



Designing Engineering Curriculum for Pre-Service Teachers in preparation for NGSS: Medical Mission Drop (Curriculum Exchange)

Anne Marie Bergen, Cal Poly State University

Anne Marie Bergen's teaching philosophy "Active Learning, Meaningful Experiences, and Compassionate Teaching," sets her foundation for inspiring students and teachers to drive their own learning and gain a greater understanding for the world around them. Anne Marie discovered the natural connection students had to experiential learning when she was an intern at Sonora's Foothill Horizons Outdoor School, leading hiking classes for sixth-grade students and their teachers. She went on to become head naturalist at Foothill Horizons and later performed a variety of roles in Oakdale schools, including GATE (Gifted and Talented Education) teacher/coordinator, district science mentor teacher, elementary science specialist, and district science fair coordinator. During her final ten years in the Oakdale Joint Unified School District, Anne Marie was the District Science teacher /coordinator creating a science program that was laboratory and field based reaching over 2500 students and 120 teachers annually. Currently she is the Science Teaching Specialist for the Liberal Studies Department, Cal Poly, San Luis Obispo. She has a B.S. in Biology from Cal Poly, multiple subject credential from Chapman, and M.A. in Educational Leadership from St. Mary's. Honors include: 2010 Presidential Award for Excellence in Mathematics and Science Teaching, Cal Poly Commencement Speaker 2009, Cal Poly Honored Alumni 2008, Amgen Award for Science Teaching Excellence 2006, California Teacher of the Year in 2003, Stanislaus County Teacher of the Year 2002. She has created many grant funded programs including From the River to the Tap, the Salmon Project, and Passport to Science. Anne Marie has been a presenter at conferences including the Association of Environmental and Outdoor Educators, the California Science Teachers Association, and the National Science Teachers Association. Her leadership in science education includes Chair of the California Teacher Advisory Council (CaTAC) and Advisory Council member for CSL Net.

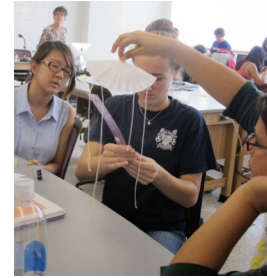
Dr. Katherine Chen, California Polytechnic State University

Katherine Chen is a Professor and Chair of the Materials Engineering department at Cal Poly, San Luis Obispo. She has been involved in many different K-12 engineering outreach activities, from summer camps to classroom visits to after-school programs, and to working with pre-service teachers.

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Target Grade Level: Pre-Service Teachers, K-12 applications,
Elementary 3rd-6th

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In preparation for the Next Generation Science Standards (NGSS), a team of teachers, science educators, and science and engineering professors at a comprehensive polytechnic university are collaboratively developing engineering modules for pre-service teachers in the Liberal Studies major. These engineering modules are designed to expose future teachers to the field of engineering and to serve as examples of hands-on activities that could later be used in their K-12 classrooms. The associated pedagogy of **open-ended design challenges in meaningful context and the iterative engineering design cycle** are also part of the curriculum. Hands-on engineering design activities are to be integrated into four of the six existing science courses for Liberal Studies majors. The initial engineering experience is presented in the physical science course focused on forces, motion, and energy. The emphasis of this initial activity is an introduction to the engineering design process through an in-class parachute activity titled “Medical Mission Drop,” adapted from an *Engineering is Elementary (EIE)* module.

Intro to Engineering Pre-activity: On a large Post-it® sheet, teams create and draw a "user persona" of an engineer and give it a personality that is guided by questions (what do they look like, what do they do, traits, etc.). All team members contribute to the user persona. This activity reveals students' perceptions of engineering including misconceptions and stereotypes.

Medical Mission Drop:

The Challenge: Design a parachute to drop sensitive medical equipment and personnel into a remote village recuperating from a devastating tsunami. Equipment must not be broken and medical personnel must survive the drop! Therefore there needs to be a slow drop rate! *How does the design of a parachute affect speed of a falling parachute? What are the most important factors?*

Research as a jigsaw activity: The in-class parachute activity is broken into three phases and occurs over two days of class. The first phase involves three jigsaw groups examining the effects of the *parachute canopy size, the canopy material, and the suspension line length*. For this phase, the groups investigate the effect of only one design variable on drop speed. The second phase of the activity has the teams reassemble with different jigsaw experiences to share results and combine their efforts to design and build the optimal parachute. A **parachute packing score** and **drop rate** parameters are introduced to demonstrate the trade-offs that occur in most engineering designs.

Design and Test; Repeat: The teams test their designs by dropping them from an indoor balcony and are involved in a third phase of improving the parachute design. A debrief of the activity is done with the entire class. In addition, each team is asked to reflect on their process of the design activity and to construct their own representation of the engineering design process to share it with the rest of the class.