and Materials)

**There are limited scholarships available on a first come first served basis, one per family.*



Preparing Future K-12 Math Teachers for California's Schools: The Necessity of Integration Across STEM

Babette Benken
Richard D. Green Professor of Mathematics Education
Director of Graduate Studies
California State University, Long Beach
Babette.benken@csulb.edu

CSU Long Beach: An Overview

- Urban and public HSI
- Always top 3 in number of credentials/authorizations awarded for the CSU System
- Students:
 - ~38,000 (~6,000 or 16% are post-baccalaureate)
 - Over 80% identify as students of color
 - ~20% identify as first-generation
 - 56% are female
 - ~80% work at least part time; ~64% work off campus

Elementary Program

- Waiver program for mathematics
- Requires 12 units (4 courses) in math content (all include technology):
 - The Real Number System
 - Geometry & Measurement
 - Probability & Statistics w/Algebraic Applications
 - Problem Solving with Applications (capstone)
- 5 additional math content courses available for those concentrating in math (concentrations are strongly encouraged—supports gaining additional authorizations to extend to middle school)

Elementary Program

- Required and dedicated math methods course
- Includes integrated STEM unit that focuses on the following:
 - Knowledge of math & science content
 - Knowledge of CCSS-M & NGSS standards
 - Mapping across grade levels and content
 - Designing integrated STEM lessons
 - Increasing confidence in both developing & teaching integrated STEM
 - Ability to communicate understandings orally and in writing
 - Ability to utilize technology to support STEM lesson development & teaching

Secondary Program

- Waiver program for mathematics
- Single Subject & FLM credentials, as well as SMA and SA authorizations offered
- Must satisfy numerous course requirements or CSET
- Special computer applications course for secondary math teachers (satisfies CA technology level 1 requirement)
- New courses:
 - Mathematical Modeling for Secondary Math Teachers
 - Abstract Algebra for Secondary Math Teachers

Secondary Program

- 2 required and dedicated math methods courses & dedicated math student teaching seminar—all include technology (CSU funding upon completion of student teaching)
- Ex: Student teaching seminar includes unit focused on using an online learning platform (EdReady) to both support candidates' understanding/review of math content & scaffold their learning of how such a platform can be used to support their future K-12 students' learning of math content.
- CSU funding for real-world lab research experiences

The Triad Project: Meeting the Professional Development Challenges of the NGSS

Al Schademan
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California State University, Chico
aschademan@csuchico.edu

The Triad Project Partnership



- CSU Chico and Chico Unified School District
- Goal: To produce the next generation of science teachers
- Funding: The S. D. Bechtel, Jr. Foundation. Next Generation of Educators Initiative (NGEI)



*Preparing Educators to Be
Effective • Reflective • Engaged*



Triad: The Big Picture



- A Triad = Teacher Candidate, Cooperating Teacher, Content Specialist
- Co-Plan, co-teach, revise, and publish an integrated NGSS/CCSS unit that meets the needs of all students.
- Professional development for all involved.
- Teacher candidate is first author of published unit.
- Teacher candidate takes elementary or secondary science methods course during the project.

Triad Guiding Principles

Teacher professional development is most effective when it is:

- Longitudinal
- Collaborative
- Non-hierarchical

And when each member is:

- Engaged in a goal-directed activity
- Both a learner and a significant contributor



Prioritized Skills for Teacher Candidates

1. Design and implement rigorous units.
2. Engage students in learning.
3. Provide access to the curriculum for all students.
4. Design and administer classroom assessments.
5. Collaborate effectively with peers.



Triad Units Available Online!

<http://mysoe.net/triad/>



Grade 1: Amazing Animal Parents (1-LS1-2)



Grade 1: Why Can We See Through a Window but Not a Door? (1-PS4-3)



Grade 2: Are Chemical Reactions Reversible or Irreversible? (2-PS1-4)



Grade 2: Mitigating Erosion Through the Engineering Design Process (2-ESS1-1, 2-ESS2-1)



Grade 3: Animal Adaptation and Habitat (LS3)



Grade 3: Protect Yourself From the Flood! (3-ESS2-1, 3-ESS2-2)



Grade 4: Exploring Structures and Functions (4-LS1-1)



Grade 4: Hydraulic Mining and the Transfer of Energy (4-PS3-4)



Grade 4/5: Investigating Water Erosion – Stream Tables and Field Trip (4-ESS2-1)



Grade 5: Chemical Reactions (5-PS1-4)



Grade 5: What's the Distribution of Water on Earth? (5-ESS2-2)



Grade K-1: What's the Weather Like Today? (K-ESS2-1, K-ESS2-2, K-PS3-1)

Teacher Research Strategies for Preparing Outstanding STEM Teachers

Stamatis Vokos
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Incorporating Summer Research Experience into the STEM Teacher Preparation Pathway



CAL POLY
CESAME



High-Impact Teacher-Researcher Experiences

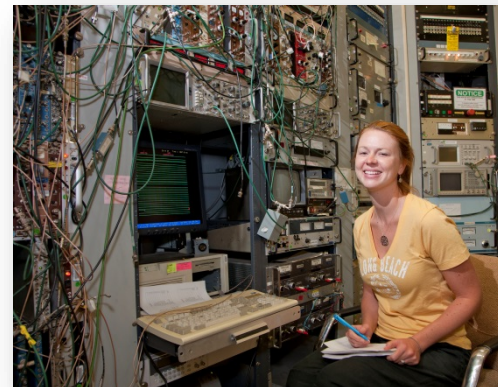
STAR incorporates paid summer research experiences into the teacher preparation and induction pathways for pre-service and early career STEM teachers.

Through this effort, the 22-campus California State University system aims to prepare a new generation of “teacher-researchers” who are highly qualified to engage their students in science and engineering practices and serve as leaders in K-12 STEM Education.



High-Impact Teacher-Researcher Experiences

- Full-time research at one of 22 lab sites for nine summer weeks
- Fellows are paid \$500/week (most also qualify for relocation support)
- Weekly education workshops translate lab culture and practices into classroom
- Fellows perform original research, and present it at a conference
- Fellows construct lesson plans based on their research
- Fellow build professional networks among teachers and researchers



Where?

At some of the most prestigious and active research labs in the nation.



 AFRL	 CSU Labs	 Sandia National Laboratories SNL	 LIGO
 NASA Ames	 NASA Armstrong	 NASA Jet Propulsion Laboratory	 SETI INSTITUTE SETI Institute
 NOAO	 LLNL	 Southwest Fisheries Science Center NOAA Southwest Fisheries Science Center	 NOAA ESRL
 RTC		 Stratospheric Observatory for Infrared Astronomy NASA SOFIA	 SPACE SCIENCES LABORATORY <small>UNIVERSITY OF CALIFORNIA</small> Berkeley Space Science Lab
 NATIONAL ACCELERATOR LABORATORY SLAC		 Pacific Northwest NATIONAL LABORATORY Pacific Northwest National Laboratory	

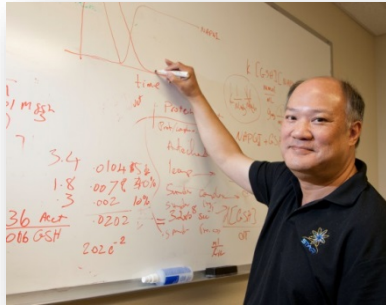


What do STAR Fellows work on?

Physics



Mathematics



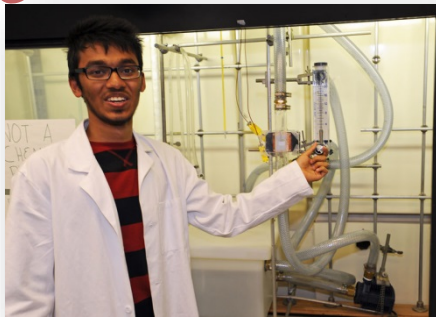
EVERYTHING STEM!

Biology

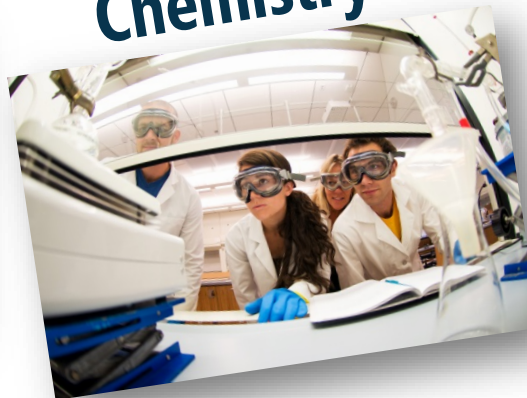


Engineering

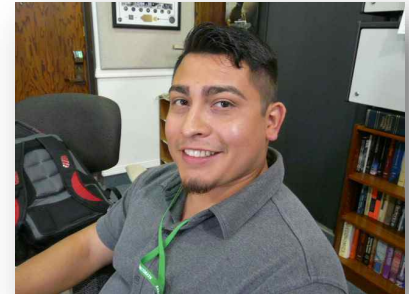
Electrical
Mechanical
Software
Process



Chemistry



Computer Science



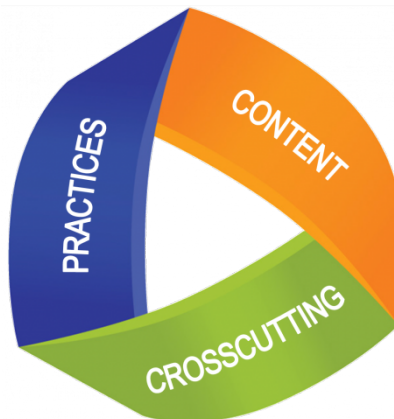
Why?

Real-world research experience helps to make excellent K-12 teachers¹.

- We want to **RECRUIT** talented people into teaching careers
- We want to **PREPARE OUTSTANDING** teachers
- We want to **RETAIN** talented people for longer by integrating teaching and research



¹Baker & Keller (2010) Science Teacher and Researcher (STAR) Program: Strengthening STEM Education through Authentic Research Experiences for Preservice and Early Career Teachers. *Association of American Colleges & Universities Peer Review*, p. 22-26.



The STEM Lab School Project

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The STEM Lab School Project

Megan Sulsberger
California State University Monterey Bay

STEM Lab School Goals

- 1) Provide pre-service teachers with opportunities to practice teaching STEM with real children in a school setting;
- 2) Explore best practices for incorporating maker opportunities into STEM lessons utilizing the 5E model;
- 3) Provide faculty with opportunities to informally assess and coach pre-service teachers on educational aims related to STEM and maker education;
- 4) Provide pre-service teachers with the opportunity to reflect on the impact of a lab school project on their STEM teacher preparation

Plan for STEM Lab School Experience

- Pre-service teachers utilized a NGSS-aligned curriculum to co-plan an inquiry-based, STEM lesson with maker opportunities
- Clinical Coaches, Cooperating Teachers, and CSUMB faculty partners used a STEM prioritized rubric to help candidates set goals and evaluate progress in improving teaching practices based on evidence
- Feedback to candidates focused on instructional design and implementation of STEM and ensuring equitable access to making experiences

Inquiry and Assessment: Evidence of Learning

To assess the project's impact, the Teacher-STEM survey (Friday Institute for Educational Innovation, 2012) was utilized to evaluate the potential impacts this experience may have had on the Pre-Service Teachers' attitudes and self-efficacy.

Constructed response and focus group data were also collected and coded to derive research themes.

Preservice Teacher T-STEM Data (post)

“I know the steps necessary to teach science effectively.”

- 86% of pre-service teachers agreed with this statement

“I know what to do to increase student interest in science.”

- 88% of pre-service teachers agreed with this statement

Research Theme - STEM Lab School Provides Pre-Service Teachers Practice with Inquiry-Based Teaching

Examples from coded teacher constructed response data:

- Teacher becomes a “sound board” and uses “student misconceptions to drive experiences”
- Teacher preparedness allows for deeper experience and greater student inquiry
- Management looks different: Teachers must “strike a balance between what could be perceived as out of control and not constraining student excitement”
- There is a unique collegiality built between student and teacher as the teacher “takes a step back” or “takes the role of an assistant”



Alia Firoozi	Stone Soup	14
Landon Scott	Stone Soup	18
Zariah Vidales	Stone Soup	18
Hunter Williams	Stone Soup	8
Gabriel Hyatt	Stone Soup	8
Lacey Schrock	Stone Soup	8

The STEM Zone and STEM in Sports

Deidre Sessoms
California State University, Sacramento
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Chevron's STEM ZONE

- Hands-on and interactive warehouse-style environment
- Features learning stations focused on STEM in Sports
- Agronomy, slope and acceleration, Bernoulli's Principle, reaction time, biofeedback, and thermal imaging
- STEM ZONE

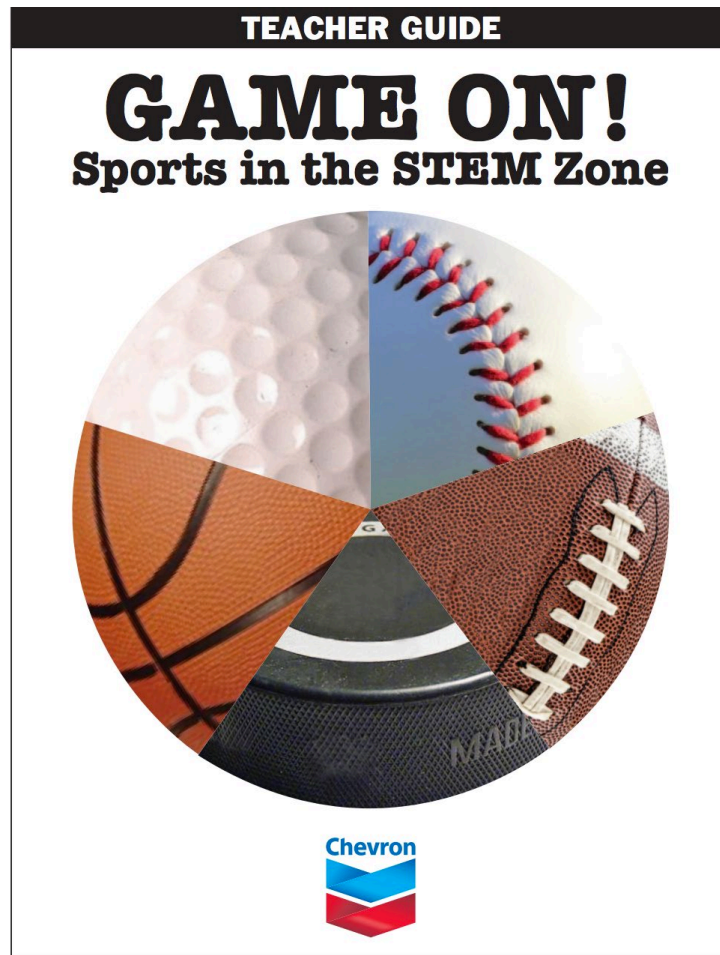
STEMZONE



CSU Role in STEM ZONE

- “Teachers” at STEM ZONE are CSU STEM students, future K-12 teachers
- Attendees at STEM ZONE are 3rd – 9th grade students from primarily Title 1 schools & after school/out of school programs, with their teachers
- Teachers’ guide & curriculum available

STEM Zone website & resources





Thank You!