UNIVERSITY OF SOUTH CAROLINA
College of Engineering and Computing

Chemical Engineering Enhanced Learning Experience

September 12, 2011

Dear High School Teachers,

The College of Engineering and Computing at the University of South Carolina is hosting a one day Enhanced Learning Experience for all high school students interested in learning more about engineering and computing. This unique experience will provide students a hands-on learning experience on a real college campus with real college students and actual college professors.

The day will focus on Chemical Engineering; please see below for a detailed list of activities. The program will begin at 10 am with a brief introduction and welcome to the College and then the students will begin their experience with the department of Chemical Engineering. Sessions will run for 1.5 hours (10:00am-11:30am and 12:30pm-2pm) with a lunch break from 11:40am-12:20pm. Dates for the learning experiences will vary and will be determined after the application date on a school by school basis.

The College of Engineering and Computing is offering reimbursement for expenses associated with the trip, including the costs for a South Carolina bus (charter buses will not be reimbursed), the bus driver, bus mileage reimbursement and substitute teachers. Lunch will also be provided at no cost to the school or students. Each session will be limited a maximum of 30 students.

The enhanced learning experiences will begin in October and will continue through November. Only a limited number of schools will be selected. Enhanced Learning Experience days will vary and will be determined after all schools have been selected on a school by school basis. If you are interested in bringing a group to USC please fill out and return the below application by **5pm on September 30, 2011** to: University of South Carolina, College of Engineering and Computing, Attn: Stefanie Pirwitz, Columbia, SC 29208. Applications may also be e-mailed, pirwitz@cec.sc.edu, or faxed, (803) 777-3818.

I look forward to hearing from you. If you have questions or concerns please contact me at pirwitz@cec.sc.edu or (803) 777-2706.

Sincerely,

Stefanie Pirwitz
Outreach Coordinator
College of Engineering and Computing

UNIVERSITY OF SOUTH CAROLINA
College of Engineering and Computing

Chemical Engineering Enhanced Learning Experience Application

The College of Engineering and Computing is accepting proposal submissions for high school students to participate in the Chemical Engineering Enhanced Learning Experience (ELE) at the University of South Carolina. This one day experience is designed to work in conjunction with the South Carolina educational standards to provide students with hands experiences in Chemical Engineering.

Please complete the following application. Applications must be received no later than 5pm on **September 30, 2011**. Applications will not be accepted after the deadline. Please email completed application as an attachment to pirwitz@cec.sc.edu. Applications may also be faxed to (803) 777-3818) or mailed to: University of South Carolina, College of Engineering and Computing, Attn: Stefanie Pirwitz, Columbia, SC 29208.

General Information

School Name: _____

School Address: _____
Street *City* *Zip code*

Contact Name: _____ E-mail Address: _____

Phone Number: _____ Fax Number: _____

Class Type: _____ AP ___ Honors ___ Adv. ___ Other _____
(physics, chemistry, calculus, computing, etc.)

Purpose

Please type your answers to the following questions in a Word document and attach upon submission.

1. What impact will the Enhanced Learning Experience have on your students?
2. What educational standards can be applied to the Enhanced Learning Experience?
3. What do you hope your students will learn from the Enhanced Learning Experience at USC?
4. How many students do you hope to bring to USC? From what grades?
5. How much money will be needed for the Enhanced Learning Experience?

Signature: _____ Date: _____

Department of Chemical Engineering
COLLEGE OF ENGINEERING AND COMPUTING
UNIVERSITY OF SOUTH CAROLINA

Chemical Engineering Enhanced Learning Experience Activities

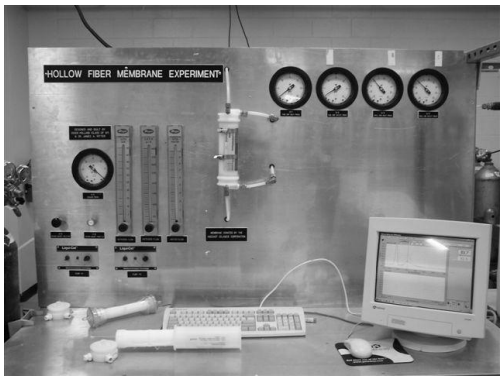
I. Fuel Cell Testing

Fuel cells are being developed to make electricity from hydrogen. The applications range from cell phones and flashlights to tomorrow's electric cars. In this activity students will operate an actual fuel cell to learn how engineers in the research lab improve fuel cells for the production of power. The fuel cell test station consists of a 10 cm^2 proton exchange membrane fuel cell, humidity bottles, flow controllers and electronic load all controlled by a LabVIEW data acquisition program. At the fuel cell test station the students will measure the operating current as a function of the voltage at constant hydrogen and oxygen flow rates, cell operating pressure and cathode oxygen concentration. Students will then plot the polarization curves (voltage vs. current density) for each of the tests performed and discuss the trends observed.

Fuel Cell Test Station

II. Hollow Fiber Membrane Contactor: Gas and Vacuum Stripping of Oxygen From Water

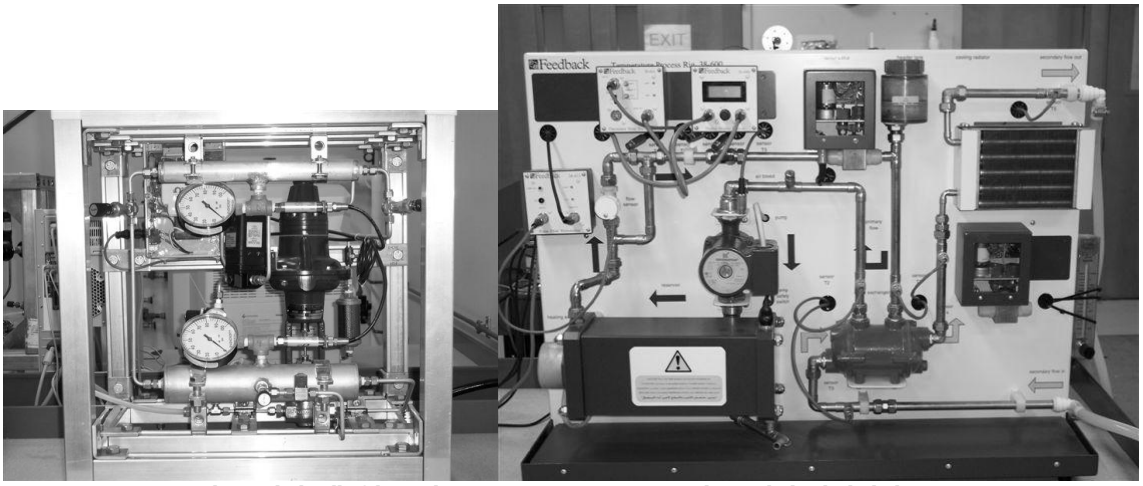
Most people would not think that there are similarities between artificial kidneys and water purification systems, but the same general principles of chemical engineering apply. A high efficiency hollow fiber membrane can be used as an artificial kidney or as a means to make oxygen-free water for electronics manufacturing. With this membrane contactor, thousands of tiny porous tubes act as an inert support to facilitate diffusion between liquid and gas. The students will study the performance of this membrane contactor under various flow conditions. As the data are being generated, the students will plot the fraction of oxygen removed as a function of the liquid flow rate for each of the flow conditions and discuss the relative performance of each.



Hollow Fiber Membrane Module

III. Pressure and Temperature Control Using Computer-Based Systems

Chemical engineers use computers and advanced mathematical analysis to safely control and operate chemical processes. In this experiment, student will control the air pressure in a two-tank system. The two tank air pressure control system consists of a process control valve, two aluminum tanks and supporting gauges and instrumentation. The entire process is controlled by a LabVIEW data acquisition and control system. The students will be able to learn the methodology of tuning process control equipment by first performing an open loop experiment. In this experiment, the process control valve is placed in manual and the valve position is changed, in a step fashion, and the resultant tank pressure recorded. After this data are recorded, the students can fit differential equation models to obtain the system gain, time constant and any time delay measures. These parameters can be further entered into the closed loop programs and the students can explore the effects of Proportional (P), Proportional-Integral (PI) and Proportional-Integral-Differential (PID) type controllers.



Pressure Control Module (left) and Temperature Control Module (Right)

The temperature training module is a two loop system, using water as the process fluid which allows the study of the principles of process control using primary and secondary circuit temperature the process variable to be controlled. The student can perform step changes in the heater output and using basic calculus obtain gain and time constants which can be further used for inputting into a feedback process controller. The students can then explore other methods of obtain tuning parameters and watch these methods “real-time” on the computer monitor.