

1 Feinberg, A. *et al.*, *Science* **317**, 1366-1370 (2007).

2 Tanaka, Y. *et al.*, *Lab on a chip* **7**, 207-212 (2007).

#### 2726-Pos Board B745

##### Environmental and Structural Influences on Self Assembling Peptide-Porphyrin Aggregates

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There is considerable interest in the development of second and third generation photovoltaics with higher efficiency and lower cost of production. Dye-sensitized solar cells (DSSCs) use organic species as the absorptive AND conductive species in the photovoltaic device, where molecules enter the excited state upon photon absorption and create a current based on the excited electrons. We have used a biomimetic approach to previously develop a self-assembling peptide-porphyrin aggregate system which maintains conductivity at pH values well above the peptide-free system. This system uses a scaffold peptide to bind and orient m-Tetrakis(4-sulfonatophenyl)porphine (TPPS) molecules into conductive "J-aggregates". In this work we characterized a number of second generation peptide designs with the goal of better understanding the chemical and structural relationships in formation of J-aggregated species. Early studies showed an inverse relationship between alpha helix formation in the scaffold peptide and J-aggregate formation. using circular dichroism and absorbance spectroscopy we have investigated this structural relationship and found that peptide secondary structure alone is insufficient to promote J-aggregate formation in solutions above pH 3.6. Additionally, spectroscopic investigations of the binding affinity of peptide for porphyrin as a function of ionic strength confirmed that the primary driving force in complex formation is electrostatic interactions between the anionic TPPS and the cationic peptide. using this knowledge we designed a 3rd generation peptide scaffold with intent on increasing overall aggregate size and stability.

#### 2727-Pos Board B746

##### Light Harvesting and Light Activatable Protein Maquettes Designed from Scratch

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Electron transport chain (ETC) modularity inspires framework for renewable energy harvesting. In order to design maquettes capable of light-harvesting and light activated electron transfer using natural and synthetic Zn porphyrins, chlorins and bacteriochlorins, we have explored cofactor structural requirements for binding to the maquettes. Binding of several synthetic Zn porphyrins with different substituents to the hydrophilic single chain maquettes were studied. Based on this binding data we have hypothesized an amphiphilic character of a tetrapyrrole as an essential requirement for efficient and fast binding (with in few seconds) at room temperature. Having a nonpolar side compatible with the hydrophobic interior of the maquette and a polar side compatible with polar amino acids and solvent on the outside of the maquette are the simple requirements which will allow for hydrophobic partitioning, hence facilitating the ligation of the metal to specifically tailored histidines to stabilize binding. using this approach we can have a control over orientation of the molecule in the maquette, which is an important requirement for efficient energy transfer or electron transfer in the maquettes. This simple amphiphilic model will enable us to design new synthetic tetrapyrrole cofactors that bind to maquettes, which will allow for engineering and assembly of maquettes capable of light-harvesting as well as photochemistry. We have also engineered a covalently expressible c-type cytochrome maquette and successfully replaced the central iron with Zn creating a light activatable covalently attached Zn porphyrin containing maquette. We also present preliminary studies showing that billins, which are involved in harvesting of yellow-red light of solar spectrum can be attached in-vitro to cysteines in designed protein maquettes.

#### 2728-Pos Board B747

##### Structure and Electronic Configurations of the Intermediates of Water Oxidation in a Highly Active and Robust Molecular Ruthenium Catalyst

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Photosynthesis is one of the most important chemical processes on our planet. Splitting water into O<sub>2</sub> and H<sub>2</sub> using sunlight is a clean and sustainable proposition for addressing energy and environmental problems encountered in our society. Mimicking this reaction in a manmade device will allow for

sunlight-to-energy conversion with water providing electrons and protons for production of chemical fuels. About 30 years ago Meyer and coworkers reported the first ruthenium-based catalyst for water oxidation, known as the "blue dimer". This catalyst may be considered as an artificial analog of the oxygen-evolving complex (OEC) in Photosystem II (PS II). Recently it has been demonstrated that single-site Ru and Ir catalysts are also active in water oxidation. These single-site catalysts are attractive model compounds for both experimental and theoretical studies of mechanism of water oxidation and show improved catalytic activity compared to "blue dimer". A better understanding of this mechanism and identification of the rate-limiting steps could pave the way to light-driven generation of molecular hydrogen by water splitting.

A mononuclear ruthenium complex [Ru(bda)(pic)<sub>2</sub>] (pic=4-picoline) was found to show high catalytic activity as well as high chemical stability. EPR, Raman and XAS characterization of the electronic structure and molecular geometry of Ru(III)-OH<sub>2</sub>, Ru(IV)=O and Ru(IV)-OO-Ru(IV) are reported in the single site water oxidizing complex. Formation of metal bound peroxides as the result of O-O coupling has been implicated in the mechanism of catalytic water oxidation by Photosystem II oxygen evolving complex (OEC) and in Ru-based catalysts. However, such intermediates were never isolated and their structural and electronic characterization has not been reported. We believe that the intermediates described here are direct products of the O-O bond formation step in the studied catalyst.

## Biophysics Education

#### 2729-Pos Board B748

##### What can we Learn from Teaching Physics at San Quentin State Prison?

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In the United States, more than half of formerly incarcerated people return to prison within three years of release. Typically, only 2 percent of state prisoners are college graduates. Several statewide studies exploring the issue have concluded that postsecondary correctional education is one of the most effective avenues for reform. Besides improving critical reasoning skills, education improves chances for employment after release from prison. The data are hopeful - the rates of recidivism are nearly 50% lower for prisoners earning an associate's degree than for ex-offenders who did not participate in college-level educational programs. The Prison University Project at San Quentin State Prison is an outreach organization whose all-volunteer instructors enable prisoners to enroll in college-level courses, culminating in an Associate's degree. Unfortunately, however, California's statewide requirements for an Associate's degree do not include a lab-based science course that is mandatory for transfer into a four-year state college in California. We have designed an algebra-level, physics course that is intended to bridge this requirement for prisoners so that they may qualify for direct transfer to a Bachelor's program upon release. Our goal was to develop a physics course that could be taught in a prison setting while also meeting the standards of a college-level course. We also constrained ourselves to a total budget of \$100, including textbooks. We administered the course over Summer 2012 semester, successfully implementing 11 comprehensive laboratory exercises exploring topics ranging from mechanics and energy to simple harmonic motion. Here, we present the details of the course design and discuss the unique challenges and opportunities of teaching physics at San Quentin. We believe this course serves as a useful model for teaching science in underfunded schools, both in the United States and in developing countries.

#### 2730-Pos Board B749

##### Engaging Community College Students in Biophysics Research

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It is commonly agreed that the future competitiveness of the US economy will depend on its ability to attract talent and foster innovation in STEM (Science, Technology, Engineering and Mathematics) disciplines. At the same time it is also becoming clear that this need can only be met by attracting, educating, and retaining a larger and more diverse cohort of STEM students. In this regard, Community Colleges (CC), serving a disproportionate number of underrepresented minority, female and nontraditional students, represent a pool of potential talent that, due to a misguided perception of its students as being less capable, often remains untapped. Here, we discuss our strategies to attract and support the academic advancement of CC students in the STEM fields