Mathematical Modeling as a Habit of Mind
Brigitte Lahme, Sonoma State University and Krista McAtee, Sonoma Valley School District
For many people, mathematics means performing procedures fluently to “get the right answer.” How do you go from this view of mathematics instruction to a culture where students regularly engage in mathematical modeling from Kindergarten to graduate school? Engaging in mathematical modeling can seem overwhelming especially if we view modeling problems only as huge open-ended projects. So how do students learn to engage in mathematical modeling in a way that it will become a mathematical habit of mind? In this talk we will look at examples of mathematical modeling in high school and college courses and discuss the evolution of mathematics instruction.

Mathematical Ecology of Climate Change and Invasive Species
Robin Decker, University of California Davis
Mathematical ecologists use models to understand and predict changes in the distribution and abundance of life. Integrodifference equations are recurrence relations that can be used to model the continuous distribution of individuals over generations. I will show how integrodifference equations can be used to help us understand two different, urgent ecological problems: 1) How will climate change transform the current distributions of plants? 2) How do we predict the rate of spread of invasive species, and which invader traits accelerate the spread?

Pathway Association: Finding a Group of Related Genes that are Jointly Associated with a Trait of Interest
Tao He, San Francisco State University
Single variant analysis in genome-wide association studies (GWAS) has been proven to be successful in identifying thousands of genetic variants associated with hundreds of complex traits. However, these identified variants only explain a small fraction of inheritable variability in many traits. As a remedy, set-based methods were proposed and hold great promise because the genetic variants tend to work together to achieve biological function. In this work, we combine a high-dimensional of genetic variants that belong to a biological pathway to form an integrated signal aimed to identify pathways that are associated with the trait.

The Joy of Mathematics: Student Projects from the Fall 2015 Math 180 Class
Martha Shott and Grace Brown, Sonoma State University
You thought Mathematica could only take derivatives and integrate? Come see some amazing student projects – card games, population management, and forensic investigation — from Grace Brown and Martha Shott’s Fall 2015 Math 180 class.

Being (slightly) Flippant about Flipping
Steven Pon, University of California Davis
In recent years, the idea of a "flipped" classroom has been promoted as a cure for what ails many modern mathematics classrooms. Does this "flipped" classroom have been promoted as a cure for what ails many modern mathematics classrooms.

Models, Models, Everywhere: Student Projects from the Fall 2015 Math 470 Class
Martha Shott, Sonoma State University
We all know and love differential equations, matrices, and regression analysis, but how do they apply to the world outside of the mathematics classroom? Get a glimpse at the variety of possibilities through projects by the Fall Mathematical and Statistical Modeling students.

No Talk—Spring Break

Sperm Motility in Populations
Julie Simons, California Maritime Academy
As sperm travel towards the egg, they use a primarily planar flagellar waveform to swim. During this process, they must effectively navigate a highly complex environment that includes interactions with surfaces and nearby neighbors. We will discuss mathematical modeling approaches to understand this process in a fully three-dimensional context. This model will enable us to understand experimentally-observed motility patterns and postulate on the importance of waveforms, swimming in populations, and the complexity of the fluid environment.

Algorithms for Logarithms
Sam Brannen and George Ledlin, Sonoma State University
The number of elementary arithmetic operations is small. Addition and multiplication, and their inverses, subtraction and division, are familiar to all primary school children. The simplest operation, counting, is learned in pre-school. Exponentiation is usually introduced in middle school, and its two “inverses” – root extraction and logarithmization, are postponed till the last year of secondary school or relegated for remediation in college. Yet knowledge of exponentiation, root extraction, and logarithmization is essential to all science majors. We explore the idea from the point of view of logarithmics to celebrate the 400th anniversary of their invention by John Napier in 1614 and because logarithms pervade theoretical computer science, where discrete logarithmics require much attention.

The Transit of Venus
Jim Pedgrift, Sonoma State University
The Transits of Venus which took place in 1761 and 1769 were the first opportunities for the scientific community to establish a reliable estimate for the size of the solar system. The concept of the calculation is rather subtle but the actual mathematics involved is accessible to any SSU math student. Retired SSU math lecturer, Jim Pedgrift will walk us thru the history and the trigonometry of the historic event.

An Algebraic Approach to Analyzing NBA Teams
Steven Devlin, University of San Francisco
An important but hard problem in basketball analytics is how to quantify contributions to team success. Some contributions are important but subtle (movement without the ball, screens, passing). Furthermore, anything that happens in a basketball game does so in the context of five teammates sharing the court. This introduces a kind of co-dependence among observations – to what extent is my team’s success when I play really due to me, and not the teammates I play alongside? In this talk we use ideas from linear and abstract algebra, specifically representation theory, that are particularly well suited to answering these types of questions, and more. We’ll give a full analysis of some NBA teams by applying these techniques to actual NBA play-by-play data.

Mathematical Modeling of Prion Dynamics in Yeast
Suzanne Sindl, University of California Merced
Understanding complex biological processes often requires collaborations between mathematical and biological scientists. In this lecture, I will share some recent work in modeling prion diseases. Unlike a disease caused by a virus or a bacteria, in prion diseases the infectious agent is created by the host organism itself. Prion proteins are responsible for a variety of neurodegenerative diseases in mammals such as Creutzfeldt-Jakob disease in humans and "mad-cow disease" (Bovine Spongiform Encephalopathy or BSE) in cattle. While these diseases are fatal to mammals, prions are harmful to yeast, making yeast an ideal model organism for prion diseases.

The common formulation for prion dynamics is the Nucleated Polymerization Model (NPM) given either in the form of a PDE or in an integrodifference type model. In this talk, I will describe some recent work we did on modeling prion dynamics as well as future plans for creating more realistic models.