Lunes 28 de febrero 2022. 9:00-10:00 am (Hora CDMX)

Dra. Alanah Fitch
Department of Chemistry and Biochemistry, Loyola University Chicago

Título de la plática: **Cómo "engancharse" en la enseñanza de la electroquímica**

Resumen de la charla:

Many introductions to electrochemistry and electrochemical engineering take a mathematically rigorous approach to the description of electrochemical phenomena. For many people, a more accessible approach starts with a conceptual and graphical depiction. Accessibility is further enhanced when concepts are tied to known examples of electrochemical systems.

The approach introduces a series of modules, each beginning with a real world example system, a *hook*, with which the reader has experience. Underlying the *hook* are foundational ideas. Foundational ideas are the anchoring concepts that are explored in detail. At the end of each module, the *hook* is reexamined in light of the expanded foundational ideas. (See figure illustrating the concept.)

Hooks are examples of specific energy technologies, corrosion processes, electroanalytical methods, catalysts, coatings, materials, etc. Anchoring concepts tie to mass transport, electron transfer, homogeneous reactions, kinetics, double layers, among other principles. Anchoring concepts are often buttressed on the mathematically complex, but in this approach, the physical picture and graphical representations provide core appreciation of the fundamental ideas underlying all electrochemical phenomena.

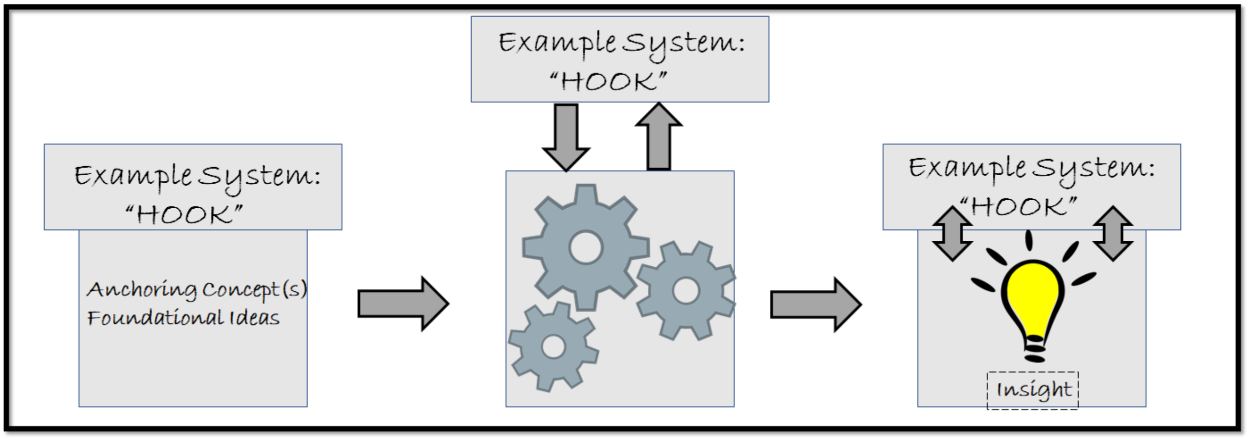
In one of the modules, electron transfer of transition metal complexes is an anchoring phenomenon of glucose biosensors. The theoretical perspective on rates of electron transfer buttresses understanding of how glucose biosensors function.

An example of a module of a materials system of the conducting polymer PEDOT (poly(3,4-ethylenedioxythiophene) deconstructs into initial concepts of energy gaps between the highest occupied molecular orbital (HOMO) and lowest unoccupied molecular orbital (LUMO). These gaps are related to reduction/oxidation potentials. This module ends with a larger view of the electrochemical properties of PEDOT polymers, infused with concepts of previously introduced rates of electron transfer.

The anchoring phenomenon of the double layer is at the heart of electrochemical double layer capacitor (EDLC) technologies. In this module, an understanding of the double layer transitions to understanding of ion transport in solution, where solvents and electrolytes are critical. These key components are reconstructed to understand the operation of EDLCs.

These and other content modules capture the complexity of electrochemistry. The learner's deeper understanding of foundational ideas will enlighten perspectives on other electrochemical

systems.



Underlying an example system "hook" (the lid) is a box of anchoring concepts (foundational ideas). Lift the lid and the gears of fundamental ideas engage. Return the lid to the box and view the hook in light of the newly acquired foundational understanding. Many small boxes added to a large box build a broad perspective on electrochemistry.

Semblanza Académica

- B.A., 1975, Antioch College
- M.S., 1977, University of Arizona
- Ph.D. 1981, University of Illinois, Champaign-Urbana
- Postdoctoral, 1981-1984, University of Wisconsin, Madison
- Postdoctoral, 1984-1985, Northwestern University

- Research interests:
- We have recently completed a spectroelectrochemical study of cross-linked hemoglobins in which we have measured the oxidation/reduction kinetics of a variety of cross-linked hemoglobins. We have ascertained that the driving force for autooxidation of hemoglobin is not the electron transfer of the irons in the heme. This has substantial implications for the development of stable blood substitutes. The second step in this project will be to develop clay-protein matrices for spectroelectrochemical sensing. The rationale behind this idea is that the clay matrix will prevent denaturation of the proteins enhancing the stability and functionality of the proteins.
- In the area of clay chemistry we are interested in what controls the movement of a molecule moves in nano-sized negatively charged channels. The channels are constructed from stable swollen clay films. The overall charge (positive, neutral, negative) on the probe molecule, the effect of negative peripheral charge on a cationic probe in "docking" at the clay surface, and the hydrophobicity of the

molecule are tailored to result in changes in the transport properties. By understanding the molecular controls on diffusion we can rationally tailor the clay to either enhance or retard this diffusion. This molecular tinkering will allow control the diffusion of a pollutant under a waste site (environmental research) and in the construction of electroactive composites (nanobatteries). We use molecular modeling, X-ray diffraction, UV-Vis fiber optics, and, our staple, electrochemistry to monitor the transport of the probes in thin (5 micron thick) clay films.

- A third major focus of research is lead, the 2nd most toxic species on the national toxic registry. In this area we have three inter-related projects. One involves fingerprinting the source of lead by the use of lead isotope surveys. We have recently completed a study utilizing lead to track the immigration of European Americans to Southern Illinois in between 1810-1860. A second project involves the successful creation of a lead Cinderella´s slipper. The reagent designed is 300 times more selective to lead than to any other metal, making it the most selective lead reagent developed to date. The second phase of this project will entail using the reagent to create lead sensors. The third lead related project involves community driven environmental lead research. We have developed an instrumental curriculum around community derived soil and dust samples for lead.