DEPARTMENT OF CHEMISTRY & BIOCHEMISTRY
LIST OF FACULTY RESEARCH INTERESTS

Daniel Bercovici
Synthetic Organic Chemistry

1. Development of new organic methodologies
    a. Hydroborations of unique alkynes – ynamides
    b. Diels-Adler reactions with vinyl boranes
2. Asymmetric Reaction development
3. Total Syntheses of biologically active molecules

Emily Bockmon
Marine Chemistry

1. Characterizing the seawater carbon dioxide chemistry of local environments
    a. Depth profiles of carbonate chemistry at the Cal Poly Pier
    b. Spatial and temporal understanding of the chemistry of Morro Bay
2. Instrumentation development for carbonate chemistry characterization
    a. Using LabView to automate sample handling and analysis
    b. Creating better, easier and/or cheaper instrumentation
3. Ocean acidification
    a. Impacts of changing seawater chemistry on organisms
    b. Interactions and relationships between carbon, oxygen and nutrients

Seth Bush

1. Studying the emergence of Science Faculty with Education Specialties
2. Developing and studying teacher professional development process
3. Improving teacher recruitment and training
4. Building and testing inquiry-based science toys, games and manipulatives

Tammy Campbell

1. Nucleoside and oligonucleotide synthesis and evaluation
2. Peptides: catalysis, recognition and selection
3. Origins of life

Jennifer Carroll

1. Marine natural product isolation and characterization
    a. Rational collection of marine invertebrates and algae by SCUBA
    b. Screening of samples for biological activity
    c. Isolation of active components by chromatography (Flash and HPLC)
    d. Dereplication of known compounds by mass spectroscopy and literature review
    e. Elucidation of novel compounds by high field ID and 2D NMR techniques
2. Development of o-chem experiments in natural products

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Phil Costanzo

1. Tailored polymer synthesis
    a. Preparing polymers via controlled radical, free radical and step-growth polymerization techniques
    b. Impart functionality utilizing functional initiators and monomers and by post-polymerization functionalization
    c. Develop structure-property relationships
2. Characterization of stimuli-responsive materials in solution and solid state
3. Evaluation of materials for commercial applications, such as fuel-cell membranes, propellant binders, surfactants and self-healing composite materials
4. Development of polymer synthesis experiments that probe structure-property relationship

Scott Eagon

Our research group focuses on the development of small molecule pharmaceuticals and probes, particularly those targeting infectious diseases and cancer. Students are involved in all aspects of drug synthesis and pre-clinical development. Our group is also interested in developing new synthetic methods to produce compounds quickly and with minimal purification in an effort to reduce development costs. Students majoring in Chemistry, Biochemistry or related majors are welcome to join, but two quarters of organic chemistry lab are required to join due to the complexity of the chemistry involved. Students minoring in computer science or those with experience in Unix environments are also welcome to contribute to our in silico drug screening program. Current projects include the development of kinase-based chemotherapy agents, biological probes to better understand disease-related proteins, anti-malarials with novel modes of action targeting multi-drug resistant strains of Plasmodium falciparum, the development of host-oriented compounds to combat anthrax, the development of new classes of antibiotics and in silico screening programs to discover new drug candidates for infectious diseases. Please visit our research web page to learn more at www.calpoly.edu/~eagon

Ray Fernando

1. Waterborne Polymeric coatings
2. Surface chemistry and rheology of latex-surfactant interactions
3. Anti-fouling coatings for marine applications
4. Polymers and Coatings Concentration
5. Blended BS + MS in Polymers and Coatings Science
6. Industrial internships

Emily Fogle

Mechanistic Enzymology. My research seeks to better understand the detailed chemical mechanisms that enzymes use. In particular I am interested in pyridoxal phosphate dependent enzymes as well as oxidoreductases.

1. Methods used to gain insight into these enzymes include:
    a. Steady state kinetics
    b. pH rate profiles
    c. Kinetic isotope effects

   d. Site-directed mutagenesis
2. Other skills involved in these studies include:
   a. Overexpression of proteins
   b. Protein purification
   c. Basic molecular biology techniques

Derik Frantz

Design and synthesis of non-natural molecular constructs possessing unusual structures

1. Constrained macrocyclic polyaromatic hydrocarbons
2. Extended Π-systems for device applications

Anya Goodman

1. Discovery of enzymatic activity for proteins with known structures. (BASIL collaboration http://basiliuse.blogspot.com/ , CHEM474)
2. Comparative genomics, genome structure and evolution: fruit fly genomes (collaboration with GEP http://gep.wustl.edu) PRE-REQ: Bioinformatics Applications (Pre-req: BIO/CHEM441)
3. Curriculum development for biochemistry courses: develop new experiments for CHEM371 and create video tutorials for labs and activities. PRE-REQ: Biochemical Principles (CHEM371)

John P. Hagen

1. Physical Chemistry: Structure property relationships of soluble and insoluble surfactants. Students would be working with the tensiometer, Langmuir trough, fluorescence microscope and Brewster angle microscope
2. Lab development, physical chemistry: Developing a physical chemistry lab experiment based on the kinetic salt effect
3. Educational research: How do novice and expert learners define “Polarity”?

Taylor Haynes

Organometallics method development

1. Expanding the synthetic utility of copper-catalyzed aerobic oxidations through the development of a series of tandem reactions
   a. Developments in this area have elucidated a divergent method that allows for the selective synthesis of either 1,3-diones or α,β-unsaturated ketones from a common set of starting materials
2. Studying the effects of a highly tunable ligand framework on the photophysical properties of Iron(II) complexes
   a. A Tridentate ligand core consisting of a pyridine and two N-Heterocyclic Carbenes that can be finely tuned by adjusting the steric and electronic parameters of each binding site and studying the subsequent effects on the electronic properties of Iron(II) complexes

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Mike Heying

1. Improving theoretical descriptions of the thermodynamic properties (pressure, density, chemical potential, etc.) and structures (pair distribution functions) of model fluids
    a. Utilizing these improvements to better understand and predict phenomena like phase changes in these systems
    b. Building (theoretically) more non-idealities into these "ideal" fluids to better mimic more realistic and more interesting systems
    c. Simulating model fluids (hard particles, soft potentials, etc.) in various ensembles as a way of providing comparative experimental data
2. Reactor Kinetics
    a. Continuous reactors, where reactors are continually fed in and products are continually removed are often used for large-scale production
    b. Investigating the kinetics of fermentation of beer through a set of continuous reactors as a way of potentially making what are complicated fermentation rate equations simpler and easier to study. We hope to use our kinetic equations to consider how we can make this process more advantageous, in terms of maximizing the rate of production while minimizing the concentration of off-flavor compounds

Chad Immoos

1. Fluorescence detection of Reactive Carbonyl Species
    a. Synthesis of pre-fluorescent probes
    b. Investigation of fundamental reaction chemistry
2. Copper Complexes for Fluorescence Detection of Nitric Oxide
    a. Synthesis of pre-fluorescent probes
    b. Fluorescence bio-imaging in biological systems
3. Merging metallo-biomimetics and hydrophilic polymers
    a. Synthesis of transition metal catalysts to mimic biological reactivity
    b. Covalent attachment of catalysts in block co-polymers
    c. Investigation of reactions in polymers and at polymer surfaces

Dane R. Jones

1. Volatile organic compound (VOC) analysis in coatings and consumer products and VOC analysis method development using gas chromatography/mass spectrometry (GC/MS)
2. Development of chemical environment regulatory policies

Eric M. Jones

Biophysical chemistry of proteins and peptides:

1. Purification and spectroscopic characterization of peptide toxins from Amanita phalloides mushrooms
2. Amyloid-forming peptides and proteins; mechanisms of protein self-assembly into amyloids and related structures
3. Protein- and peptide-based materials
4. Applications of vibrational spectroscopy in biochemistry

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Eric J. Kantorowski

1. Mechanistic organic chemistry, synthetic methodology, organic synthesis
2. Cyclopropane chemistry: electrophilic- and radical-mediated ring opening of cyclopropanes and other strained systems
3. Synthetic methodology aimed at the preparation of bioactive natural products and analogs
4. Collaboration with external agencies to scout for compounds that show promise against Alzheimer's, autism spectrum disorder (ASD) and other disorders and diseases
5. Pedagogical innovation using modern technology

Kevin B. Kingsbury

1. Polymer Chemistry
    a. Novel Hydrogels with controlled architectures using RAFT and 'Click' Chemistry
    b. Semiconducting polymers for Polymer LED's
2. Organometallic and Organic Chemistry
    a. Polymerization catalysts
    b. Transition metal carbynes
3. Development of 'Green' Laboratory Experiments for Inorganic and Polymer Chemistry

Alan Kiste

1. Development of new methods for analyzing chemistry students' learning and production of chemistry symbolism and representations, and the analysis of student representations using these new methods
2. Development, assessment and evaluation of new pedagogical interventions
3. Examination of how students utilize learning resources in large lecture classes

Corinne Lehr

1. Environmental chemistry of toxic metalloids including arsenic, antimony and selenium including field measurements in environments such as oceanic phytoplankton mats and hypersaline lakes
2. Refinement of analytical methods for the analysis of swimming pool waters
3. Development of inquiry-based science activities for afterschool programs
4. Revision of the Chem 110 curriculum including new inquiry-based labs

Andres Martinez

My research is focused on the development of simple and portable diagnostic tests that could be useful for diagnosing disease or detecting analytes in the field. My group works primarily with devices made out of paper and studies everything from capillary wicking of fluids in paper to the shelf life of reagents stored on paper-based devices. Students in my research group learn about fabrication, fluid dynamics, qualitative and quantitative analysis and global health (and we get to work with cool tools like a liquid dispensing robot, a laser cutter, a 3D printer and

an environmental health chamber). PRE_REQ: Creativity, curiosity and a strong work ethic. No specific course work is required. For more information, please visit https://web.calpoly.edu/~awmartin

Ashley McDonald

1. Using computational chemistry to study noncovalent interactions in complex biophysical systems, particularly nucleic acids
    a. Studying the effects of pi stacking between bases in nucleic acids
    b. Developing computational tools (computer programming) to examine the effects of geometry on pi stacking in nucleic acids
2. Computational analysis of naphthalquinoline geometries to understand their binding affinity and specificity for triplex DNA
3. Calculating interaction energies between DNA aptamers and ligands, to understand mechanisms for riboswitches and potential nucleic acid therapeutics
4. Broad interest in computational drug design

Kristen Meisenheimer

1. Reactivity profiling of relevant natural products
    a. Involves synthetic modifications to biologically active natural products
    b. Purification and characterization of the synthetically modified natural products
2. Development of organic chemistry experiments using flash chromatography

Nisa Satumtira Morey

1. Synthesis and characterization of novel metal organic frameworks for heavy metal detection in aqueous systems
    a. Microwave synthesis of novel materials
    b. Quantitative analysis of heavy metal concentrations in water samples using fluorescence spectroscopy

Grace Ann Neff

1. History of Science, History of Women in Science
2. Development of hands-on-inquiry-based chemistry activities and lesson plans for K-12 classrooms using easily attainable materials
3. Outreach to area K-12 science teachers

Javin Oza

If you could engineer a biochemical system to perform a new function, which problems in science/medicine/society would you address? We answer this question to address previous intractable problems in:

1. Human cancer biochemistry
2. Bio-inpsired materials
3. Leverage biotechnologies to enable learn-by-doing

We pursue these goals through the integration of biological engineering tools with hypothesis driven science. Please visit www.Oza-Lab.com to read more about our research and team.

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Hasan Palandoken

1. Broad field of Organic Synthesis
2. Medicinal chemistry
    a. Investigation of cell surface ion exchangers as expedient molecular targets for new brain cancer therapy
    b. Synthesis of cell surface ion exchange inhibitors and their prodrug forms
3. Polymer chemistry
    a. Study of the alkoxyamine (RONH2) functional group in new materials as versatile ligating sites for carbonyl (i.e., aldehyde/ketone) substrates
    b. Synthesis and characterization of alkoxyamine polymers
    c. Testing the alkoxyamine polymers for the selective immobilization, molecular presentation and controlled release of various carbonyl compounds (e.g., pharmaceuticals, biomolecules)

Erik Sapper

Using math, statistics, models and machine learning to design new coatings and polymeric materials from the perspective of defeating failure, breakdown and degradation while optimizing performance and functionality

1. Organic coatings and polymeric materials
    a. Lifetime prediction of coatings in service environments
    b. Color and appearance of coatings
    c. Coatings for corrosive and extreme environments
    d. Coating failure modes and test method development
    e. Electrochemistry, sensors and *in situ* measurement
2. Computational design of materials
    a. Multiscale modeling of material performance
    b. Quantitative structure-activity relationships
    c. Materials informatics and chemometrics
    d. Bayesian networks and probabilistic graphical models
    e. Autonomous science and evolutionary algorithms

Gregory Scott

1. Characterization of nanomaterials via scanning probe microscopies (scanning tunneling microscopy and atomic force microscopy)
2. Identification of the relationships between morphological, electrical, and optical properties of nanomaterials
3. Development and assessment of immediate feedback tools for use in teaching and learning
4. Measurement of conceptual expertise in chemistry

Sandra Ward

The Ward research group is interested in using supramolecular chemistry to form amphiphilic host/guest inclusion complexes that will self-assemble into larger nanostructures such as vesicles for applications in drug delivery or liquid crystal phases for applications into biological and chemical sensors. Students interested in this research will gain experience in organic synthesis and study the properties of their synthesized compounds using techniques including differential scanning

calorimetry, thermal gravimeteric analysis, polarized optical microscopy, dynamic light scatting, UV-Vis, fluorescence, IR and NMR spectroscopy.

Katharine Watts

1. Connecting natural products to biosynthetic pathways in soil bacteria
    a. Cloning and analysis of natural product biosynthetic gene clusters
    b. Expression of biosynthetic gene clusters in heterologous hosts
    c. Isolation and structure elucidation of pathway intermediates and products
    d. Elucidation on enzyme function in biosynthetic pathways
2. Microbial diversity and biosynthetic potential in environmental samples
    a. Isolation of unique microbes from environmental samples
    b. PCR-screening of genomic DNA for biosynthetic genes
    c. Gene sequencing and analysis

Steven Wilkinson

1. Protein stabilization mediated by small molecule "osmolytes"
    a. Development of structure-and-activity based biochemical assays of protein stability
    b. Characterization of osmolyte-dependent protein stability for multiple protein models
    c. Investigation of stabilization mechanisms
2. Biochemical characterization of proteins potentially involved in antibiotic-resistance mechanisms in Clostridium difficile
    a. Cloning, overexpression and purification of putative gene regulatory proteins
    b. Characterization of DNA-and-ligand-binding properties
    c. Analysis of molecular mechanisms and gene regulatory functions

Shanju Zhang

1. Optoelectronic Macromolecules: synthesis, microstructure and optoelectronic properties of conjugated polymers with applications in photovoltaic cells, light-emitting diodes, transistors and biosensors.
2. Anisotropic Nanomaterials: synthesis, surface modification and self-assembly of 1D and 2D nanoparticles including nanowires, nanorods, nanotubes, and grapheme for various emerging applications.
3. Polymer Nanocomposites: preparation, processing, and properties of functional nanocomposites with applications in smart coatings and energy conversions.

David Zigler

1. Artificial photosynthesis using earth abundant transition elements
    a. Synthesis of new ligands and metal complex photosensitizers
    b. Computational modeling of redox and excited state properties
    c. Photophysics and photochemistry using optical spectroscopies
    d. Electrochemistry to study redox reactions of the new molecules
2. Interactions between quantum dots (nanoparticles) and biomolecules in the environment and body (In collaboration with Professor Jones)
    a. Synthesize semiconductor nanoparticles of various sizes
    b. Use optical spectroscopies (Raman, UV-Vis, Photoluminescence) to study the nanoparticle/biomolecule interface

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Matt Zoerb

Atmospheric chemistry with a focus on aerosol particle composition and formation

1. Organic aerosol: Sources and reactivity, gas-phase aerosol precursors
    a. Biological production, marine photosynthetic production
    b. Wildfires, combustion
    c. Anthropogenic, industrial sources
2. Ambient aerosol measurement, instrument/method development
    a. Chemical composition, size distributions
    b. Field and laboratory sampling and measurement
    c. Mass spectrometry, spectroscopy, particle sizing techniques