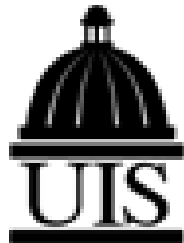


The Third Annual
Science Research Symposium
University of Illinois at Springfield
Health and Sciences Building



25 April 2003

8:30-9:30 Information Table & Refreshments (*Health & Sciences Building [HSB] Lobby*)

MORNING ORAL PAPER SESSION (9:00-10:30)

Biological Sciences

Moderator: Jessica Bonnett

Brookens Auditorium

9:00-9:10: Opening Remarks

9:10-9:30: The Antimicrobial Properties of *Baptisia leucophaea* Leaf Extracts. *Christine Waller,¹ M. Lucia Vazquez,¹ David G. Jenkins,¹ and Gary L. Trammell². Departments of Biology¹ and Chemistry,² University of Illinois at Springfield, Springfield, IL 62703

9:30-9:50: Nitrate and Ammonium and Their Conversion in Sediments of the Illinois River Floodplain. *Joseph L. Bartletti, Michael J. Lemke, and David G. Jenkins. Biology Department, University of Illinois at Springfield, Springfield, IL, 62703.

9:50-10:10: Temporal Changes in Total and Culturable Bacteria in the Illinois River and Three Floodplain Lakes. *Tim E. Goode and Michael J. Lemke. Biology Department, University of Illinois at Springfield, Springfield, Illinois 62703

10:10-10:30: Lipase Your Fat Away: Take 2. *Katie A. DeClerck. Taylorville High School, Taylorville, IL.

10:30-10:45 Coffee Break *HSB 2nd Floor Lobby*

*Note: _____ = presenter; * = student*

POSTER SESSION (10:45-12:00N) *Note: ____ = presenter; * = student*
Posters presented by authors at this time (*posters on display all day*)
2nd Floor Hallway, Health and Sciences Building

BIOLOGICAL SCIENCES

[1] Digital Imaging of Microorganisms Using Fluorescence and Light Microscopy Techniques. *Mandy Cook and Michael Lemke. Biology Department, University of Illinois at Springfield, Springfield, IL 62703

[2] Allozyme variation among and within *Daphnia obtusa* populations of an ephemeral pond complex. *Douglas J. Oppedal and David Jenkins, Department of Biology, University of Illinois at Springfield, Springfield, IL 62703-5407

[3] The Long-Term Effects of Ototoxic Agents at Multiple Dose Levels on Cochlear Morphology and Function. *Christy Y. Johnston, Carol Bauer and Thomas Brozoski. Division of Otolaryngology, Department of Surgery, Southern Illinois University School of Medicine, Springfield, Illinois 62701

CHEMISTRY

[4] Using FT-NMR in Organic Reactions. *Tammy Gunter and Gary Trammell. Chemistry Program, University of Illinois at Springfield, Springfield, Illinois 62703.

[5] Preparation of Activated Carbon from Milo Seed. *Amanda S. Frank, and Harshavardhan D. Bapat, Chemistry Department, University of Illinois at Springfield, Springfield, IL 62703

EDUCATIONAL TECHNOLOGY

[6] Library and Instructional Technology Resources for Science Research At UIS. Roger West, Patrick Cheak, and Denise Green. Brookens Library and Educational Technology, University of Illinois at Springfield, Springfield, Illinois 62703 .

12N - 1:00 p.m. Lunch - *On your own; for our guests, we suggest dining at the UIS Food Court, Lower Level, Public Affairs Center [PAC]*.

AFTERNOON ORAL PAPER SESSION (1:00-3:00 p.m.)

Chemistry, Computer & Physical Sciences

Moderator: Nicole Cosenza

Brookens Auditorium

1:00-1:20 Online Delivery Methodology: A "Quick-and-Dirty" Evaluation. Mary Sheila Tracy. Computer Science Program, University of Illinois at Springfield, Springfield, IL 62703

1:20-1:40 Effects of Acids on Uranium Glazed Fiestaware. *Robert Bregant II¹ and Keenan Dungey². ¹Glenwood High School, Chatham, IL, and ²Chemistry Program, University of Illinois at Springfield, Springfield, IL 62703

1:40-2:00 Organic Hybrids of the Layered Double Hydroxide, α -Cobalt Hydroxide. *Scott Ehrhardt and Keenan Dungey. Chemistry Program, University of Illinois at Springfield, Springfield, IL 62703

- 2:00-2:20 Software Safety in Safety Critical Systems. *Ravikanth Krovvidy. Department of Computer Science, University of Illinois at Springfield, Springfield, IL.
- 2:20 - 2:40 Chaotic Communication. Hei-Chi Chan. Mathematical Sciences Program, University of Illinois at Springfield, Springfield, IL 62703
- 2:40-3:00 The Scaled Sturm Computation. Jingyu Zhang. Department of Computer Science, University of Illinois at Springfield, Springfield, IL 62703

Note: _____ = presenter; * = student

LIBRARY AND INSTRUCTIONAL TECHNOLOGY RESOURCES FOR SCIENCE RESEARCH AT UIS. West, Roger, Patrick Cheak, and Denise Green. Brookens Library and Educational Technology, University of Illinois at Springfield, Springfield, Illinois 62703

Without proper instructional technology and library resources, modern scientific research is impossible. At UIS several software programs, bibliographic databases, full text journal aggregators and numerous presentation equipment options are available to assist scholars and students. Examples displayed will include:

* Atlas.ti: A Comprehensive Virtual Data Analysis Environment Atlas.ti is a software application written by Thomas Muhr (Scientific Software Development, Berlin, Germany) that provides a virtual environment in which a researcher can easily organize all raw textual, graphical and audio data relevant to a particular project into a single project file.

* EndNote: Bibliographic Data Management Tool This tool searches remote databases and library catalogues on the Internet, imports references into and organizes personal libraries of citations. Endnote also produces papers written on word processors with correctly formatted in-text citations and bibliographies.

* Science Direct database: index and full text to Elsevier journals

* Web of Science citation indexes: find out "who is quoting who?" in research literature Journals@Ovid: large index and full text database for biological and medical literature PsycArticles: full text of APA published scholarly psychology journals.

ONLINE DELIVERY METHODOLOGY: A "QUICK-AND-DIRTY" EVALUATION.

Tracy, Mary Sheila. Computer Science Program, University of Illinois at Springfield, Springfield, Illinois 62703

A simple assessment of the delivery methodology for online classes versus "face-to-face" classes was performed using pre- and post-lecture tests in conjunction with simultaneous lectures for two cohorts of students. The results support the hypothesis that online delivery of material is as effective as classroom lectures. Students from two Computer Science classes, one an introductory course and the other a senior-level course, were the field-test participants. Approximately half of the students from each class remained in the classroom for presentation of a lecture with Microsoft PowerPoint slides by the course instructor. The rest of the students were sent to the main public computer laboratory (HSB 108) to view the same set of slides, with narration provided by an accompanying audio stream. The lecture was discussion of the usability engineering principles dealing with good screen design. Most of the students were unfamiliar with the topic, yet the material was comprehensible by both the novice students, as well as the advanced ones. Data derived from the test scores demonstrate that the mean of the learning curve for the novices was 0.334 and for the advanced students, 0.178. These mean values indicate that the delivery method played no significant role in students' ability to grasp the material presented.

THE ANTIMICROBIAL PROPERTIES OF BAPTISIA LEUCOPHAEA LEAF EXTRACTS.

Waller, Christine,1 M. Lucia Vazquez,1 David G. Jenkins,1 and Gary L. Trammell2 Departments of Biology1 and Chemistry,2 University of Illinois at Springfield, Springfield, IL 62703

The antimicrobial activities of three crude extracts of the Baptisia leucophaea leaves were investigated using the disc diffusion method against four bacteria (two gram-positive and two gram-negative). All three extracts (chloroform:methanol, methanol, and ethanol) showed antimicrobial activity against four tested bacteria, Staphylococcus epidermidis, Micrococcus luteus, Pseudomonas fluorescens, and Escherichia coli. Bacterial zones of inhibition showed ranges from 8-22 mm in diameter. Chemical

properties inhibiting microbial growth were evaluated by utilizing nuclear magnetic resonance, high-performance liquid chromatography, thin-layer chromatography, and ultraviolet spectrometry.

NITRATE AND AMMONIUM AND THEIR CONVERSION IN SEDIMENTS OF THE ILLINOIS RIVER FLOODPLAIN.

Bartletti, Joseph L., Michael J. Lemke, and David G. Jenkins. Biology Department, University of Illinois at Springfield, Springfield, IL, 62703.

Throughout the last century, anthropogenic disturbances have drastically altered and degraded the Illinois River and its associated floodplains. Changes in land use within the floodplain have significantly reduced river-floodplain interaction, eliminating important ecological functions along the aquatic terrestrial transition zone (ATTZ). This study compared spatial and seasonal nitrogen dynamics within sediments along the ATTZ from sites that were connected to the Illinois River and sites that were not connected. Sediment samples ($n = 3$) were collected at 60 d intervals from 13 habitats beginning at the recession of the flood-pulse, June 2002. Nitrate, nitrite and ammonium were extracted from sediments and measured as well as the rates of the microbial-mediated processes of nitrification and denitrification. Sediment samples from the ATTZ ranged from 55 % saturation within the permanently inundated sites to 7 % saturation within completely dry sites. Nitrate concentrations ($\mu\text{g/g dm}^{-1}$) within permanently inundated connected sites increased significantly ($p < 0.05$) from 109.76 \pm 7.31 to 328.28 \pm 34.48 in summer followed by a decrease to 174.68 \pm 32.24 during late fall. Sediment ammonium concentrations varied greatly along the ATTZ, with permanently inundated sites maintaining the highest concentrations throughout the year and dry sites maintaining the lowest concentrations. Nitrification rates varied seasonally; dry sites demonstrated low rates throughout the year while sites along the ATTZ showed higher rates during all sampling periods. These results indicate that sedimentary nitrogen processing is significantly greater along the ATTZ of sites connected to the Illinois River than sites which are not connected.

EFFECTS OF ACIDS ON URANIUM GLAZED FIESTAWARE.

Bregant II, Robert¹ and Keenan Dungey.² ¹Glenwood High School, Chatham, IL, and ²Chemistry Program, University of Illinois at Springfield, Springfield, IL

The purpose of this experiment was to determine the effects of various acids, commonly found in foods, on Fiestaware with regards to the leaching of uranium at potentially hazardous levels. Varying concentrations of H₃PO₄ (phosphoric acid), CH₃COOH (acetic acid) and H₃C₆H₅O₇ (citric acid) were created. Twenty milliliters of each solution at approximately the strength of that found in food was placed on a Fiestaware plate. After 24 hours, the acid was poured off, visual plate color changes were noted, and the radiation was measured with a Vernier radiation probe. These results were compared with a background radiation test done immediately prior to each acid test. The experiment was repeated at a 10 times acid concentration, and radiation results tabulated. The plate exhibited slight visible discoloration with each additional acid test, suggesting that the pigment, uranium(VI) oxide, was being removed. The radiation results, however, showed that the radiation levels of the acid solutions were not significantly higher than the radiation level of the general background. The minor variations in acid and background radiation counts could be mainly attributed to the random variation of atomic fission events. Results indicated that the acids did not measurably leach radiation from the plate and therefore Fiestaware does not appear to be a health hazard with regard to its radioactivity.

SOFTWARE SAFETY IN SAFETY CRITICAL SYSTEMS.

Krovvidy, Ravikanth. Department of Computer Science, University of Illinois at Springfield, Springfield, Illinois 62703.

Software is used increasingly in safety-critical devices such as cardiac pacemakers, traffic control systems, and interactive virtual environments for industrial control. With further technological advances in software and reduction in hardware costs, even more safety-critical applications can be expected. Software safety issues are critical when a computer malfunction can cause death or some other disaster. Software safety techniques assess the likelihood of "catastrophic" events due to software malfunctions in real-time, safety-critical processes. A catastrophic event is an event that may result in loss of life or property because software has entered a state that safety engineers have identified as "unacceptable." For example, software controlling a commercial airline should not cause the airplane to go into a quick barrel roll maneuver. This paper will introduce the reader to the area of software safety, and illustrates the

use of software safety techniques to identify and avoid potentially catastrophic states through an example. REFERENCES: [1] Leveson, N.G. "Software Safety: Why, What and How," ACM Computing Surveys, Vol. 18, No. 2, June 1986, pp. 125-163; [2] Lutz, Robyn R. "Software Engineering for Safety: A Roadmap," ACM Computing Surveys, 2000, pp. 215-224; [3] Leveson, N.G. "Evaluation of Software Safety," IEEE, 1990, pp.223-224; [4] Friedman, Michael A., and Jeffrey M. Voas. "Software Assessment: Reliability, Safety, Testability," John Wiley & Sons, Inc., 1995.

ALLOZYME VARIATION AMONG AND WITHIN DAPHNIA OBTUSA POPULATIONS OF AN EPHEMERAL POND COMPLEX.

Oppedal, Douglas J. and David G. Jenkins. Department of Biology, University of Illinois at Springfield, Springfield, IL 62703-5407

We are studying allozymic variation of *Daphnia obtusa* (Crustacea: Branchiopoda) as an indicator of gene flow of a well-studied ephemeral pond system in central Illinois. The ponds differ in levels of connectivity during times of high water. *Daphnia obtusa* inhabit all the ponds and are zooplankters that filter-feed on algae, etc. *Daphnia* are cyclic parthenogens, and reproduce asexually with occasional sexual recombination, and are very small and easy to study. The parthenogenetic life cycle generates large clonal populations that are represented well by a few individuals to estimate gene transfer between ponds or within ponds. We are analyzing 6 enzymes in 36 animals per each of 8 populations: aldehyde oxidase (AO), amino aspartate transferase (AAT), Glucose-6-phosphate dehydrogenase (GPD), glucose phosphate isomerase (GPI), phosphoglucose mutase (PGM), and mannose phosphate isomerase (MPI). These enzymes are part of glycolysis and the Krebs cycle, so protocols are readily available. The enzymes may be functionally the same but structurally different allowing for detection via electrophoresis. The differences between populations are scored for alleles and the percent of heterozygotes vs. homozygotes. The frequency and number of polymorphisms (differences between enzymes detected via electrophoresis) are also assessed, and used to estimate gene flow.

LIPASE YOUR FAT AWAY: TAKE 2.

DeClerck, Katie A. Taylorville High School, Taylorville, IL.

The purpose of this project, "Lipase Your Fat Away: Take 2" was to determine, through running a comparison assay, which butter-like solid spread product is more easily digested by the human body. The more the product oxidized, the more lipase activity it had, and the easier it is for the consumer's body to digest. The following products were tested: Prairie Farms butter, Brummel and Brown spread, Great Value shortening, and Blue Bonnet margarine. Sodium phosphate buffer (mono and dibasic forms) were added to lipase powder. This simulated the natural conditions of a human's small intestine where lipid digestion occurs. A lipase mixture was added to all experimental butter-like solid lipase products. Controls were set up with the butter-like sood product mixtures without the lipase enzyme. The mixtures were incubated in a vortex mixer at 35oC for 90 min. This enabled the mixtures to emulsify and increase the amount of digestion lipase would have on the mixtures. After 90 min, an extraction solvent was added to each of the flasks to stop all lipase activity. Phenolphthalein was added to each of the flasks and 1M NaOH was titrated into each flask until the mixtures reached their endpoint. The results show that butter had the most lipase activity followed by the margarine, the spread and the shortening.

ORGANIC HYBRIDS OF THE LAYERED DOUBLE HYDROXIDE, -COBALT HYDROXIDE.

Ehrhardt, Scott and Keenan Dungey. Chemistry Program, University of Illinois at Springfield, Springfield, IL 62703

A layered double hydroxide is a material that is able to intercalate neutral guest molecules or to exchange inorganic and organic anions for interlayer ions.¹ The goal of our work is to adjust the interlayer separation to increase the ability for specific anions to move into and out of the interlayer space. We have adapted two synthetic procedures from the literature,^{2, 3} both of which use a coprecipitation method. Previously, we were able to precipitate -cobalt hydroxide with a sodium butylsulfonate in the interlayer spacing. Our success with the sodium butylsulfonate prompted the use of longer alkyl chains, like those in sodium dodecylsulfate and sodium hexadecylsulfonate. In order for us to characterize the structure of the materials, we used X-ray diffraction. The use of FTIR gave the approximate orientation and identity of the interlayer ions. We also used thermal treatment of the cobalt hydroxide to characterize the stability of the materials. This is helpful in determining the long-term potential for battery electrode applications. REFERENCES: 1) Newman, S. P. and Jones, W.: "Synthesis, Characterization and

Applications of Layered Double Hydroxides Containing Organic Guests," New Journal of Chemistry 1998, 105-115; 2) Kurmoo, M.: "Hard magnets based on layered cobalt hydroxide: The importance of dipolar interaction for long-range magnetic ordering," Chemistry of Materials 1999, 11, 3370-3378' 3) Rajamathi, M.; Kamath, P. V.; Sehadri, R.: "Chemical Synthesis of alpha-Cobalt Hydroxide," Materials Research Bulletin 2000, 35, 271-278.

PREPARATION OF ACTIVATED CARBON FROM MILO SEED.

Frank, Amanda S. and Harshavardhan D. Bapat, Chemistry Department, University of Illinois at Springfield, Springfield, IL 62703

Each year millions of tons of hazardous wastes are generated in the United States. Using our resources to manage these wastes is an effective way of addressing this important issue. The high degree of porosity and surface area make activated carbon useful in absorbing organic chemicals in several processes such as filtration, purification, deodorization, decolorization, and separation. Activated carbon is characterized by numerous pores (ranging from macro to micro in size) resulting from a pseudo-graphitic arrangement of carbon atoms. This porosity is a result of the elimination of non-carbon impurities and the oxidation of the surface carbon atoms. Milo (*Sorghum vulgare*) seed was chosen as the carbonaceous raw material for a number of reasons, such as: its ability to withstand rigorous thermal and chemical activation processes, the presence of low inorganics, and it is inexpensive and easily available. Physical and chemical activation was explored to induce porosity in milo. The physical process involved pyrolyzing the raw material followed by subsequent gasifications. The chemical process involved treating the raw material with sodium hydroxide, followed by pyrolysis and gasification. The activated carbon was then analyzed using a scanning electron microscope. The preliminary results show a wide distribution of pores, indicating extensive surface area. Possible applications of the activated carbon include treatment of hazardous wastes, storage of different adsorbents, and as a stationary phase.

TEMPORAL CHANGES IN TOTAL AND CULTURABLE BACTERIA IN THE ILLINOIS RIVER AND THREE FLOODPLAIN LAKES

Goode, Tim E. and Michael J. Lemke. Biology Department, University of Illinois at Springfield, Springfield, Illinois 62703-5407

Floodplain restoration and connectivity to the river may be a factor affecting bacterial numbers. The purpose of this study was to describe temporal changes in the microbial abundances of three floodplain lakes and the Illinois River from March 2002 to present. Sampling of surface waters was done bi-weekly at Big Lake, which is connected to the river, Edlin Lake, which is connected frequently throughout the year, and Spunky Bottoms Nature Preserve, which is not connected to the river. Total and culturable bacteria were monitored throughout the year by using fluorochromic stains and spread plate culturing techniques, respectively. Edlin Lake had consistently higher total bacteria. The Illinois River had significantly higher colony forming units (CFU/ml) than Spunky Bottoms and Big Lake ($p = 0.03$ and $p = 0.01$, respectively). Significantly higher total bacteria were present in summer at all sites ($p < 0.01$). Culturable bacteria were lowest during winter at Edlin and Big Lakes (avg. 4,600 and 2,600 CFU ml⁻¹, respectively). The restored, unconnected, shallow lake Spunky Bottoms, consistently had fewer bacteria than other sites; shallow lakes that were connected to the Illinois River had higher numbers of bacteria.

USING FT-NMR IN ORGANIC REACTIONS.

Gunter, Tammy and Gary Trammell. Chemistry Program, University of Illinois at Springfield, Springfield, Illinois 62703-5407

The Cannizzaro reaction involves the disproportionation of two aldehydes to a primary alcohol and a carboxylic acid. Standard reaction conditions involved a strong base in an organic solvent such as ethanol. Isolation of each of the products involves a series of solvent extractions. We have found that the reaction can be carried out very efficiently without using solid KOH. Isolation of the products is simplified and the use of organic solvents considerably reduced. Ephedrine has been banned by the NCAA, the NFL, the Olympic organization and many other American sports leagues because of its effects on persons' hearts. In every gas station there usually is a counter area full of ephedrine or ephedra supplements to help lose weight or to gain energy. One of these supplements is Yellow Jackets. We describe and characterize a procedure suitable for an undergraduate organic chemistry experiment where caffeine and ephedrine from Yellow Jackets can be extracted by using a combination of solvents.

THE LONG-TERM EFFECTS OF OTOTOXIC AGENTS AT MULTIPLE DOSE LEVELS ON COCHLEAR MORPHOLOGY AND FUNCTION.

Johnston, Christy Yvonne, Carol Bauer and Thomas Brozoski. Division of Otolaryngology, Department of Surgery, Southern Illinois University School of Medicine, Springfield, Illinois 62701.

The objective of this experiment was to investigate the long-term effect of cisplatin and carboplatin, on cochlear morphology and physiology. Cisplatin has been reported to be a selective cochlear outer hair cell toxin, while carboplatin has been reported to be a selective cochlear inner hair cell toxin. However existing studies have used various dose routes, e.g., systemic or cochlear, and have not systematically examined the long-term consequences of treatment. In the present study both toxins were applied directly to the round window of the cochlea. The drugs were applied using different doses and exposure durations. The effects of the drugs on the morphology and function of the cochlea were compared using two treatment groups: (1) round window application (RWA) of cisplatin, (2) RWA of carboplatin. Cochlear function was assessed before treatment and a minimum of 2 wks after treatment, using acoustic brainstem evoked response (ABR) recordings. Subjects were sacrificed and their cochleas were processed for quantitative histology using the method of Bohne (2001). Cytocochleograms were constructed and correlated with the pattern and degree of hearing loss as determined by the ABR. The results were interpreted in the context of tinnitus, with the objective of understanding the import of inner hair cell and outer hair cell damage for tinnitus generation.

CHAOTIC COMMUNICATION.

Chan, Hei-Chi. Mathematical Sciences Program, University of Illinois at Springfield, Springfield, Illinois 62703

In this talk, I will discuss how chaotic-dynamics can be used to enhance the effectiveness of signal transmission. The key is that complex and random behaviors (chaotic-dynamics) become tractable when observed from a statistical point of view. I will also discuss some recent mathematical results involved in this area.

DIGITAL IMAGING OF MICROORGANISMS USING FLUORESCENCE AND LIGHT MICROSCOPY TECHNIQUES.

Cook, Mandy and Michael Lemke. Biology Department, University of Illinois at Springfield, Springfield, IL 62703.

By combining traditional and newly developed techniques in compound microscopy, a whole, fascinating, unseen world can be revealed to the researcher. With the use of fluorescence and light microscopy techniques, along with digital imaging, we are able to rapidly quantify microbes and simplify the way we capture images of microbial movement and behavior. The objective of this tutorial is to describe four compound microscopy techniques that are of importance to students and researchers and portray them in a video poster format. With the technique of brightfield microscopy, samples are stained to increase contrast. Fluorescence microscopy utilizes a mercury arc lamp to emit fluorescence light to specimens on a slide, thus samples stained with fluorochromes will excite and emit fluorescence wavelengths, which is viewed through the objective lens. In Differential Interference Contrast (DIC) microscopy, prisms bend light to create more resolution and provide an image that is more 3-dimensional in nature. DIC is especially useful in imaging live, unstained specimens. Lastly, by combining DIC and sequential images, a movie of live specimens can be created. By using these techniques, we can quantify cells and sizes, and observe complex processes such as chemotaxis. Capturing and displaying images of microscopic organisms is essential to the study and teaching of microbiology, thus it is important to understand a variety of microscopic techniques.

KEYNOTE SPEAKER

Brookens Auditorium; 3:00 - 4:00 p.m.

Dr. Jerry L. Atwood
Department of Chemistry
University of Missouri-Columbia
- will speak on -
Supramolecular Chemistry and
Biological Self-organization

Dr. Jerry L. Atwood, Curators' Professor and Chair of the Department of Chemistry at the University of Missouri will present the keynote lecture. His research focuses on the chemistry beyond the molecule in the new field of Supramolecular Chemistry. His interests lie in characterization and manipulation of the intermolecular non-covalent interactions (i.e. hydrogen bonding, cation- π , charge-charge, hydrophobic-hydrophobic, charge transfer interactions etc.) that are responsible for the complex molecular interplay mechanisms known to be prevalent in biological systems. His group synthesizes and examines a broad array of host-guest chemical systems (e.g. liquid clathrates, macromolecular hosts). The resulting structures give detailed organizational information regarding a number of complex intermolecular interactions, with implications to the origin of life problem and biological self-assembly processes. Note: photo from <http://www.missouri.edu/~chemwww/chemfaculty/atwood.html>

4:10 - 5:00 Social & Awards: Best Student Poster & Paper
HSB 2nd Floor Art Gallery

Quotes on Science

Every great advance in natural knowledge has involved the absolute rejection of authority.
- Thomas Henry Huxley (1825 - 1895)

Science is organized knowledge. Wisdom is organized life.
- Immanuel Kant (1724 - 1804)

By always thinking unto them. I keep the subject constantly before me and wait till the first dawns open little by little into the full light.
- Isaac Newton (1642-1727)

*Science is a very human form of knowledge. We are always at the brink of the known; we always feel forward for what is to be hoped. Every judgment in science stands on the edge or error, and is personal. Science is a tribute to what we *can* know although we are fallible.*
- Jacob Bronowski (1908-1974)

What I am going to tell you about is what we teach our physics students in the third or fourth year of graduate school... It is my task to convince you not to turn away because you don't understand it. You see my physics students don't understand it... That is because I don't understand it. Nobody does.
- Richard P. Feynman (1918-1988)

Science knows no country, because knowledge belongs to humanity, and is the torch which illuminates the world. Science is the highest personification of the nation because that nation will remain the first which carries the furthest the works of thought and intelligence.
- Louis Pasteur (1822-1892)

If I have seen further than others, it is by standing upon the shoulders of giants.
- Isaac Newton (1642-1727)

Nothing shocks me. I'm a scientist.
- Harrison Ford (1942 -) as Indiana Jones

Back off man. I'm a scientist.
- Bill Murray (1950 -); Ghostbusters 1984

Acknowledgments

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Nada Chang

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Thank You

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