

University of Colorado  
Department of Chemical Engineering  
*James and Catherine Patten Seminars*

**2010 PATTEN DISTINGUISHED SEMINAR**

**Thursday, September 23, 2010**

**11:00 AM**

**Wittermyer Courtroom, Wolf Law Building**

**RECEPTION FOLLOWING SEMINAR IN BOETTCHER RECEPTION HALL**

**HOW ENZYMES ADAPT: DESIGN BY EVOLUTION**

**Frances H. Arnold**

**Dick and Barbara Dickinson Professor  
Department of Chemical Engineering  
Bioengineering and Biochemistry  
California Institute of Technology**



When making his case for the key role of natural selection in evolution, Darwin pointed to the enormous phenotypic variation that could be achieved in relatively few generations of artificial selection. Today, artificial selection (or ‘directed evolution’) applied to proteins allows us to observe how readily the functional molecules of life adapt in the face of defined selection pressures. A powerful approach to generating useful new biological molecules, directed evolution both circumvents and underscores our profound ignorance of how sequence encodes function. In this talk I will describe our efforts to evolve a cytochrome P450, and demonstrate how accumulating relatively few beneficial mutations (as little as 1-2% of the sequence) can make very significant changes to enzyme function. Where natural evolution has gone (e.g. impressive diversification of function in the P450 enzyme superfamily), directed evolution can follow. Even more interesting are the catalysts nature may not care about, but chemists dream of. While yielding useful biocatalysts for chemical synthesis, these studies provide new insights into the mechanisms underlying evolution of natural enzymes.

**Biographical Sketch**

Frances H. Arnold is the Dick and Barbara Dickinson Professor of Chemical Engineering, Bioengineering and Biochemistry at the California Institute of Technology, where her research focuses on evolution of biological systems in the laboratory. Arnold is a co-founder of Gevo, Inc. and serves on the Science Advisory Boards of several advanced biofuels and biotechnology companies. She was elected to the National Academy of Engineering in 2000, the Institute of Medicine in 2004, and the National Academy of Sciences in 2008.