Malinda S. Zarske

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Faculty member with the Engineering Plus program at the University of Colorado Boulder, teaching undergraduate product design and core courses, as well as instructor for the CU Teach Engineering program, teaching STEM education courses for pre-service teachers. Research interests include: the impacts of project-based service-learning on student identity—especially women and nontraditional demographic groups in engineering—and pathways and retention to and through K-12 and undergraduate engineering, teacher education, and curriculum development. Brings more than 20 years of teaching experience and passion for hands-on engineering design to university classes and the community.

PROFESSIONAL PREPARATION

PhD	University of Colorado Boulder	Civil engineering, environmental	2012
	Dissertation: Impacts of Project-Based Service-Learning on Attitudes towards Engineering in High School and First-Year Undergraduate Students, Advisor: Angela R. Bielefeldt		
MS	University of Colorado Boulder	Civil engineering, environmental	2002
MA	The Johns Hopkins University	Teaching, secondary science	1998
BS	St. Mary's College of Maryland	Biology	1995

ACADEMIC AND WORK EXPERIENCE

College of Engineering and Applied Science, University of Colorado Boulder

August *2019 – present*

Associate Director, *Engineering Plus Program*

Work with the Engineering Plus program administration and faculty to improve messaging and marketing of our program, increasing our college presence, highlighting our new pathways and student achievements, as well as outreach and recruitment to current undergraduate and high school students about Engineering Plus and CU Teach Engineering. Coordinate and lead weekly meetings for first-year engineering projects courses across multiple departments. Accountable for shared organizational goal-setting, achievement and reporting of results. Part of college-wide scholarship committee and faculty governance committee.

August *2014 – present*

Senior Instructor (*starting August 2019*), ***Instructor,*** *Engineering Plus Program*

Research: engineering education, innovative curriculum development, project-based service-learning, student identity, pathways/retention to and through K-12 and undergraduate engineering, and teacher education

Areas of expertise: Undergraduate engineering education, K-12 engineering education, engineering design instruction, project-based service learning, engineering professional identity, curriculum development, and teacher professional development

Teaching:

- *First-Year Engineering Projects* (GEEN 1400) and *Engineering Projects for the Community* (GEEN 2400), both interdisciplinary, hands-on design-build-test courses that guide student teams in entrepreneurial product development for Colorado clients.
- *Basic Electronics* (GEEN 3010), a junior-level hands-on circuits course for non-electrical engineering majors.
- *Teaching Design* (GEEN 4400), a hands-on curriculum and instruction course for junior and senior engineering students concurrently earning secondary teaching licenses.
- *Step 1* (EDUC 2020) and *Step 2* (EDUC 2030) through the University's CU Teach Engineering program, both courses that encourage engineering, science,

and mathematics students to explore teaching as a career by providing first-hand experiences co-teaching science/math lessons in local K-12 classrooms.
- Supervises and mentors undergraduate students' teaching semesters through CU Teach Engineering

Professional Development: Teach K-12 teacher *workshops* on implementing engineering design pedagogy in the K-12 classroom and how to align curricula with national standards in science and engineering.

Diversity:
- Teaches *Engineering Projects* summer course through the College of Engineering's diversity-serving programs summer bridge experiences for rising first-year undergraduates.
- With a *broadening participation in engineering* focus, mentor graduate and undergraduate engineering fellows to teach in local K-12 classrooms through the ITL Program's TEAMS initiative, including design and delivery of pedagogy training and instilling self-efficacy for and awareness about engineering career pursuits.
- Faculty advisor for the Boulder section of the *Society of Women Engineers* (SWE).

Curriculum Development and Dissemination:
- On the development and editorial teams for the *TeachEngineering* digital library.

Publishes and presents program results nationally.

2012 – 2014 ***Director, K-12 Engineering Education,*** *BOLD Center*

Oversaw a multi-faceted K-12 engineering program focused on underserved students, to improve student retention and performance throughout the college. Accountable for shared organizational goal-setting, budget management, achievement and reporting of results. Mentored and managed graduate and undergraduate engineering fellows who teach in local K-12 classrooms, including design and delivery of pedagogy training. Faculty advisor for the Boulder section of the *Society of Women Engineers* (SWE). On the development and editorial teams for the *TeachEngineering* digital library. Published and presented program results nationally.

2011 – 2013 ***Instructor,*** *Integrated Teaching and Learning (ITL) Program*

Taught *First-Year Engineering Projects* (GEEN 1400), an interdisciplinary, hands-on design-build-test course with a focus on product development, oral and written communication skills, project management, and teamwork. Guided student teams in entrepreneurial product development to create affordable living innovations that meet design requirements for clients throughout Colorado communities.

2002 – 2009 ***ITL K-12 Engineering Education Coordinator***, *ITL Program*

Implemented a multi-faceted K-12 engineering program focused on underserved students. Annually mentored and managed ~12 graduate and undergraduate engineering fellows in local K-12 classrooms, including design and delivery of pedagogy training. Oversaw the development of K-12 engineering education curricula for inclusion in the NSF-funded *TeachEngineering* digital library. Developed, coordinated and co-taught *Creative Engineering Design* (engineering design elective course at DSST Stapleton High School, 2004-2009), developed and co-taught *K-12 Engineering Outreach Corps* (CEAS, 2004-2005) and developed and co-taught summer K-12 student classes and teacher professional development (2002-2009).

2000 – 2002 ***Engineering GK-12 Fellow,*** *ITL Program*

Under than NSF GK-12 grant, developed and taught original engineering curricula weekly to elementary school students. Curricula created as a Fellow was later incorporated into the *TeachEngineering* digital library and is still widely used today by elementary teachers nationwide.

1999 – 2000	***Middle School Teacher**,* Shaw Heights Middle School, *Westminster, CO* Taught sixth-grade science and math. Developed new sixth-grade science curriculum.
1997 – 1999	***High School Teacher***, Broadneck High School*, Annapolis, MD* Taught biology, marine biology and physical science using engineering design projects. Part of the team that created and implemented a new, district-wide biology curriculum.
1995-1996	***Natural Resources Water Specialist*,** Maryland Department of Natural Resources, *Annapolis, MD*

ADITIONAL RELEVANT ACADEMIC EXPERIENCE

2009 –2011	***Chair**, Pre-College Division, American Society for Engineering Education* Managed 12th-largest ASEE division (of 50), including budget, monthly communication and planning with P-12 project team, and annual reports to ASEE Board.

AWARDS RECEIVED

2019 Sullivan-Carlson Innovation in Education Award, CU Boulder, May 2019

Student teams project People's Choice Awards, Engineering Design Expo, Fall 2015, Fall 2016, Spring 2017, Fall 2017, Spring 2019, Fall 2019

Meritorious Service Award*,* ASEE Pre-College Engineering Education Division, 2017

Best Paper Award*,* ASEE Pre-College Engineering Education Division, 2012

Best Poster Award*,* GEARS Graduate Symposium, College of Engineering and Applied Science, CU Boulder, 2010

Employee Recognition Award, College of Engineering and Applied Science, CU Boulder, 2008

Best Teacher Award, Broadneck High School, 1998

ENGINEERING and ENGINEERING EDUCATION GRANTS

Engineering Excellence Fund (EEF) Grant: ITL Advanced Electronics Computing Stations; **PI**. $3,000, 2019

NSF Grant: TeachEngineering: Democratizing Engineering Education for PK-12 Teachers; **co-PI**. DGE 19141701, $3.2M, August 2019-present

NSF Grant: TeachEngineering: Expanding & Sustaining Curriculum Access for K-12 Teachers; **co-PI.** DGE 1544495, $900K, 2015-2019

NSF GK-12 Track 3 Grant: Engineering for Society—An Energy and Environmental Sustainability Research Pathway to Cultivate Engineering Leaders and Enrich Education for Disadvantaged Youth; **co-PI**. DGE 0946502, $3.4M, 2010–2018

Engineering Excellence Fund (EEF) Grant: Electronics Testing Equipment and Reusable Project Supplies for Design-based Circuits Course*;* **PI**. $3,000, 2017

NSF REE Grant: Inclusive Excellence to Bolster Diversity: A System of Capacity-Building Pathways To and Through Engineering*;* **senior personnel.** EEC 1160264, $536K, 2012-2016

NSF IEECI Grant: RedShirt Transitional Program: Creating Engineering Capacity and Expanding Diversity through Strategic Partnerships*;* **co-PI.** EEC 0835907, $100K, 2009-2011

NSF Track 2 GK-12: Inspiring and Building Tomorrow's Workforce: A Grades 3-12 Engineering Continuum**; co-PI.** DGE 0338326; $1.9M; 2004-2009

NSF NSDL Digital Library Grant: *TeachEngineering*—Hands-On Resources for K-12*;* **senior personnel.** DUE 0226322; $575,886, 2003-2004; and DUE 0532709; $683K, 2005-2009

FIPSE Grant, US Department of Education: Development of a Hands-On, Integrated, Standards-Based Grades 3-6 Engineering Curriculum **co-PI.** $307K, 2003 – 2005

COURSES TAUGHT *(*Denotes course both developed and taught)*

First-Year Engineering Projects, interdisciplinary engineering design course for entry-level students
Engineering Projects for the Community,* sophomore-level interdisciplinary engineering design course
Basic Electronics,* junior level circuits course for non-electrical engineering majors
Step 1: Inquiry Approaches to Teaching, curriculum and instructional experience in elementary schools
Step 2: Inquiry-Based Lesson Design, curriculum and instructional experience in secondary schools
Knowing and Learning for Engineers,* educational psychology course focused on STEM development
Teaching Design,* engineering curriculum/instructional design for upper-division engineering students
*K-12 Engineering Outreach Corps**, upper-division university engineering technical elective
*Creative Engineering Design**, engineering design elective course at DSST Stapleton High School
K-12 teacher & counselor professional development & K-12 student electives, engineering design
Middle and high school math and science classes in Maryland and Colorado public schools

K12 WORKSHOPS TAUGHT *(*Denotes course both developed and taught)*

Teaching NGSS Engineering and Design Thinking using TeachEngineering Digital Library, ASEE Annual Conference, Tampa, FL, June 2019

Integrating Engineering into Your STEM Curriculum, GRTE 5040*,* 1 cr, CU Teach Engineering mentor teacher training, 2014-Present

Anchoring Engineering Activities – Engineering Design and Prototyping Skills, GRTE 5040*,* 1 cr, CU Teach Engineering mentor teacher training, 2017-Present

Teaching Design: A Methods Course for Teaching the Engineering Practices of the NGSS Framework, UTeach Consortium Annual Meeting, Austin, TX, May 2019

Incorporating Engineering into Step 1 and Step 2 courses, UTeach Consortium Annual Meeting, Austin, TX, May 2019

Engineering Student Teachers: Fitting STEM licensure WITH an Engineering Undergraduate Degree Program, UTeach Consortium Annual Meeting, Austin, TX, May 2016, 2017, 2018

Engineering lessons and hands-on activities for use in science, engineering, and math classrooms and informal settings, BVSD Science Teacher Training, August 2015

CUTeach Engineering: Putting the "E?" into STEM for All Students, Colorado Association of Science Teachers, Denver, CO, November 2015

Engineering lessons and hands-on activities for use in science, engineering, and math classrooms and informal settings, ASEE Annual Conference, Seattle, WA, June 2015

TeachEngineering: K-12 Engineering Digital Library, ITEEA Annual Conference, Long Beach, CA, March 2012

TEAMS K12 Teacher Summer Workshop, Boulder Valley and St. Vrain School Districts, 2002-2012
Engineering is Elementary, St. Vrain School District, 2013

Front Range Guidance Counselor Workshop, 2008, 2013

Various weeklong K12 teacher engineering content workshops, summers 2002- 2007

PROFESSIONAL SOCIETY MEMBERSHIP AND LEADERSHIP

American Society for Engineering Education (ASEE), Member, 2002-present

ASEE Board of Directors *Committee on Diversity, Equity, and Inclusion (CDEI),* Member, 2018-present

ASEE Board of Directors *Committee on P-12*, Member, 2017-present

ASEE Pre-College Division, Immediate Past Chair 2011-13, Chair 2009-11, Chair Elect 2008-09

Society of Women Engineers (SWE), Member, 2012-present

ADDITIONAL EDUCATIONAL AND SERVICE ACTIVITIES

Advisory Boards

Advisory Board Member, *Ohio Northern University/Ohio State University/Olathe Northwest High School NSF DRK-12 Grant*, 2018-present. Grant to develop curricula and assessment for engineering problem-framing design content.

Advisory Board Member, *Utah State University NSF Grant*, 2017-Present. Grant seeks to develop a model of disciplinary literacy in engineering from practicing engineers.

Advisory Member, Extended Network of Professional Development (PD) Providers, *Engineering Is Elementary*, Boston Museum of Science, 2018-Present

Advisory Member, *E4USA AP Engineering Course*, University of Maryland (lead), 2019-Present

Advisory Board Member, *Purdue University /Utah State University NSF DRK-12 Grant*, 2010-2013. Grant explores engineering design as a STEM learning experience for diverse high school students.

Invited Panels and Presentations

Invited Presentation, *Phillips 66 Case Study Challenge* (LEEDS and Engineering), Boulder, October 2019. Topic: Design and Design Thinking

Invited Workshop, ASEE PCEE, *Tampa*, June 2019. Topic: Using *TeachEngineering* to bring design thinking and NGSS engineering standards into your classroom.

Invited Participant, *Engineering Dean's Institute,* San Antonio, April 2019. Topic: P-12 Engineering Education: Status and Opportunities.

Invited Guest Lecture, *CU Engineers Without Borders student chapter,* Engineering Exploration Series Boulder, February 2019. Topic: Your Choice. Your Design. Your Future! Nurture all your passions with a degree in Engineering Plus.

Invited Presentation, *Colorado Space Business Roundup,* Denver, December 2018. Topic: Education: STEM's Impact on Student's Interest in Space.

Invited Presentation, *2016 STEM Think Tank*, Nashville, July 2016. Topic: Teaching engineering design to K-12 students and curricular resources for K-12 engineering.

Invited Presentation, *Colorado Science Educators Network and Boulder Valley School District*, 2015, 2016. Topic: Teaching engineering design to K-12 students and curricular resources.

Invited Webinar, *TeachEngineering Digital Library: Publishing Searchable K12 Engineering Curricula*, Sparkfun, Boulder, July 2015

Invited Presentation and Judge, *Colorado State Science Fair*, 2013. Topic: Cu Engineering and What Is Engineering?

Invited Participant, *National Center for Engineering and Technology Education* (NCETE), August 2011. Caucus to bring together experienced leaders in K-12 to discuss the development and implementation of engineering design in STEM settings at the high school level.

Invited Participant, *NSF-Sponsored Rigorous Research in Engineering Education Program Workshop* (RREE), August 2010. RREE's Exploring How People Learn Engineering workshop to improve the research methodologies of people with prior experience in conducting engineering education research.

Journal and Proposal Reviews

Manuscript Reviewer, *Journal of P-12 Engineering Education Research (JPEER)*, 2011-present.

Manuscript Reviewer, *Advances in Engineering Education (AEE)*, 2011-present.

Manuscript Reviewer, *Journal of Engineering Education (JEE)*, 2010-2016.

Manuscript Reviewer, *American Society for Engineering Education,* 2002-present.

Proposal Reviewer, *NSF Research Initiation Grants in Engineering Education (RIGEE)* review panel, 2011.

UNDERGRADUATE STUDENT RESEARCH MENTORED

1. Megan Keogh, 2018-19, How do peer interactions in an active learning environment affect a woman's confidence as an engineer?, *Discovery Learning Apprentice*
2. Amy Lenneman, 2019-2019, Evaluation of Novel Middle School Mentoring Program to Improve Mentee Experience**,** *Discovery Learning Apprentice*
3. Katie Waugaman, 2017-2018, How do these engineering ethics lessons affect students' perspectives of an engineering education?, *Discovery Learning Apprentice*
4. Maia Vadeen, 2015-2016, How does engineering knowledge and teaching knowledge intersect for undergraduate engineering students?, *Discovery Learning Apprentice*
5. Jaclyn Cunitz, 2014-2015, How is community formed in a new,diverse engineering major without set classes?, *Discovery Learning Apprentice*
6. Madison Gallipo, 2013-2014, Does four years of engineering education at the high school level, when taught by qualified teachers, significantly increase a students' interests and attitudes towards engineering, as well as increase the number of students who pursue an engineering – related path after high school?, *Discovery Learning Apprentice*
7. Samantha Maierhofer, 2012-2013, Does training students in team dynamics improve course outcomes and student experiences?, *Discovery Learning Apprentice*
8. Dana Schnee, 2012-2013, Do projects involving direct interaction with a community client have a greater and more enduring impact on students' skills when compared to service-themed projects and projects lacking community collaboration?, *Discovery Learning Apprentice*
9. Meg Podlegar, 2008-2009, By creating engineering based lesson plans and activities, we can engage young students early on in understanding engineering as a possible future career, *Discovery Learning Apprentice*
10. James Prager, 2008-2009, Developing chemical engineering activities for advanced high school students, *Discovery Learning Apprentice*
11. Benjamin Sprague, 2008-2009, developing innovative K-12 engineering physics curricula for a nationally disseminated digital library project, *Discovery Learning Apprentice*

PEER-REVIEWED ENGINEERING EDUCATION AND ASSESSMENT PUBLICATIONS

* denotes undergraduate student co-author

1. Keogh, M.*, **Zarske, M. S.,** Tsai, J. Y. (2019). "Examining how skill-building workshops affect women's confidence over time" *Proceedings*, ASEE Annual Conference, Tampa, FL.
2. Keogh, M.*, **Zarske, M. S.,** & Tsai, J. Y. (2018). "Active Learning Group Work: Helpful or Harmful for Women in Engineering?" *Proceedings*, ASEE Annual Conference, Salt Lake City, UT.
3. Waugaman, K.*, & Tsai, J. Y., & **Zarske, M. S.** (2018). "Connecting with First-year Engineering Students' Interest in Social Justice Issues through Ethics Lessons to Sustain Student Retention in Engineering," *Proceedings*, ASEE Annual Conference, Salt Lake City, UT.
4. Pamela S. Lottero-Perdue & **Zarske, M. S.** (2018). "Using Biography to Support Pre-Service Science and Engineering Teachers Learning about Engineering Practices and Habits of Mind," *Proceedings*, ASTE Annual Conference, Baltimore, MD.
5. **Zarske, M. S.,** Vadeen, M. L.*, Tsai, J. Y., Sullivan, J. F., & Carlson, D. W. (2017). "Undergraduate Engineers and Teachers: Can Students be Both?" *Journal of Pre-College Engineering Education Research*. Vol. 7, No. 1, summer 2017.
6. **Zarske, M. S.,** Tsai, J. Y., Sullivan, J. F., & Carlson, D. W. (2017). "Seeking Engineering Undergraduates for K-12 STEM Teacher Licensure: Fuels the Soul or Too Many Barriers?" *Proceedings*, ASEE Annual Conference, Columbus, OH.
7. Reitsma, R. F., Hsieh, P.H., Diekema, A. R., Robson, R., and **Zarske, M. S.** (2016). "Map- or list-based recommender agents? Does the map metaphor fulfill its promise?" SAGE,

http://ivi.sagepub.com/content/early/2016/10/12/1473871616669193.full.pdf+html First published on October 12, 2016 as doi:10.1177/1473871616669193

8. **Zarske, M. S.,** Vadeen, M. L.*, Tsai, J. Y., Sullivan, J. F., & Carlson, D. W. (2016). "Undergraduate Engineers and Teachers: Can Students be Both?" *Proceedings*, ASEE Annual Conference, New Orleans, LA.
9. **Zarske, M. S.,** Cunitz, J. L.*, Forbes, M. H., & Sullivan, J. F. (2015). "General Engineering Plus: Creating Community in a Flexible yet Technical Engineering Degree" *Proceedings*, ASEE Annual Conference, Seattle, WA.
10. **Zarske, M. S**., Gallipo, M. J.*, & Yowell, J. L. (2014). "STEM High School: Does multiple years of high school engineering impact student choices and teacher behavior?" *Proceedings*, ASEE Annual Conference, Indianapolis, IN.
11. Steckel, J., Quinones, P. A., **Zarske, M. S.,** & Knight, D.W. (2014). "Innovation Center: Preparing High School Students for the 21st Century Economy by Providing Resources and Opportunities to Create Genuine Projects with Industry Partners," *Proceedings*, ASEE Annual Conference, Indianapolis, IN.
12. **Zarske, M. S.,** Yowell, J. L., Maeierhofer, S.*, & Reamon, D. T. (2013). "Teamwork in First-Year Engineering Projects Courses: Does Training Students in Team Dynamics Improve Course Outcomes and Student Experiences?" *Proceedings*, ASEE Annual Conference, Atlanta, GA.
13. **Zarske, M. S.,** Schneee, D. E.*, Bielefeldt, A. R., & Reamon, D. T. (2013). "The Impacts of Real Clients in Project-Based Service-Learning Courses," *Proceedings*, ASEE Annual Conference, Atlanta, GA.
14. Knight, D. W., Sullivan, J. F., Kotys-Schwartz, D. A., Meyers, B. A., Louie, B., Luftig, J. T., **Zarske, M. S.,** & Hornback, J. M.* (2013). "The Impact of Inclusive Excellence Programs on the Development of Engineering Identity among First-Year Underrepresented Students," *Proceedings*, ASEE Annual Conference, Atlanta, GA.
15. Yowell, J. L., **Zarske, M. S.,** Knight, D. W., & Sullivan, J. F. (2013). "Impact of TEAMS Clubs: An Afterschool Engineering Enrichment Program that Impacts K-12 Students and College Student Leaders," *Proceedings*, ASEE Annual Conference, Atlanta, GA.
16. **Zarske, M. S.,** Ringer, H. L., Yowell, J. L., Sullivan, J. F., & Quiñones, P. A. (2012). The Skyline TEAMS Model : A Longitudinal Look at the Impacts of K-12 Engineering on Perception , Preparation and Persistence. *Advances in Engineering Education*. Vol. 3, No. 2, summer 2012. http://advances.asee.org/vol03/issue02/03.cfm
17. **Zarske, M. S.,** Yowell, J. L., Sullivan, J. F., Bielefeldt, A. R., O'Hair, M. T., & Knight, D. W. (2012). "K-12 Engineering for Service : Do Project-Based Service-Learning Design Experiences Impact Attitudes in High School Engineering Students?" *Proceedings*, ASEE Annual Conference, San Antonio, TX. *Best Paper Award.*
18. Brown, E. F., Richards, L. G., Parry, E. A., **Zarske, M. S.,** & Klein-Gardner, S. S. (2012). K-12 "Engineering Education: Priorities, Research Themes, and Challenges." *Proceedings*, ASEE Annual Conference, San Antonio, TX.
19. Schnittka, C., Parry, E. A., Day, L. D., Macalalag, Augusto Z, J., Padilla, A. J., **Zarske, M. S.,** & Quinones, P. A. (2012). "Best Practices in K-12 and University Partnerships Panel." *Proceedings*, ASEE Annual Conference, San Antonio, TX.
20. **Zarske, M. S.,** Reamon, D. T., Bielefeldt, A. R., & Knight, D. W. (2012). "Service-Based First Year Engineering Projects: Do They Make a Difference ?" *Proceedings*, ASEE Annual Conference, San Antonio, TX.
21. **Zarske, M.S.,** Reamon, D.T., and Knight, D. (2011) "Altruistic Engineering Projects: Do Project-Based Service-Learning Designs Impact Attitudes In First-Year Engineering Students?," *Proceedings*, ASEE Annual Conf, Vancouver, BC.
22. **Zarske, M.S.,** Rockenbaugh, L. A., Kotys-Schwartz, D., and Reamon, D. T. (2011) "Engineering for American Communities: Engaging Engineering Students in Multidisciplinary Altruistic Engineering Design projects," *Proceedings*, ASEE Annual Conf, Vancouver, BC.

23. Walden, S. E., Brown, E. F., & **Zarske, M. S.** (2011). Best Practices Panel – Assessment in K-12 Engineering Education and Outreach. *Proceedings*, ASEE Annual Conference,Vancouver, BC, Canada.
24. Reitsma, R., Marshall, B., **Zarske, M.** (2010) "Aspects of 'Relevance' in the Alignment of Curriculum with Educational Standards." *Information Processing and Management.* 46. 362-376.
25. Reitsma, R. F., Klenk, P. A., **Zarske, M. S.,** & Sullivan, J. F. (2010). Are French Fries and Grades Bad for You? Conflicting Evidence on How K-12 Teachers Search in a K-12 Engineering Digital Library. *Proceedings*, ASEE Annual Conference, Louisville, KY.
26. Marshall, B., Reitsma R.F., and **Zarske, M.S.** (2009) "Dimensional Standard Alignment in K-12 Digital Libraries: Assessment of Self-Found vs. Recommended Curriculum," *Proceedings*, Joint Conference on Digital Libraries, Austin, TX.
27. **Zarske, M.S.,** Sullivan, J.F., Knight, D., and Yowell, J.L. (2008) "The Impact on Engineering Graduate Students of Teaching in K-12 Engineering Programs," *Proceedings*, ASEE Annual Conf, Pittsburgh.
28. **Zarske, M.S.,** Sullivan, J.F., Knight, D., Yowell, J.L. and Wiant, D. (2007) "The TEAMS Program: A Study of a Grades 3-12 Engineering Continuum," *Proceedings*, ASEE Annual Conf., Honolulu, HI.
29. **Zarske, M.S.,** Kotys-Schwartz, D., Sullivan, J.F. and Yowell, J.L. (2005) "Creative Engineering: Helping Ninth-Grade Students Discover Engineering," *Proceedings*, Session 2610, ASEE Annual Conference, Portland, OR.
30. Sullivan, J.F., Cyr, M.N., Mooney, M.A., Reitsma, R.F., Shaw, N.C., **Zarske, M.S.** and Klenk, P.A. (2005) "The *TeachEngineering* Digital Library: Engineering Comes Alive for K-12 Youth," *Proceedings*, Session 3510, ASEE Annual Conference, Portland, OR.
31. Sullivan, J.F. and **Zarske, M.S.** (2005) "The K-12 Engineering Outreach Corps: A Service-Learning Technical Elective," *Proceedings*, Session 2510, ASEE Annual Conference, Portland, OR.
32. **Zarske, M.S.,** Sullivan, J.F., Carlson, L.E. and Yowell, J.L. (2004) "Teachers Teaching Teachers: Linking K-12 Engineering Curriculum with Teacher Professional Development," *Proceedings*, ASEE Annual Conference, Salt Lake City, UT.
33. **Zarske, M.S.,** "Engineering Endnotes," a bi-monthly newsletter column for the Colorado Association of Science Teachers; September 2004, December 2004, February 2005, May 2005, June 2005.
34. **Zarske, M.S.,** Axelrad, P., Yowell, J.L. and Sullivan, J. F. (2003) "Lessons in Navigation for Middle School Students," *Proceedings*, Inst. of Navigation GPS/GNSS Annual Conf., Portland, OR.
35. **Schaefer, M.R.,** Sullivan, J.F., Yowell, J.L. and Carlson, D.W. (2003) "A Collaborative Process for K-12 Engineering Curriculum Development," *Proceedings*, ASEE Annual Conf., Nashville, TN.

CURRICULUM DEVELOPED

Undergraduate Eningeering Curricula

1. *Engineering for the Community* (GEEN 2400) – Semester long undergraduate sophomore-level course - Design engineering products for local community clients, with emphasis on humanitarian engineering and integrated systems with electrical, mechanical, and software components. - 3 credit hours
2. *Basic Electronics* (GEEN 3010) - Semester long undergraduate junior-level course - Examines basic concepts of electricity, digital systems, circuit design and circuit analysis. - 3 credit hours
3. *Teaching Design* (GEEN 4400) - Semester long undergraduate senior-level course - Examines teaching engineering design to a variety of audiences including secondary schools, project teams, and other communities. Students practice integrating design thinking into local schools and companies, develop ready-to-use tools and resources, and explore the design education literature. – 3 credit hours

K-12 Engineering Curricula

Elementary Grades

1. *Can You Catch the Water?* — Activity; Grade Level: 4 (3-5); Students construct three-dimensional models of water catchment basins using everyday objects to form hills, mountains, valleys and water sources. They experiment to see where rain travels and collects, and survey water pathways to see how they can be altered by natural and human activities, as well as systems that clean and distribute water. https://www.teachengineering.org/activities/view/cub_earth_lesson2_activity3
2. *Conductivity* — Activity; Grade Level: 4 (3-5); Student groups make simple conductivity testers each using a battery and light bulb. They learn the difference between conductors and insulators of electrical energy as they test a variety of materials for their ability to conduct electricity. https://www.teachengineering.org/activities/view/cub_energy2_lesson04_activity3
3. *Creating an Electromagnet* — Activity; Grade Level: 4 (3-5); Student teams investigate the properties of electromagnets. They create their own small electromagnets and experiment with ways to change their strength to pick up more paperclips. Students learn about ways that engineers use electromagnets. https://www.teachengineering.org/activities/view/cub_mag_lesson2_activity1
4. *Design and Test Model Solar Water Heaters* — Activity; Grade Level: 4 (3-5); To explore different ways of using solar energy, students build a model solar water heater and determine how much it can heat water in a given amount of time. Solar water heaters work by solar radiation and convection. https://www.teachengineering.org/activities/view/cub_energy2_lesson09_activity2
5. *Go with the Energy Flow* — Lesson; Grade Level: 4 (3-5); This lesson is part of a series of six lessons in which students use their growing understanding of various environments and the engineering design process, to design and create their own model biodome ecosystems. Students learn about energy and nutrient flow in various biosphere climates and environments, food chains and food webs, and the roles of the hydrologic, carbon, and nitrogen cycles in sustaining the worlds' ecosystems so living organisms survive. https://www.teachengineering.org/lessons/view/cub_bio_lesson03
6. *Learn to Build a Rocket in Five Days or Your Money Back* — Lesson; Grade Level: 4 (3-5); Students discover the entire process that goes into designing rockets. In previous lessons in this unit, students learned how rockets work; now they learn what real-world decisions engineers must make when designing and building rockets. https://www.teachengineering.org/lessons/view/cub_rockets_lesson05
7. *Potato Power* — Activity; Grade Level: 4 (3-5); Students use potatoes to light an LED clock (or light bulb) as they learn how a battery works in a simple circuit and how chemical energy changes to electrical energy. https://www.teachengineering.org/activities/view/cub_energy2_lesson04_activity2
8. *Pulley'ing Your Own Weight* — Activity ; Grade Level: 4 (3-5); Using common materials (spools, string, soap), students learn how a pulley can be used to easily change the direction of a force, making the moving of large objects easier. https://www.teachengineering.org/activities/view/cub_simple_lesson05_activity1
9. *Rocket Power* — Activity; Grade Level: 3 (3-5); By making and testing simple balloon rockets, students acquire a basic understanding of Newton's third law of motion as it applies to rockets. Using balloons, string, straws and tape, they see how rockets are propelled by expelling gases, and test their rockets in horizontal and incline conditions. https://www.teachengineering.org/activities/view/cub_solar_lesson01_activity2
10. *Stations of Light* — Activity; Grade Level: 4 (3-5); Student groups rotate through four stations to examine light energy behavior: refraction, magnification, prisms and polarization. They see how a beam of light is refracted (bent) through various transparent mediums. https://www.teachengineering.org/activities/view/cub_energy2_lesson03_activity1
11. *The Science of Swinging* — Lesson; Grade Level: 3 (2-4); Students learn what a pendulum is and how it works in the context of amusement park rides. While exploring the physics of pendulums, they are also introduced to Newton's first law of motion — about continuous motion and inertia. https://www.teachengineering.org/lessons/view/cub_pend_lesson01

12. *Too Much Pressure! Modeling Force-Pressure-Area Relationships* — Activity; Grade Level: 5 (5-8); Students learn all about water pressure and how engineers design faucets. Teams build simple systems that model faucets and test them to see the relationships between pressure, area and force. https://www.teachengineering.org/activities/view/cub_faucets_lesson1_activity1
13. *Waterwheel Work: Energy Transformations and Rotational Rates* — Activity; Grade Level: 4 (3-5); Students learn the history of the waterwheel and common uses for water turbines today. They explore kinetic energy by creating their own experimental waterwheel from a two-liter plastic bottle and investigate the transformations of energy involved. https://www.teachengineering.org/activities/view/cub_energy2_lesson08_activity2
14. *Watch It Slide!* — Activity; Grade Level: 4 (3-5); Students use inclined planes as they recreate the difficult task of raising a monolith of rock to build a pyramid. They compare the push and pull of different-sized blocks up an inclined plane, determine the angle of inclination, and learn the changes that happen when the angle is increased or decreased. https://www.teachengineering.org/activities/view/cub_simple_lesson04_activity1
15. *Wind Power! Designing a Wind Turbine* — Activity; Grade Level: 4 (3-5); Students learn how engineers transform wind energy into electrical energy by building their own miniature wind turbines and measuring the electrical current they produce. They explore how design and position affect the electrical energy production. https://www.teachengineering.org/activities/view/cub_energy2_lesson07_activity2

Middle School Grades 6-8

16. *A Spectral Mystery* — Activity; Grade Level: 8 (7-9); Students use the spectrographs from the "Building a Fancy Spectrograph" activity to gather data about light sources. Using their data, they make comparisons between different light sources and make conjectures about the composition of a mystery light. https://www.teachengineering.org/activities/view/cub_spect_activity6
17. *Building a Fancy Spectrograph* — Activity; Grade Level: 8 (7-9); Students create and decorate their own spectrographs using simple materials and holographic diffraction gratings. https://www.teachengineering.org/activities/view/cub_spect_activity4
18. *Breaking the Mold* — Activity; Grade Level: 8 (6-8); In this math activity, students conduct a strength test using modeling clay, creating their own stress vs. strain graphs, which they compare to typical steel and concrete graphs. https://www.teachengineering.org/activities/view/cub_brid_lesson04_activity1
19. *Design Inspired by Nature* — Activity; Grade Level: 7 (6-8); Students discover how engineers can use biomimicry to enhance their designs. They learn how the careful observation of nature can lead to new innovations and products and reverse engineer a flower to glean design ideas for new products. https://www.teachengineering.org/activities/view/cub_lifescience_lesson03_activity2
20. *Dress for Success* — Activity; Grade Level: 8 (6-8); In this design activity, students investigate materials engineering as it applies to weather and clothing. Teams design and analyze different combinations of materials for effectiveness in specific weather conditions. https://www.teachengineering.org/activities/view/cub_weather_lesson01_activity1
21. *Fancy Feet! Stress & Strain Forces in Shoe Design* — Activity; Grade Level: 7 (6-8); Students use the engineering design process to solve a real-world problem—shoe engineering! Working in small teams, they design, build and test a pair of wearable platform or high-heeled shoes, taking into consideration the stress and strain forces. https://www.teachengineering.org/activities/view/cub_feet_activity1
22. *Load It Up!* — Activity; Grade Level: 8 (6-8); Students take a hands-on look at the design of bridge piers (columns). First they brainstorm types of loads that might affect a Colorado bridge. Then they determine the maximum possible load for that scenario, and calculate the cross-sectional area. https://www.teachengineering.org/activities/view/cub_brid_lesson02_activity1
23. *Mobile Forces* — Activity; Grade Level: 8 (6-8); The application of engineering principles is explored as students create their own mobiles, taking into consideration the forces of gravity and convection air currents. https://www.teachengineering.org/activities/view/cub_art_lesson01_activity1

24. *Oil Spill Consequences and Cleanup Technologies* — Lesson; Grade Level: 6 (5-7); Students learn details about the Exxon Valdez oil spill, which was one of the most publicized and studied human-caused environmental tragedies in history, then experiment with many "engineered" strategies to clean up their own manufactured oil spill and learn the difficulties in dealing with oil released into our waters. https://www.teachengineering.org/lessons/view/cub_enveng_lesson01
25. *Polluted Air = Polluted Lungs* — Activity; Grade Level: 7 (4-7); To gain a better understanding of the roles and functions of components of the human respiratory system and our need for clean air, students construct model lungs that include a diaphragm and chest cavity. https://www.teachengineering.org/activities/view/cub_biomed_lesson04_activity1
26. *Spectroscopy* — Curricular Unit; Grade Level: 7 (6-8); Students learn how using spectrographs helps people understand the composition of light sources. Using simple materials including holographic diffraction gratings, students create and customize their own spectrographs—just like engineers. https://www.teachengineering.org/curricularunits/view/cub_spect_curricular_unit
27. *Weather Alert* — Activity; Grade Level 8 (6-8); Students discuss the characteristics of storms, including the relationship of weather fronts and storms. Using everyday materials, they develop models of basic lightning detection systems and analyze their models to determine their effectiveness as community storm warning systems. https://www.teachengineering.org/activities/view/cub_weather_lesson03_activity1
28. *What's Down the Well?* — Activity; Grade Level: 6 (5-7); Students learn about physical models of groundwater and how environmental engineers determine possible sites for drinking water wells. During the activity, students create their own groundwater well models using coffee cans and wire screening. https://www.teachengineering.org/activities/view/cub_enveng_lesson04_activity1
29. *Where Does All the Water Go?* — Activity; Grade Level: 6 (5-7); Vtudents learn the vocabulary associated with groundwater, see a demonstration of groundwater flow, and learn about the measurements that environmental engineers need when creating a groundwater model of a chemical plume. https://www.teachengineering.org/activities/view/cub_enveng_lesson03_activity1
30. *Who's Down the Well?* — Lesson; Grade Level: 6 (5-7); Students learn about several possible scenarios of contamination to drinking water, which comes from many different sources, including surface water and groundwater. They analyze the movement of sample contaminants through groundwater, in a similar way to how environmental engineers analyze the physical properties of groundwater to predict how and where surface contaminants. travelhttps://www.teachengineering.org/lessons/view/cub_enveng_lesson04

High School Grades 9-12

31. *Service-Based Engineering Design Projects* — Curricular Unit; Grade Level: 10 (9-12); This unit describes a general approach to guiding students to complete service-based engineering design projects, with specific examples provided in detail as associated activities. With your class, brainstorm ideas for engineering designs that... https://www.teachengineering.org/curricularunits/view/cub_service_unit
32. *Engineers Love Pizza, Too!* — Activity; Grade Level: 9 (9-12); In this service-learning engineering project, students follow the steps of the engineering design process to design an assistive eating device for a young girl who has a medical condition that restricts the motion of her joints. https://www.teachengineering.org/activities/view/cub_service_activity01
33. *Tower O' Power: Strength-to-Weight-Ratio Competition* — Activity; Grade Level: 9 (9-12); In this activity, students learn about creating a design directly from a CAD (computer-aided design) program. Teams design towers in CAD and manufacture the parts with a laser cutter. https://www.teachengineering.org/activities/view/cub_tower_activity1
34. *Watch Out for the Blind Spots: Design a Vision Testing Device* — Activity; Grade Level: 10 (9-11); In this service-learning engineering project, students follow the steps of the engineering design process to design a vision testing device. More specifically, they design a prototype machine that can be used to test the peripheral vision. https://www.teachengineering.org/activities/view/cub_service_activity02

35. *Zero-Energy Housing* — Activity; Grade Level: 9 (9-11); Students investigate passive solar building design with a focus solely on heating. They learn how insulation, window placement, thermal mass, surface colors, and site orientation play important roles in passive solar heating. https://www.teachengineering.org/activities/view/cub_housing_lesson05_activity1

Informal Learning

36. *Build an Electromagnet!* — Informal Learning; en español; Grade Level: 4 (3-5); Students build electromagnets and use them to pick up objects. https://www.teachengineering.org/sprinkles/view/cub_electromagnet_sprinkle1
37. *Can You Catch the Water?* — Informal Learning; en español; Grade Level: 4 (3-5); Students model a water catchment basin and survey water pathways to understand factors that affect water flow. https://www.teachengineering.org/sprinkles/view/cub_catchwater
38. *Fancy Feet Shoe Design* — Informal Learning; en español; Grade Level: 7 (6-8); Students design, build and test shoes to develop new styles and improve existing designs. https://www.teachengineering.org/sprinkles/view/cub_fancyfeet
39. *Wind Power* — Informal Learning; en español; Grade Level: 4 (3-5); Students build small wind turbines to see how much wind energy they can transform into electrical energy. https://www.teachengineering.org/sprinkles/view/cub_windpower_sprinkle

COMMUNITY SERVICE

K-12 Outreach

Provided classroom lessons for:

Superior Elementary School, Superior CO, K through 5th grade classes, August 2012 - Present

Eldorado K-8 School, Superior CO, 6th, and 7th grade classes, August 2017 – Present

Northglenn High School GO (Girls Only) Engineering Day, 2017-2018

Graland School, Science & Engineering Judge, Curriculum team, 2010-2013

High School Success Institute for Minority Students. Summers, 2002-2009

Girls Embrace Technology workshops, CU Boulder, 2002, 2003

Expanding Your Horizons for middle school girls sponsored by AAUW, 2001, 2002

Leadership

Girl Scout Troop Leader. Elementary grades, August 2014 - Present

Girl Scout GECCCOs (Girls Exploring Camping, Cycling,& Canoeing Outdoors) Leader, Middle grades, August 2017-Present

Co-founder and team leader, *Engineering for American Communities* (EFAC), 2010-2011. Student service organization for undergraduate and graduate students at CU-Boulder

Service learning projects in first-year and sophomore engineering design projects courses

Projects for: Children's Hospital of Colorado, Rocky Mountain Fire Protection District, Boulder Homeless Shelter, Boulder Outreach for Homeless Overflow (BOHO), Community Gardening, There With Care, Jeff & Paige singing duo, Broomfield Heights Middle School (assistive tech), Broomfield High School (assistive tech), Community Montessori (STEM modules), Ryan Elementary School (STEM modules), Trail Ridge K-8 School (STEM modules, assistive tech), Joycare Daycare Center, Local farmers (agriculture tech), Local citizens (assistive tech and entrepreneurial projects)