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Emerging Chemists Workshop – Project List

01- How to Study Proteins by Mutagenesis (Biochemistry)
We are studying the different roles of individual amino acids in a protein. After we find amino acids that we hypothesize are important, we mutate them and analyze whether the protein activity was affected. For this experiment, you will purify by electrophoresis the gene that produces our protein, and how we can find with computational methods candidates for mutagenesis.

02- Molecular Modeling of Oxygen Escape Pathways from Globins (Computational Chemistry)
We are studying the pathways by which oxygen can escape from a monomeric globin molecule. For this experiment you will use a molecular modeling program on our computer cluster and the results of molecular dynamics simulations to understand more about how the protein functions due to its motions.

03- The Synthesis and Characterization of Gold Nanoparticles (Nanoscience A)
We are studying how the electronic properties of gold nanoparticles can be changed via molecules adsorbed on their surface. For this experiment, you will synthesize gold nanoparticles that are coated with a tetraoctylammonium bromide capping agent and compare their electronic structure to particles with thiol based adsorbates via UV-vis absorbtion spectroscopy.

04- How to Decipher the Atomic Structure of a Protein (Biochemistry B)
We are studying lactonases, which are enzymes that regulate cell-to-cell communication signals in bacteria. To understand their function, we obtain a 3D map of the atomic structure using X-ray diffraction methods. For this experiment, you will briefly see the Gryphon crystalliation robot before converting X-ray data into a 3D map of atoms within the enzyme.

05- Scanning Electron Microscope Analysis of Nanocrystals (Nanoscience B)
We are studying how nanometer sized crystals diffuse through solution and grow off surfaces such that they can be used in advanced solar cells. For the experiment, you will utilize a scanning electron microscope to view the nanocrystals prepared under different growth conditions.

06- Confocal Expression Study of Embryonic Pattern Formation in Zebrafish (Biology)
We are studying the assignment of regional fates along the long axis of the vertebrate body using transgenic zebrafish. For this experiment, you will chart the dynamics of development using a confocal microscopy, which allows for visual reporting of data in real time in fish embryos.

07- Ultra-High Vacuum Temperature Program Desorption of Surfaces (Nanoscience C)
We are studying how the structure of various surfaces impacts their ability to catalyze reactions. To effectively study surfaces (where materials are present in minute amounts ~10^{13} atoms) it is necessary to study these systems under ultra-high vacuum (UHV), where less that a billion molecules of air are present. For this experiment, you will get samples from atmospheric conditions to UHV, and then analyze the surface composition by temperature programmed desorption.

08 – Electron Paramagnetic Resonance Determination of Proteins (Biochemistry C)
We are studying the function and mechanism of the metalloproteins nitrile hydratase, an enzyme used in bioremediation and polymer synthesis, and DapE, a target for potential antibiotics. Electron paramagnetic resonance (EPR) spectroscopy is used to examine the metal environment of this protein, which in turn determines activity. For this experiment, you will prepare and analyze EPR solutions to determine metal identity and environment.