SCHOOL OF SCIENCE AND MATHEMATICS

Student Research Poster Display

Fall 2007

Caputo Hall Lobby

·BIOLOGY·

·CHEMISTRY·

·COMPUTER SCIENCE·

·EARTH SCIENCES·

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Note: The names of Millersville University faculty advisors are designated by an asterisk (*) in the abstracts.

Physics

1. Nanostructure Array Miniaturization

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The fabrication of nanostructure arrays show potential for applications such as high sensitivity biosensors and semiconductors. With nanosphere lithography, very small patterns can be created at a high throughput, and at a relatively low cost. One disadvantage of this technique is the difficulty in controlling the nanostructure size and separation. This issue is addressed here by exploring the method of reducing the nanostructure size through Reactive Ion Etching (RIE). The RIE process uses plasma (ionized gas) to etch materials just like wet etching does but with more control such as the isotropy of etching. A monolayer of Polystyrene (PS) spheres was created on a cleaned Si substrate. Then oxygen was used for etching the 200 nm PS spheres in the RIE process. A loose-packed nanosphere array was created with its size controlled by the etching time and the spacing controlled by the initial choice of sphere.

2. Wave Electrophoresis

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Department of Physics, West Virginia University

We present a study of the dynamics of charged particles under the influence of two propagating waveform electric potentials. The average transverse velocity of a particle as a function of system parameters was found both computationally and analytically. These model systems demonstrate a feasible method of electrokinetic separation based on mobility in which analyte molecules of opposite charge are transported in the same net direction. Potential applications for this process, called wave electrophoresis, include lab on chip devices.

3. Fabrication of Nano-Engineered thin films by Thermal Evaporation

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Sculptured thin films are grown by manipulating a material on the nano scale. They can be produced by laser ablation or thermal evaporation of the material to a rotating substrate under the right conditions. The Millersville University Physics department has an old evaporation chamber; Dr. Gilani and I are working to modify this existing evaporation chamber in order to facilitate the production of Nano-Engineered thin films

here at Millersville University. These modifications include the fabrication of a new vacuum chamber, purchasing and installing vacuum rated servo stepper motors and the necessary control mechanisms. As of September 2007 we have been able to design and fabricate the vacuum chamber and procure the majority of the electronic components necessary. The majority of work completed has been done on the fabrication of the vacuum chamber. This included researching the requirements of a high vacuum chamber, developing a design that fulfills these requirements and constructing the chamber. The chamber was competed and tested in August of 2007 and achieved a minimum pressure of $2.7*10^{-6}$ Torr. Research is continuing on both growth of columnar and sculptured thin films.

4. Hydrodynamical Modeling of Accretion Disks and Supernova Explosions

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Hydrodynamical simulations can be used to explain a wide range of topics in astrophysics. Numerical solutions of the Euler equations can be performed using the piecewise parabolic method. We present a study using the hydrodynamic software Virginia Hydrodynamics-One (VH-1), which can be used to simulate astrophysical fluids in one and two dimenisions. Accretion disks are a common occurrence in binary systems, and we have attempted to simulate the creation of an accretion disk around a compact object. Accretion disks form when a donor star transfers its gas through the Lagrange point, a point where the two gravitational potentials equal each other, to its companion. When accretion disks form around white dwarf stars, a Type Ia supernova explosion can result. Several mechanisms by which Type Ia supernovae could occur in a white dwarf have been proposed. The first mechanism is detonation, which is a supersonic shock wave that consumes the entire star. The second mechanism is deflagration, which is a subsonic flame wave. Other mechanisms involve a transition from deflagration to detonation, called a Detonation-Deflagration Transition (DDT), which is caused by the buildup of pressure behind a deflagration wave. Whichever mechanism is correct, the physics of the shock wave that forms is governed by the Rankine-Hugoniot jump conditions. We have applied these conditions for the expansion of a shock wave in one dimension.

5. The Study of Supernova Remnants in Infrared

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Data reduction and analysis is performed for three Supernova Remnants (SNRs) in the Large Magellanic Cloud. The three SNRs studied are DEM L71, N103B, and N132D. Infrared images were taken with the Spitzer Space Telescope at wavelengths of 3.6, 4.5, 5.8, 8.0, 24, 70, and 160 μm with the IRAC and MIPS instruments as part of a general LMC SNR survey in Spitzer's first cycle of observations. The MOPEX software package was used in order to reduce the IRAC data for the four shorter wavelengths. The

morphology of the SNRs was compared to their X-ray morphology found in images from the Chandra X-ray Observatory. DEM L71 was clearly visible at 24 and 70 μm, though further investigation is needed at the IRAC wavelengths and also at 160 μm. SNR N103B was visible at each wavelength with the exception of the 160 μm band. N132D was found in the 24 and 70 μm bands only. The result of the morphological comparison was that the outer shells of the X-ray images were larger than the visible outer shells of the IR images due to the X-ray images showing the current position of the blast wave from the explosion, while the IR shows the material cooling behind the shock.

Mathematics

6. Double Bubble Experiments in the Three-Torus

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Sponsored by Ronald Umble*

In the spring of 2007, our undergraduate research seminar directed by Drs. Ron Umble of Millersville University and Frank Morgan of Williams College studied surface-area-minimizing double bubbles in the 3-torus. A double bubble is formed when two bubbles are joined together separated by a shared membrane. The 3-torus can be thought of as a cube with opposite sides identifying. In 2001, Miguel Alvarez, et. al. conjectured that there are exactly ten surface-area-minimizing double bubbles in the 3-torus.
The goal of our project was to determine whether or not these ten conjectured surface-area-minimizing double bubbles can physically exist. To do this, we constructed two Plexiglas box models of the 3-torus then blew soap bubbles into the boxes and successfully produced each of the ten conjectured types. This proves that each of the ten types can physically exist. In this paper we describe the techniques we used to produce the ten conjectured surface-area-minimizing double bubbles in the 3-torus.

7. Equitable Circular Labelings of Graphs

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This poster summarizes results obtained concerning the new concept of equitable circular labeling of 2-connected graphs and, in particular, circulant graphs of order n and jump size j. In the 1970's m-circular labeling were studied as admissible maps and can be defined as functions from the vertex set of a graph to the set $A_m = \{(a, a+1) \mid a \in \mathbb{Z}_m\}$ where $\mathbb{Z}_m$ is the set of integers modulo m and satisfying three specific conditions: 1) each

element a of $_m$ is induced by at least one vertex of the graph; 2) if two vertices are adjacent in the graph, and one is labeled $(a,a+1)$, then the other's label must come from the set $\{(a-2,a-1), (a-1,a), (a,a+1), (a+1,a+2), (a+2,a+3)\}$; 3) pairs of vertices inducing a must be connected by a path all of whose vertices also induce a. Our research expands upon this by requiring that the sets of vertices inducing the elements of $_m$ differ in cardinality by at most one. In this case the m-circular labeling is called equitable. Our results relate the value of $_m$ in an equitable m-circular labeling to the order n of the circulant graph in the cases where the jump sizes are $j = 3,4,5$.

Earth Science

8. An Analysis of Future Climate Predicted For the Chesapeake Bay by the IPCC AR4 models

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The purpose of this study is to analyze the projected climate over the Chesapeake Bay Watershed by the IPCC AR4 models. As a means of doing this the A2 and B1 emission scenarios were chosen because they represent the largest range of direction in all the emission scenarios. The mean model is the average of all individual models and is often used as a tool for the most accurate future climate projections. By removing some poorly performing models versus the 20th century data, the mean model was able to undergo a statistically significant improvement. With an improved mean model, it is projected that mean annual temperature will increase across the watershed by 4.65 degrees Celsius under the A2 emissions scenario and 2.49 degrees Celsius under the B1 scenario. Additionally, annual precipitation is projected to increase by 5.04% under the B1 scenario and 7.18% under the A2 scenario with the greatest increases projected for winter and spring. While no concrete relationship exists between precipitation and streamflow, it is possible only to speculate that changes in precipitation may alter the time and duration of the spring freshet. Flooding events and drought conditions could be an even greater future concern as there appears to be an upward trend for the amount of 5 day rain fall, consecutive dry days, and extreme temperature events—particularly under the A2 scenario.

9. An Investigation of Channeled Wind Events in Southeast Alaska using Synthetic Aperture Radar

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[3] Johns Hopkins University Applied Physics Laboratory

A recent compositing study at NWS Forecast Office Juneau identified areas where satellite synthetic aperture radar (SAR) wind speed data consistently revealed enhanced channeled wind events for specific synoptic scale meteorological situations. However, due to the wind direction dependence on SAR wind speed retrieval, and inherent wind direction ambiguity within the channels, the actual values of wind speed for the events is uncertain. The current research focuses on two such areas in Southeast Alaska's inside waters. Those areas: (1) show a tendency for enhanced channeled wind under specific synoptic conditions; (2) are within quick sailing range of a nearby harbor; and (3) potentially provide new insight into complex channeled wind events. During the fall of 2006 and spring of 2007, for each study area, local boat operators were on-call for field programs aimed at collecting in situ wind vector observations coincident with satellite SAR overpasses during channeled wind events. The current research presents preliminary results from the field programs. The complete in situ and SAR wind speed comparison data set will be employed to determine the accuracy of SAR-derived winds under various synoptic situations (i.e., develop an error climatology) and to assess the impact of improved input wind directions in these critical locations on the forecast process.

10. Analysis of Streams Draining the Three Major Bedrock Formations in Lancaster County, PA on the Basis of pH, Specific Conductivity, and SiO_2 Concentrations

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The purpose of this experiment was to determine whether the chemistry of streams draining the New Oxford Formation, Conestoga Formation, and Wissahickon Formation in Lancaster County, Pennsylvania, reflect the composition and characteristics of the underlying bedrock. This was determined by analyzing stream waters for pH, specific conductivity, and silica (SiO_2). The New Oxford Formation is composed primarily of sandstone, which is fairly resistant to weathering. Because of this, silica should not be present in high concentrations; however the sampling indicated relatively high silica levels in the streams tested, indicating another influence on the water chemistry. Unmapped diabase dikes in close proximity to the sampling locations would weather more readily than sandstone and increase the silica concentrations in the water. The pH in one sample stream was found to be relatively high for sandstones, indicating a possible influence of carbonates in the area. The Conestoga Formation is composed of limestone,

and the waters should theoretically yield high conductivity readings and high pH. This was found to be true by the data collected. An interesting correlation was found, however, indicating an inverse relationship between pH and specific conductivity. The pH of the waters theoretically should have been higher, however the Antietam Formation is located nearby and contains ferruginous quartzite, white would counteract the buffering effect of the limestone. The Wissahickon Formation is composed of albite-chlorite schists, which have a fairly low weatherability. Waters draining this bedrock would typically have fairly low specific conductivity readings as well as fairly low silica concentrations. Data indicated that these assumptions were correct; however pH readings were rather acidic. In chlorites, iron can substitute for other cations, and through dissolution, would decrease the pH of the water. Varying pH levels may indicate that the chlorite schists vary in iron content.

11. Muscovite Weathering in the Brubaker Run Watershed Regolith

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Chemical weathering of bedrock minerals dictates the nutrients found in soils. Macronutrients such as K^+, Ca^{2+}, and Mg^{2+} are needed in large quantities to develop healthy biomass. Bedrock plays a vital role in determining the quality of soils for agriculture and ecosystems. The location where bedrock minerals are chemically destroyed is termed the "critical zone." This zone is a complex interaction of water, soil, rock, air, and living organisms that breakdown elements so biomass can uptake the nutrients. The purpose of this study is to determine where in the critical zone of the Brubaker Run watershed is the chemical destruction of the K^+-bearing mineral muscovite occurring. To determine where the minerals are weathering in the regolith, thin sections of the bedrock, saprolite, and soil were prepared and viewed. The mineral content of each slide was evaluated by point-counting. Thin section observations indicate that the bedrock is heterogeneous, containing quartz (31%), muscovite (38%), chlorite (25%), garnet (0.8%), REE-rich epidote (1.5%), and calcite (1.2%) minerals. In the saprolite, calcite, REE-rich epidote, and garnet are completely dissolved, and chlorite is extensively weathered. Muscovite and quartz are the only bedrock minerals found in the soil thin sections. Because the only macronutrient hosted by muscovite is K^+, the Brubaker Run ecosystem is Mg^{2+}- and Ca^{2+}-limited. This has strong implications for the agricultural resources of the area.

12. Integrating LEAD Research in Education

Junod, Robert; Gadde Hareesh; Daley, Thomas; Meyers, Eric; States Sean, Cecelski, Stefan; Kurdzo, James; Ketchell, Kristin; Kerschner, Brian; Carp, Robert; Yalda, Sepideh*; Wiziecki, Edee*; Clark, Richard*
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Linked Environments for Atmospheric Discovery (LEAD) is making meteorological data, forecast models, and analysis and visualization tools available to anyone who wants to interactively explore the weather as it evolves. One of the principal goals of LEAD is to democratize the availability of advanced weather technologies for research and education. The degree of democratization is tied to the growth of student knowledge and skills, and is correlated with education level. Undergraduates will have the opportunity to query observational data and model output, explore and discover relationships through concept mapping using an ontology service, select domains of interest based on current weather, and employ an experiment builder within the LEAD portal as an interface to configure, launch the WRF model, monitor the workflow, and visualize results using Unidata's Integrated Data Viewer (IDV). Such a robust and comprehensive suite of tools and services can create new paradigms for embedding students in an authentic, contextualized environment where the knowledge domain is an extension, yet integral supplement, to the classroom experience. This poster presentation will provide an overview of the efforts at Millersville University including the development of the LEAD-to-LEARN modules and the integration of the LEAD portal into the educational materials, and the collaborative efforts between LEAD Education and Outreach thrust and National Center for Supercomputing Applications (NCSA) cybereducation group. The collaborative work has had four main areas of focus: 1) review, analysis, and accessibility of LEAD-to-LEARN modules initially developed by undergraduates at Millersville; 2) development of a basic version of the Integrated Data Viewer (IDV) for pre-college use (IDV Basic); 3) design and compilation of a menu-driven module for pre-college use (ncDestroyer); 4) use-cases for integrating LEAD technology into undergraduate subject material. IDV Basic and ncDestroyer were created to facilitate the integration of IDV in an educational environment.

13. Analysis of long-term temperature trends in the upper atmosphere

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Holt, Dr. John*; Zhang, Dr. Shunrong*
MIT Haystack Observatory, Westford, Massachusetts

Climate change, be it in the troposphere or the upper atmosphere, is one of the most critically pressing issues in our society today. Meteorologists and climate scientists have demonstrated that the lower atmosphere has been experiencing alarming rates of warming, but only recently has the space weather community begun to address the question of whether there is an observable signal in the upper atmosphere. Largely this is because of the scarcity of data. Now for the first time, a large enough database of observations is readily available for extensive analysis of temperature trends in the ionosphere. Data acquired from 1978 to 2007 by the Millstone Hill incoherent scatter radar (46.2 °N, 288.5 °E) have been analyzed in order to provide a direct estimate of temperature trends between 250 and 550 kilometers. These long-term trends indicate significant daytime-hour cooling, varying between approximately -3.5 K/Year to -8.0 K/Year depending on altitude and time of day. These measurements are accurate both for ion temperatures (T_i) and neutral temperatures (T_n) with daytime standard deviations as

low as 0.8 K/Year, showing that these are very reliable results that are considerably larger than theoretical predictions based solely on increasing concentrations of greenhouse gases in the lower atmosphere. This poster presents some of the preliminary findings gleaned during a summer internship at the MIT Haystack Observatory.

14. A Climatology of Marine Meteorological Phenomena in the Alaska Region using Synthetic Aperture Radar

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[1]The Pennsylvania State University, Department of Meteorology

The Alaska region offers a wide range of mesoscale and microscale marine meteorological phenomena. These phenomena include gravity waves, convection, island wakes, convective roll vortices, and gap flows. Each phenomenon require distinctly different wind shear and static stability regimes. The surface signatures of the above-mentioned phenomena are readily detectable in high-resolution synthetic aperture radar (SAR) imagery of the sea surface. Using an archive of over 30,000 SAR marine images of the Alaska region, we have developed frequency climatology of the above mentioned phenomena. NCEP/ NCAR reanalysis data have been employed to provide a corresponding climatology of wind shear and static stability conditions associated with each phenomenon.

Computer Science

15. Network Security and Forensics in Financial Institutions

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The security of computer networks has necessarily become of paramount concern. Financial institutions rely heavily on these networks, and the personal and financial data that travels over them is often vulnerable to attack. Hackers can attack locally or remotely by using software, the Internet, or by employing social engineering. If an attack occurs, it is the goal of computer forensics to identify the attack, collect evidence, and analyze it in the attempt to capture the perpetrators. Using various methods, it may be possible to prevent future attacks. Network security methodology can provide a logical and effective guideline to actions that should be taken by financial institutions to limit vulnerabilities and prevent attacks. These include an established security baseline, education of the employee, and a documented and enforced security policy. Network services should be hardened, and software must be audited and properly configured. A case study of a

Windows 2000 server will demonstrate how software vulnerabilities exist and must be protected. To win the war against hackers, financial institutions must physically and technologically secure their network infrastructure and the customer information it encompasses.

16. Wireless Networking Securities

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Wireless Networks are prevalent and more people are beginning to use these networks for portable communication. We concentrate on wireless networks that are based on the IEEE 802.11 standard and the security measures that can be taken to protect such networks from information leaks. Wireless networks present a whole new landscape of security flaws and vulnerabilities; while they offer the unparalleled ease-of-access and portability, this advantages also comes with its shared of security threats. Because wireless signals can be picked by anybody with a capable device, wireless networks are prime targets for exploits. The thesis examined the main security procedures for securing a wireless network. Among this examination was an audit of institutions, including Millersville University, that currently use wireless technology. Brad "cracked" the currently implemented wireless security of the institution (with permission) in hopes of determining the best methods for securing their wireless network. In conjunction with the penetration testing, the implementation costs of each type of security, the ease of implementation of each type of security, and the hindrance to the end user of each type of wireless security was also examined. The types of security methods that were researched included, but are not limited to, different types of encryption (WEP, WPA) and captive portal. The conclusion of his research was the overall wireless security plan for each institution that will assess security needs, budget, implementation, types of users, and maintenance.

17. An interactive, Web-based atlas for the woody vines of Pennsylvania

Boaman, Matt; Houder, Bryan; Mollah, Nazli;* Hardy, Christopher*
Department of Computer Science and the James C. Parks Herbarium,
Department of Biology, Millersville University, Millersville, PA 17551

We are developing an interdisciplinary (Computer Science and Biology) interactive, Web-based atlas in order to better document and monitor the distributions of the 38 species of woody vines of Pennsylvania. This small element of the Pennsylvanian flora will be a test case for a much larger atlas for the state or larger geopolitical entity. The approach integrates the general mapping services provided by Google Maps^{TM} and locality data provided by the James C. Parks Herbarium or reports by students and citizens. Currently, distribution mapping, environmental monitoring, and conservation efforts relying on large quantities of up-to-date locality data for plant species are limited by the relatively small community of professional biologists already engaged in such activities. We believe that professional biologists are not the only possessors of quality

information on plant distributions; thus, allowing contributions of locality data from the lay community may improve our ability to document and monitor plant distributions, especially in the light of potentially rapid climate change in the next few decades. Given the concern over "data quality" where laypersons are involved, as our atlas grows we will investigate (i.e., quantify) the general accuracy of user-contributed data using novel ground-verification projects integrated into the classroom and work-study activities of undergraduates. These "quality checks" on contributed locality records should provide the first evaluation of the efficacy of such science-lay community collaborations in the study of biodiversity and its conservation.

18. An interactive, Web-based informational database and key for the woody vines of Pennsylvania

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As a test-case for larger projects, we are constructing an online interactive guide to the 38 species of woody vines of Pennsylvania. We are developing the database backend using MSSQL, a relational database management system, and user-interface and database query functionality using PHP and HTML. The main page consists of a list of characters with radio-buttoned lists of character states that can be selected by users in order to search for species in our database that meet user-specified criteria (i.e., which woody vines have opposite leaves with green flowers?). Once the list of species is winnowed down, a page profiling each species of interest can be visited at which information on the appearance and ecology of each species can be found. We expect our database and key to grow rapidly since contributions of data and images will not be limited to scientists, rather open to both scientists and interested non-scientists. In a since, we model our approach after that taken by the online encyclopedia "Wikipedia."

Chemistry

19. Synthesis and Characterization of Copper Nanowires

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[2]Illuminex Corp., Lancaster, PA

The synthesis of copper nanowire arrays using a templating process is being presented. The self-assembly property of aluminum is used during anodization when aluminum metal forms an oxide template of nanoscale cylindrical pores. These pores are filled with

copper metal to form nanowires. The oxide template is then etched away in an acid bath. The resulting copper nanowire arrays are characterized with scanning electron microscopy. Results of anodization step-down voltage experiments will be presented

20. Electroroughening and Functionalization of Nanowire Arrays for the Development of a Biosensor

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[2]Illuminex Corp., Lancaster, PA

As part of an initiative to develop a biosensor for the detection of ovarian cancer using nanowire arrays, gold and silver nanowires are cleaned and roughened using electrochemical techniques and functionalized with a self-assembled monolayer. Cleaning of the wire arrays removes impurities from the array surface to facilitate functionalization, while roughening increases the analytical signal obtained. The gold and silver arrays were run at several ranges of applied voltages to determine their respective optimal voltages and characterized using scanning electron microscopy. The gold and silver arrays are then functionalized with a self-assembled monolayer consisting of mercaptoundecanoic acid and a spacer molecule. The acid of the monolayer acts a site to which antibodies specific for ovarian cancer antigen can bind, while the spacer ensures that the antibodies have the room to correctly bind. Fluorescent microscopy was used to determine an optimum spacer molecule and ratio of spacer to acid molecules required to produce the greatest active antibody attachment.

21. Biodegradable Nanoparticle-Aptamer Conjugates for Targeted Drug Delivery

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Polylactic acid (PLA) is a biodegradable polymer that is commonly used to encapsulate drugs for controlled and sustained release. There is great interest in developing techniques to functionalize the drug loaded nanoparticles with antibodies or small ligand molecules for targeted delivery. However, PLA lacks reactive surface groups. The goal of this work is to develop aptamer-PLA nanoparticle-drug conjugates for treatment of lung cancer. Aptamers are short segments of RNA that bind to tissue with affinity and specificity comparable to that of antibodies. They are non immunogenic and easier to engineer and develop than antibodies. A layer by layer self assembly technique was used introduce amine functional groups on PLA nanoparticles, making conjugation feasible. The same method was used to assemble nanoscale films of an aptamer engineered to target lung tissue and polyallylamine hydrochloride, a positively charged polyelectrolyte, on quartz substrates. UV-Visible spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM) and atomic force microscopy (AFM) results

indicate formation of a surface active film on PLA micro- and nanospheres, and incorporation of aptamers in layer by layer nanofilms.

Biology

22. Recent Publications from the MU Cephalopod Research Lab

Sigg, Jessica E.; Boal, Jean Geary*
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Many species of sea urchins cover their bodies with a variety of materials. One hypothesis for this behavior is that the urchins are reducing their exposure to UV radiation. The effect of UV radiation on the covering behavior of twelve sea urchins, *Lytechinus variegatus,* was recorded and the shells used as covering materials were quantified. During UV exposure, urchins used significantly greater numbers, areas, and masses of shells than did urchins during non-UV exposure. Results suggest that not only were *L. variegatus* covering in response to UV exposure, but they were also making distinct choices regarding preferred covering items. Unlike in previous studies, the urchins did not simply choose familiar objects or even the lightest objects; rather, when exposed to UV radiation they selected intermediate-sized objects, perhaps demonstrating a trade-off between the energetic costs of carrying objects and the physiological costs of exposure to UV radiation. While there appear to be many reasons for why urchins cover, these results indicate that urchin covering is nonrandom and has important functional significance.
Note: This paper is the result of Jessica Sigg's Biology Department Honors Thesis (MU'05), under the direction of Dr. Jean Boal. The research represents Jessica's own conception and experimental design. Jessica is currently a Laboratory Specialist at Environex, Inc. in Devon, PA. Karena Lloyd-Knight (MU master's degree student in 2005-6) assisted with the literature review and preparation of the final manuscript. A short review of this article was published as follows:
The Covering Behavior of Sea Urchins
The Global Marine Environment (newsletter of the Marine Biological Association), Vol.38, Fall 2007.

23. Optimizing Antibody Attachment to Gold Nanowire Arrays

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A new approach in the development of sensors that will detect extremely small concentrations of analytes such as hormones or cancer indicators in blood and other fluids very rapidly, is one that utilizes nanotechnology. In this approach, very small structures such as nanowire arrays need to be coated with active antibodies directed against the compounds to be analyzed.   We have previously attached antibodies made against an indicator for ovarian cancer (CA 125) to nanowire arrays provided by Illuminex Corporation. These arrays are groups of parallel wires measuring approximately 80 nanometers by 120 nanometers attached to a glass substrate.
 It is the purpose of these experiments to measure the degree of antibody attachment under various conditions. Specifically, this study was designed to determine what MUA-to-spacer molecule ratio would give optimal antibody attachment, to find the minimal concentration of antibodies needed to see optimal attachment, and to find optimal antibody incubation times. Through a series of chemical reactions using MUA (11-mercaptoundecanoic acid) side arms and spacer molecules (4-mercapto-1-butanol), the antibodies were covalently attached to the nanowires. In order to find the amount of antibody binding to the arrays, a fluorescein labeled second antibody was incubated with the functionalized wires. This incubation led to an emission of fluorescence. The degree of fluorescence detected is proportional to the amount of antibody attached to the nanowires and was approximately 9×10^{-4} ug of antibody per mm^2 of nanowire array. These studies have led us to establish the optimal conditions for covalent linkage of antibody to nano structures. After testing a variety of different ratios it was determined that the optimal MUA-to-spacer molecule ratio is 1:50. The optimal concentration of anti-Insulin antibody was found to be 100 µg/mL and the incubation time that gave the highest amount of attachment was 15 hours. The optimal concentration of fluorescein labeled goat-anti-mouse IgG was found to be 300 µg/mL and the incubation time that exhibited complete saturation of the nanowire arrays to give the highest amount of fluorescence was 3 hours.

24. Subcloning Candidate Suppressor Genes Involved in Restoring *HOT1*-dependent Recombination in *deg1* Mutant Yeast

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Genetic recombination is essential for maintaining genome sequences in all organisms. It also helps to create novel alleles and gene combinations that drive evolution. Despite its importance, mechanisms of recombination are not completely understood. Easy culture and genetic flexibility allow the yeast *Saccharomyces cerevisiae* to serve as an excellent experimental model for all eukaryotic organisms, including humans. *HOT1* is a recombination hotspot within the ribosomal RNA genes of yeast. It appears to be important for maintaining the integrity of these repeated genes, but its precise role and the enzymatic pathways involved are not fully understood. In *S. cerevisiae*, the *DEG1* gene is needed for *HOT1*-dependent recombination and normal growth. Mutants defective in *DEG1* are temperature sensitive and exhibit lower rates of mitotic recombination. The product of *DEG1* is a pseudouridine synthase that modifies tRNA molecules, and the connection between this activity and genetic recombination is

obscure. In an attempt to understand how *DEG1* impacts recombination, a search was made for yeast genes that can suppress growth defects of *deg1* mutants. One segment of the wild-type genome was identified as an effective suppressor, and DNA sequencing revealed that it contains three distinct genes. To identify which of the three is the true suppressor, these candidate genes were separated from each other using restriction enzymes or the polymerase chain reaction (PCR) and then isolated using gel electrophoresis. Each was inserted separately into the expression shuttle vector YCpLac118 and then transformed into bacterial cells. Successful subcloning was verified using restriction enzyme analysis. To determine if it has an effect on growth and recombination rates in yeast, each gene will be transformed into mutant *deg1* cells for evaluation. Understanding the role of genes involved in recombination will enhance our understanding of the process and may provide insight into cancer and other genetic diseases.

25. Raman Spectroscopy of Proteins for Biosensor Applications

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Raman spectroscopy is a young field in biomolecular analysis that has been researched substantially to indicate its potential in future biomedical advances in technology. When light energy collides with a molecule, a scattering of photons occurs. Raman scattering occurs when the light energy scatters at a different frequency than it had before the collision occurred. A molecule's vibrational transitions allow for the "fingerprinting" of that molecule using Raman spectroscopy. Raman spectroscopy can be used to measure particular bonds in a molecule since the Raman peaks are spectrally narrow. However, this signal can be greatly enhanced in the presence of nanostructures (less then 60nm) such as nanowire arrays. For this reason, the use of Raman spectroscopy in medical diagnosis is under study. Bovine albumin, both in solid and liquid (dissolved in water) form, was analyzed in the Raman Spectrometer and analyzed for distinguishable Raman bands. Concentrations as low as 1.25mg/ml were measured using quartz cuvettes and concentrations as low as 0.39mg/ml were measured using nanowire array substrates. A chemical "fingerprinting" of the bovine albumin could be visualized on the Raman spectra with the most distinguishable peak occurring at ~1000cm^{-1}. Surface enhanced Raman signals were seen when using nanowire arrays, enhancing Raman peak intensity and natural albumin fluorescence. Bovine albumin present in serum was also analyzed to observe if similar Raman bands would occur in comparison to the bovine albumin spectra. Indications of bovine albumin in the serum could be seen on spectral analysis. This showed that macromolecules such as albumin could be visualized in different solution mixtures.

26. Risky Sexual Behaviors Among MU Students

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Adolescents, aged 15 to 24 years of age, experience the highest incidence of STIs in the USA. Annual averages of Chlamydia, gonorrhea, and syphilis are at high numbers. Re-infection and risk perception have been implicated as reason for high occurrence of STIs among children less than 18 years of age. These results have not been validated among college students. Determinants of partner re-infection and markers of health seeking behavior in this age group are dynamic and not fully examined. The purpose of this study was to characterize partner notification, risk perceptions and health seeking practices among college students in Pennsylvania. We developed a survey which was approved by the Millersville University IRB. The survey was then loaded onto an online survey site (QuestionPro). An email was sent out to 6,940 MU students with a link to the survey, and all data were compiled without record of names or emails. One thousand and nine surveys were completed and tabulated. Fifty percent of the students completing the survey stated that they had vaginal sex without a condom. Only 39% of students said they use a condom for 75-100% of their sexual encounters, while 75% of students do not consider themselves at risk for contracting an STI or HIV. Of the students that do not think they are at risk, 53% answered that the reason not to have unprotected sex is concern over pregnancy. Only 34% of the same students answered that the reason is concern over contracting HIV. Both condom use and number of partners together had an effect on whether a student thinks they are at risk for contracting an STI. This information will help inform public and school health programs on how to help youths adopt positive and protective sexual health behaviors.

27. Operational Characteristics of Functionalized Nanowires

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The world of nanotechnology is progressing quickly in the world of medicine. We are using small devices to detect analytes found in blood and other bodily fluids. These tiny devices known as nanobiosensors will be able to detect the presence of antigens by the use of antibodies. This technique utilizes tiny parallel nanowires that are about 80 by 120 nm in size made by the Illuminex Corporation. The purpose of these experiments was to note the speed and efficiency of our sensors to detect antigens. The nanowires were prepared by coating them with specific antibodies directed against a desired antigen. Through a series of chemical reactions, a spacer molecule and MUA (11-mercaptoundecanoic acid) was attached to the wires by covalent bonding. This allows for proper spacing of the antibodies, which are also covalently linked to the nanowires. Antigen is added to the device and allowed to bind to the antibodies. In order to analyze how much of the antigen is binding, a rhodamine-labeled antibody made against a different epitope on the antigen is incubated with the nanowire apparatus. This labeled antibody indicates the amount of functional antigen-antibody complexes attached to the

wires. This procedure allows for the study of optimal antigen attachment under varied conditions. The conditions tested include: antigen and antibody concentrations, incubation times, incubation temperatures, and storage abilities of the sensor. The sensor is then observed using a florescent microscope. The red florescence (which is quantified) indicates that the antigen has attached to the antibody. It has been found that antigen binding to the first antibody is done within only a few seconds of exposure. This is significant to the efficiency of our biosensors because in a clinical setting, the faster and more accurate the results the better the device. It has also been determined that low concentrations of antibodies are sufficient for optimal binding of antigen. For maximum brightness a concentration of 120µg/ml of third antibody, 100µg/ml of first antibody and 100µg/ml of antigen are used. Due to the high cost of monoclonal antibodies used in this technique, the low concentrations necessary for maximum brightness helps to keep the device cost efficient. We also determined that the sensors could be stored for up to a few days, after the labeled antibody has been added, in a humidity chamber at temperatures of about 4 degrees Celsius before the florescence of the slides begin to fade.

28. The Role of a Novel Population of Neural Crest Cells in Forming the Turtle Shell

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The turtle shell is an evolutionary conundrum. It arose suddenly in the fossil record. It consists of more than 50 bones, most of which have no equivalent in other vertebrates. Most amazing of all are the bones of the ventral shell (the plastron) that form directly, without first creating a cartilage template. No other bones in the trunk of other existing vertebrates form this way, but the bones of the skull do. The bones of the skull are produced by cranial neural crest cells, which migrate away from the developing brain. Trunk neural crest cells, which migrate away from the developing spinal cord, do not have the ability to form bone in other vertebrates. However, the cells that form the plastron bones can be stained with antibodies that are normally used to detect neural crest cells. If they are neural crest cells, they migrate through the embryo at a later stage than the 'typical' ones. This suggests that the plastron bone-forming cells are an unusual subpopulation of neural crest cells, but it is also possible that they simply share the surface molecules stained by the antibodies. We set out to use a more definitive method to identify neural crest cells – the ability to migrate away from the developing central nervous system, the neural tube. We were able to develop procedures for isolating the neural tubes from turtle embryos and culturing them to allow neural crest cells to migrate. Using this method, we were able to observe neural crest cells migrating away from the neural tube from embryos at the stage where plastron-forming cells migrate. This data supports our hypothesis that turtle embryos contain a unique, late-migrating neural crest subpopulation that is responsible for the formation of the turtle shell, a novel structure that has provided a challenge to evolutionary theory.