



EIGHTH ANNUAL THEORETICAL AND APPLIED SCIENCE



student

RESEARCH

SYMPOSIUM



Wednesday, April 8th, 2009

9:00am to 5:30pm

The Trustees Pavilion

Ramapo College of New Jersey

Celebrating Faculty-Student Scholarship

**8th Annual
TAS Student Research Symposium**

PROGRAM

**9:00 am - 10:45 am
Oral Presentation Session I**

**10:45 am - 11:30 am
Poster Session I**

**11:30 am - 1:00 am
Oral Presentation Session II**

**1:00 pm - 2:30 pm
Lunch Break**

**2:30 pm - 3:15 pm
Poster Session II**

**3:15 pm - 5:00 pm
Oral Presentation Session III**

**5:00 pm - 5:15 pm
TAS Research Honors Awards**

**5:15 pm - 5:30 pm
Presentation of SRS Awards**

Wednesday, April 8th, 2009
Trustees Pavilion
Ramapo College of New Jersey

<http://phobos.ramapo.edu/~pbagga/SMS/sms.html>

PROGRAM

Oral Presentations I — 9:00 AM - 10:45 AM

Session Chair: Matthew Howard

- Hydrogenations without hydrogen: The use of hydrogen-transfer catalysts in organic synthesis
Tiffany Simons p. 8
- Aspartame inhibits tail regeneration in *Lumbriculus variegatus* (mudworm)
Matthew Diamond p. 9
- Expression and purification of *E. coli* RecR and it's N-Terminal interlocking mutant
Tara Drake p. 10
- The synthesis of transition metal complexes that contain 'umbrella' ligan
Alyssa Winter p. 11
- Prostaglandins and osteoblast differentiation
Monique Simpson p. 12
- Tree selection by foraging, male red-eyed vireos (*Vireo olivaceus*) in a New Jersey Highlands forest
Melanie Klein p. 13
- SimOrg: Simulated qualitative organic analysis
Jeffrey Ludwig p. 14

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All presenters are required to be present at both poster sessions

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- Growth in the dinosaur *Coelophysis*: Implications for dinosaur speed estimates from trackways
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Poster Session II — 2:30-3:15 PM

All presenters are required to be present at both poster sessions

Oral Presentations III — 3:15 PM - 5:00 PM

Session Chair: Bethany Walton

3-mercapto-5,6-diphenyl-1,2,4-triazine: A potential reagent for
pegylation of peptides and proteins
Michael Chiorazzo p. 23

Creatine slows segment regeneration and stimulates fragmentation in
the segmented worm *Lumbriculus variegatus*
Jeffrey Dodd p. 24

Recycling aluminum by utilizing the metal as an electrode in a fuel
cell
Mercedes Perez p. 25

Inhibitory effect of acetaminophen on *Lumbriculus variegatus*
(mudworm) tail regeneration
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Mixed monomolecular films of poly(n-decyl acrylate) and protein
solutions
Ashley Halstead p. 27

Alkaline pH prevents voltage reversal in yeast fermentation of banana
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Phylogenetics of G-quadruplex structural motifs in the human PDGF
gene family
Elad Tennen p. 29

TAS Research Honors Awards — 5:00-5:15 PM

Presentation of SRS Awards — 5:15-5:30 PM

Abstracts: Oral Session I

Session Chair: Matthew Howard

Hydrogenations Without Hydrogen: The Use Of Hydrogen-transfer Catalysts In Organic Synthesis

Tiffany Simons, Dr. Stephen Anderson

Unsaturated organic compounds, such as alkenes, are traditionally hydrogenated using molecular hydrogen (H₂) in the presence of a transition metal catalyst. The reaction can also be performed without a source of hydrogen by employing a hydrogen-transfer catalyst. These catalysts take hydrogen away from one reagent and give it to an organic substrate. Using this method, we successfully converted a ketone (acetophenone) to an alcohol (1-phenylethanol) using a homogeneous rhodium catalyst. The source of the hydrogen was 2-propanol, which, upon giving up hydrogen, is converted to acetone. The result of transfer hydrogenation was monitored by Infra Red spectroscopy and the product confirmed by Gas chromatography.

Aspartame Inhibits Tail Regeneration In *Lumbriculus variegatus* (Mudworm)

Matthew Diamond, Dr. William Mitchell

Lumbriculus variegatus [mudworm] is a freshwater oligochaete (phylum Annelida) that has a unique ability to regenerate its tail and head segments when detached. Aspartame (a methyl ester of the dipeptide between aspartic acid and phenylalanine) is used as an artificial sweetener in a wide variety of food products from soft drinks to breath mints. Although generally thought of as safe in low concentrations, some have questioned its safety especially in regard to its ability to breakdown into metabolites such as formaldehyde, methanol, etc. How might aspartame affect the regeneration process in *L. variegatus*? Groups of worms were subjected to varying concentrations of aspartame after approximately 0.3 mm sections of the worm's tails were removed. Tails regenerated less when the worms were treated with aspartame as seen 7 days later. Digital microscopy and vital staining methods were used to evaluate the regeneration process.

Expression and Purification of *E. coli* RecR and it's N-Terminal Interlocking Mutant

Tara Drake, Dr. Seung-Sup Kim

Bacterial homologous recombination is a process that repairs the DNA replication fork when the double-stranded DNA breaks or single-stranded DNA contains a gap. There are two different known pathways for homologous recombination, RecBDC and RecFOR, which differ based upon their enzymes repair mechanisms. The long term goal of this project is to study the structure-function relationship of the *Escherichia coli* RecR protein from RecFOR pathway. From previous structural studies showed that bacterial RecR proteins form a ring-like multi-unit complex (homotetramer). It is also known that bacterial RecR proteins have a major role in DNA binding of the RecFOR complex. To understand the relationship between the homotetramer formation and DNA binding function of *E. coli* RecR, the native and an N-terminal interlocking mutant forms of recombinant RecR were produced. The recombinant proteins were over-expressed in a bacterial expression system and purified using various chromatographic methods. The native and the N-terminal locking RecR proteins were analyzed using protein gel electrophoresis techniques including SDS-PAGE and Native gel system.

The Synthesis Of Transition Metal Complexes That Contain ‘Umbrella’ Ligan

Alyssa Winter, Dr. Stephen Anderson

Molecular interactions between a monomolecular film of poly(n-decyl acrylate) and a series of protein solution subphases were studied using the Langmuir film balance method. Surface pressure was measured as monomolecular films of the brush-like polymer were compressed on buffered solutions of albumin, fibrinogen, gamma-globulin, immunoglobulin G, and lysozyme. All protein solutions featured proteins in the bulk phase and at the surface, however, albumin exhibited the strongest surfactant behavior. The interaction of a polymer monolayer film with the proteins in the bulk and surface phases provided a means to discern the morphology of the mixed monolayer films and was used to provide a means to observe the affinity between the polymer and the different proteins.

A comparison of the monolayer characteristics of poly(n-decyl acrylate) with proteins was made to earlier studies in which the methacrylate analogue of the polymer was used. The larger backbone substituent causes the methacrylic polymer to be more rigid. The effect of backbone rigidity on the polymer-protein interactions will be presented.

Prostaglandins and Osteoblast Differentiation

Monique Simpson, Dr. Thomas Owen

Prostaglandins E1 and E2 (PGE1 and PGE2) bind to four receptors, designated EP1 through EP4, on the surface of mammalian cells. The EP2 and EP4 receptors are known to stimulate bone formation by activating adenylate cyclase, resulting in elevated cyclic AMP levels in osteoblasts, the cells responsible for forming bone. Binding of PGE2 to EP4 is also known to cause a population of bone marrow cells to become adherent and differentiate into osteoblasts. Ultimately, this project will further investigate the differentiation of bone marrow cells into osteoblasts at the molecular level. Our first goal was to clone and express the rat EP2 and EP4 receptors in cells to establish a reporter assay for the elevation of cyclic AMP following the binding of the ligand to the receptor. Rat EP2 and EP4 had been cloned from rat kidney cDNA into the pCMV Script expression plasmid. Conditions are being determined for transfection of the DNA into Cos-7 cells using CMV β -galactosidase, since this enzyme can be detected using a colorimetric assay. Once optimal conditions are determined, we will transfect each receptor DNA together with a cyclic AMP responsive reporter plasmid to demonstrate binding of ligand and receptor activation. Once established using PGE2 as a positive control, other compounds such as PGA1 and PGA2 will be tested for their ability to activate these receptors. We will then begin to explore the role of these receptors in the transformation of pluripotent bone marrow cells into committed osteoblasts.

Tree Selection by Foraging, Male Red-Eyed Vireos (*Vireo olivaceus*) in a New Jersey Highlands Forest

Melanie Klein, Dr. Eric Weiner

As tree species composition of northern hardwood forests shifts due to succession and impacts by a variety of invasive insects and diseases, sparse attention has been given to implications for forest birds. This study examines tree species selection by foraging *Vireo olivaceus* in a mixed hardwood forest in the New Jersey Highlands. The primary goals were to determine if foraging patterns may help explain why *Vireo olivaceus* is so common, and whether predictions of future population trends based on possible preferences for particular tree species may be apparent. Tree selection by 49 *Vireo olivaceus* was observed. Only territorial (singing) males were observed, and observations were mapped so that care could be taken to observe each bird only once. The species and trunk diameters of the trees in which study birds were observed foraging, and of all trees within 15 m of the focal trees, were recorded. The species composition of trees selected by study birds was subsequently compared to a species composition index of neighboring trees. Results suggest a slight preference for *Liriodendron tulipifera* and *Fagus grandifolia*, and slight avoidance of *Quercus rubra* and *Betula lenta*. However, the proportion of time spent in each of the other tree species was strongly predicted by the tree species composition index. Therefore, male *Vireo olivaceus* appear to be generalist foragers that can likely acclimate to future shifts in tree species composition. The approach reported here could serve similar studies that focus on insectivorous bird species that are known to be in decline.

SimOrg: Simulated Qualitative Organic Analysis

Jeffrey Ludwig, Dr. Scott Frees, Dr. Robert Shine

A Chemist in a lab would use Qualitative Organic Analysis to identify an unknown compound by performing classification and derivative tests. SimOrg is an online application developed to assist Organic Chemistry students in learning Qualitative Organic Analysis. This application lets users try to identify randomly selected unknown compounds by simulating classification and derivative tests. SimOrg also has a built in expert system which can at any time find the best sequences of tests to run. Game theory and decision trees influenced the design of the expert system. Test result, duration, and desirability are some aspects that are considered. SimOrg can be run in three different modes: practice, tutor, and test. In practice mode a student can simulate tests and attempt to identify an unknown. In test mode a student is required to identify a specific number of unknowns to complete an assigned test. In tutor mode a student is given feedback by SimOrg's expert system. The expert system follows the student's test selections and offers advice on the quality of the tests and may suggest better alternative tests. Whenever an unknown is successfully identified, the user can compare his or her test selections to the expert system's suggested tests. The effects of this system on the students will be analyzed in an attempt to show that computer aided learning can be beneficial in Organic Chemistry.

Abstracts: Oral Session II

Session Chair: Elad Tennen

Computer Simulation of Forest Dynamics: Developing a Fine-Scale Model

Kimberly Rodgers, Dr. Eric Weiner, Dr. Scott Frees

Computer simulation models can provide insights about how ecological variables influence forest dynamics in ways that are not generally possible from analyses of field data alone. By manipulating different parameters, simulation results can indicate the relative importance of ecological factors such as competition for resources, invasive herbivores, diseases, and overall successional processes, on the rise or decline of each tree species in a forest community.

Ecological modelers have generally programmed simulations based on parameters that are averaged at the species level. Consequently, such models may miss complex trends by overlooking the potential importance of variation in traits of individual trees and spatial variation in microenvironments. The study reported here employs a fine-scaled approach to forest simulation modeling by focusing on the fate of individual trees. In doing so, we hope to provide a more realistic view of forest processes.

To pilot the model, we input data from a survey of 2,218 canopy and subcanopy trees in eighty 0.1 hectare plots at the Ramapo County Valley Reservation. We used allometric equations of tree architecture based on data from the same site together with field mortality rates following a recent gypsy moth (*Lymantria dispar*) outbreak. Additional outbreaks were simulated in order to examine the potential long-term, negative impacts on the most affected species (oaks, *Quercus* spp.), and the indirect positive impacts on species that are expected to benefit from the reduced competition with oaks.

Future work will examine impacts of other invasive insects and diseases at the study site.

Forest Dynamics Simulation and Visualization

Daniel Fumosa, Dr. Scott Frees, Dr. Eric Weiner

This project allows ecologists to simulate the effects of environmental conditions on forests and view the result in both a 2D graphical application and a 3D immersive environment.

The simulator, which is the main part of the project, will read in data on a forest and perform the simulation. The data contains plot, health, species, and diameter with no location of the trees in the forest. We use a random placement algorithm to generate x and y coordinates for each tree. A replacement algorithm is used to decide which trees will replace the dying ones. The output of the simulation is the new forest. We use the Monte Carlo method to get more accurate results.

We've developed a desktop application as a tool intended for use by ecologists and people interested in the detailed data on the simulation and initial forest information. It includes graphical 2D representations along with percentages of different species, stratum, or eventually any attribute the user chooses. This is used to view the before and after results of the simulation.

We have also developed 3D virtual environment which is intended for use by people of all ages and ecological knowledge. It allows users to wear a head mounted display and virtually walk through a forest. Users are able to select certain trees to get information pertaining to it such as species name, height, or diameter. This will be the best tool for inexperienced users to truly see what is happening inside any forest.

Development Of An Invertebrate Cell Culture Method For *Lumbriculus variegatus* (Mudworm)

Daniela Georgieva, Dr. William , Dr. Thomas Owen

This project was designed to develop a method of establishing and maintaining cell cultures from the freshwater oligochaete *Lumbriculus variegatus*. Three variables were investigated which could potentially impact cell attachment and survival. These variables were tissue disruption methods, temperature effects and media formulation effects. Cell cultures were started using two methods of tissue disruption. One method ground all segments posterior to the head region while the other sliced pieces containing multiple segments from the center of worms. Tissue fragments produced, after disruption, were placed in 2 mL of L15 (Leibovitz) medium supplemented with 200 units of penicillin G and 200 units of streptomycin. Mechanical tissue disruption was the best method of ensuring cell attachment to tissue culture dishes. Cell viability was better at 10C than at 20C primarily by inhibiting growth of fungal contaminants. Initial results showed numerous live cells on day 7 many of which survive through day 12. We have begun to use fungicide in our cultures. In addition to fungicide we are adding serum to our cell cultures, in an effort to improve cell viability and growth.

Growth in the Dinosaur *Coelophysis*: Implications for Dinosaur Speed Estimates From Trackways

Dean Bobo, Dr. Emma Rainforth

Paleontologists estimate speeds of dinosaurs from their tracks, by assuming a relationship between footprint length and hip height. Published data provides estimates of foot length/hip height ratios, which vary both between dinosaurian groups, and by size within each dinosaurian group. However, one does not always know the identity of a trackmaker. In an earlier study we showed that the published foot/hip ratios do not seem to be accurate, with much greater variability actually occurring. In the present study we are focusing on the theropod dinosaur *Coelophysis bauri*, from the Late Triassic of New Mexico. Is there variation in the foot/hip ratio with size (age) of individual? Is there allometric growth in the hind limb? If either of these is demonstrated then efforts to estimate speeds from trackways will be futile. Preliminary results indicate that whilst there is significant variation between lengths of individual phalanges (toe-bones), there is a relationship between ‘toe length’ and length of metatarsals; there does not appear to be allometry within the foot. Due to specimen preservational factors there are a paucity of specimens with complete hind limbs; but from our limited data there does not appear to be allometry between the tibia and metatarsus. The strong relationship between metatarsal and digit lengths enables us to predict lengths where data is missing. However, we note that there is significant difference between tops and bottoms of phalangeal and metatarsal bones and that measurements must consistently measure one or the other.

G-quadruplex Motifs May Be Involved In Regulated Splicing Of Human And Mouse Pre-mRNAs

*Viktor Vasilev, Zachary Zappala, Dr. Paramjeet Bagg,
Dr. Lawrence D'Antonio*

G-quadruplexes play diverse roles in key cellular processes and human disease. RNA G-quadruplex motifs have been shown to be involved in mRNA turnover, Fragile X Mental Retardation Protein (FMRP) binding, translation initiation as well as repression.

We have adopted a bioinformatics approach to study the composition and distribution patterns of G-quadruplex forming motifs in >12,000 human and mouse pre-mRNA sequences, including those that are alternatively processed. Over 400,000 of exons and introns were analyzed. Our studies revealed the prevalence of G-quadruplexes with high putative stability near 5' splice sites in the introns. Stable RNA G-quadruplexes in the vicinity of 5' splice site may be involved in modulating splicing via interactions with regulatory proteins that bind G-rich sequences and influence alternative and tissue specific splicing events.

We have also mapped five categories of Exonic Splicing Enhancers (ESEs) in a subset of ~5,000 human exons. Our analysis found a very strong correlation between the distribution of the positions of ESEs and G-quadruplexes near 5' splice sites in the exons. There is a strong correlation between the distribution patterns of QGRS and ESE positions in alternatively spliced as well as constitutive human and mouse exons. Further investigation revealed overlaps between the predicted ESEs and G-quadruplexes mapped near the splice sites. ESE mediated regulated splicing may in fact involve the G-quadruplex structure. Our findings suggest that G-quadruplexes play a regulatory role in splicing of the human pre-mRNAs.

Pegylation of Growth Hormone-Releasing Factors

Sandralynn Veech, Dr. Arthur Felix

Pegylation, the coupling of biologically active peptides and proteins with poly(ethylene)glycol (PEG), a hydrophilic and non-toxic polymer, produces alterations in both chemical and physical properties of the peptides and proteins, resulting in improved solubilities, increased metabolic stabilities, and extended circulating half-lives. An important advantage is that pegylation can improve patient compliance by reducing injection frequency without decreasing efficacy. Our goal was to develop general conditions for the pegylation of intermediate peptides: e. g. growth hormone-releasing factor (GRF) or somatocrinin, a 44 amino acid endocrine hormone produced in the hypothalamus, the active portion of which is the N-terminal 29-amino acid synthetic peptide known as sermorelin. Growth hormone-releasing factors stimulate the pituitary gland to produce and secrete growth hormone (GH); deficiencies of GH can result in growth retardation or dwarfism.

Conditions, which were previously optimized in our laboratory for the pegylation of thymosin alpha one, were expanded to include the pegylation of GRF(1-44)-NH₂ and GRF(1-29)-NH₂. GRF(1-29)-NH₂ was then pegylated with PEG5000-aldehyde by the same aminoalkylation procedure using a novel H₂O-trifluoroethanol solvent in place of methanol to maintain homogeneity. Confirmation of structure was provided by the hydrolysis of the PEG5000 GRF(1-29)-NH₂ followed by thin layer chromatography, which revealed the presence of amino acids present in the peptide hormone. The aminoalkylation procedure has been extended to include the successful pegylation of GRF(1-44)-NH₂. Biological studies of these pegylated peptide hormones are currently in progress.

Abstracts: Oral Session III

Session Chair: Bethany Walton

3-Mercapto-5,6-diphenyl-1,2,4-triazine: A Potential Reagent for Pegylation of Peptides and Proteins

Michael Chiorazzo, Dr. Arthur Felix

3-Mercapto-5,6-diphenyl-1,2,4-triazine (3-MDT) was synthesized in a single-step double dehy-dration reaction involving benzil and thiosemicarbazide. The resultant 3-mercapto-5,6-diphenyl-1,2,4-triazine has a characteristic spectrum in the ultraviolet-visible region with λ_{max} :318nm (ϵ_{max} :20,900); and λ_{max} :465nm (ϵ_{max} :312). It exhibits two major resonance forms resulting from an in-tramolecular hydride shift between the thiol-3 and nitrogen-2 of the triazine ring. In either form the sulfur group of 3-MDT was shown to be reactive towards benzoic acid and its derivatives using dicyclohexylcarbodiimide (DCC) for the coupling to prepare the thioester. Aromatic acids are preferred for this coupling since they may form a stabilized intermediate en route to the thioester. Thin layer chromatography and infrared spectrometry showed successful formation of the corresponding thioesters. These thioesters are reported to be reactive toward nucleophiles including amino-terminal compounds. In the next stage we plan to introduce poly(ethylene)glycol (PEG) into the active thioester. Reaction of this intermediate with peptides and proteins may open a new route to formation of the corresponding pegylated peptides and proteins. Since 3-MDT is released when the thioester reacts with a nucleophile, this may be use-ful for monitoring the reaction using UV-V spectroscopy.

Creatine Slows Segment Regeneration and Stimulates Fragmentation in the Segmented Worm *Lumbriculus variegatus*

Jeffrey Dodd, Dr. William Mitchell

Lumbriculus variegatus (California blackworm), is a model organism for tissue regeneration studies. Tail segments quickly regenerate from adult stem cells after they are removed. *L. variegatus* can reproduce asexually by fragmentation and stressful conditions tend to stimulate this process. Creatine (methylguanidino acetic acid) is an important compound in replenishing ATP reserves and may also aid in the growth of muscle tissue. Creatine monohydrate is used as a sports dietary supplement and has recently been considered as a possible treatment for conditions such as muscular dystrophy, Parkinson's disease and heart disease. Here we examine the effects of creatine monohydrate on tail segment regeneration in *L. variegatus*. We looked at the effect of this compound from 0.0 mM to 1.0 mM and found that it is inhibitory to regeneration, stimulates fragmentation and reduces the activity (mobility) of the treated worms. Vital staining methods were also used to evaluate the regeneration process.

Recycling Aluminum by Utilizing the Metal as an Electrode in a Fuel Cell

Mercedes Perez, Dr. Clyde Johnson

Solid-state electrochemical systems were constructed to investigate the feasibility of recycling aluminum by using a fuel cell that incorporates the metal as one of the electrodes. Improved performance was obtained with an electrochemical system that utilized an aluminum can as the anode and perforated copper plates as the surface for the cathodic reaction. This system utilized specially treated grated coconut as a solid electrolyte. The aluminum can was oxidized to aluminum hydroxide with the separation of the metal from the ink, coating and sealant used in the manufacture of the can. The aluminum hydroxide was deposited in the electrolyte and can be readily separated and recovered.

Inhibitory Effect Of Acetaminophen On *Lumbriculus variegatus* (Mudworm) Tail Regeneration

Tinisha Ricks, Dr. William Mitchell

Lumbriculus variegatus [mudworm, California blackworm] is an asexual reproducing freshwater oligochaete (phylum Annelida) which is an ideal model for measuring the effects of chemical compounds on body regeneration. During regeneration, adult stem cells migrate to the site of injury and grow into fully functional body segments. Acetaminophen [N-(4-hydroxyphenyl) ethanamide] is an over the counter non-steroidal anti-inflammatory medication which has various roles such as pain relief and the reduction of temperature, but little is known about the affects of acetaminophen on wound healing and regeneration. Here we examine the effects of acetaminophen on tail regeneration in *L. variegatus*. Worm tail segments were removed and the worm anteriors were placed in different concentrations of acetaminophen from 0.0 to 1.0 mM. We found that acetaminophen slowed the rate of tail segment regeneration when observed using digital microscopy. Vital staining methods were also used to evaluate the regeneration process.

Mixed Monomolecular Films of Poly (n-decyl acrylate) and Protein Solutions

Ashley Halstead, Dr. Robert Mentore

Molecular interactions between a monomolecular film of poly(n-decyl acrylate) and a series of protein solution subphases were studied using the Langmuir film balance method. Surface pressure was measured as monomolecular films of the brush-like polymer were compressed on buffered solutions of albumin, fibrinogen, gamma-globulin, immunoglobulin G, and lysozyme. All protein solutions featured proteins in the bulk phase and at the surface, however, albumin exhibited the strongest surfactant behavior. The interaction of a polymer monolayer film with the proteins in the bulk and surface phases provided a means to discern the morphology of the mixed monolayer films and was used to provide a means to observe the affinity between the polymer and the different proteins.

A comparison of the monolayer characteristics of poly(n-decyl acrylate) with proteins was made to earlier studies in which the methacrylate analogue of the polymer was used. The larger backbone substituent causes the methacrylic polymer to be more rigid. The effect of backbone rigidity on the polymer-protein interactions will be presented.

Alkaline pH Prevents Voltage Reversal in Yeast Fermentation of Banana

Mercedes Perez, Dr. Clyde Johnson

A biological fuel cell was constructed to study the electrochemical properties of yeast fermentation of banana. *Saccharomyces cerevisiae*, also known as baker's yeast is known to undergo cellular respiration under both aerobic and anaerobic conditions but voltage reversal usually accompany these processes depending on the amount of available oxygen and carbon dioxide. In this study we succeeded in preventing voltage reversal by manipulating the pH of the electrolyte and monitoring the current-voltage properties over a period of several months.

The yeast successfully degraded the carbohydrates in the banana, while providing measurable electrical output. However, there was a non-linear relationship between voltage and current and the system deviated from Ohm's Law many times during the study period.

Phylogenetics of G-Quadruplex Structural Motifs in the Human PDGF Gene Family

*Elad Tennen, Dr. Paramjeet Bagga, Dr. Lawrence
D'Antonio*

The highly stable G-quadruplex structures found in the G-Rich sections of the genes are formed by multiple stacks, each of which contains four linked guanines. Based on previous research in our lab, it has been hypothesized that G-quadruplexes are involved in regulated splicing. However, the mechanism of this process is not yet clear. The current research project considered the human Platelet Derived Growth Factor (PDGF) Gene Family. These genes are expressed as growth factors in cells of Mesenchymal origin and are known to be associated with cancer. Using QGRS Mapper2 software developed in our lab, all four genes in the family, along with their isoforms, were analyzed for the occurrence of G-quadruplexes within 400 base pairs of all splice sites. The goal of these studies has been to explore the correlation between the quantity, stability and location of the G-quadruplexes, in order to determine their role in the splicing mechanism. G-quadruplexes were found within 400 base pairs of all splice sites in the introns as well as the terminal exons. A large number of G-quadruplexes, including a highly stable motif, were located in the introns flanking the alternatively skipped exon of the human PDGFA gene isoform. Our data suggests a role of the G-quadruplexes in alternative splicing. A phylogenetic comparison of the human PDGFB gene with its chimp, mouse, rat, and dog orthologs revealed conservation of potentially stable G-quadruplexes in the vicinity of splice sites, suggesting that G-quadruplex structures are involved in splicing.

Abstracts: Posters

Characterization of a Novel Gene Potentially Involved in the Regulation of Bone Mass

Randy Astaiza, Dr. Tom Owen

Osteoporosis is a disease characterized by a progressive decrease in bone mass resulting in an increased risk of fracture. The overall goal of this project is to identify signaling pathways which regulate bone mass by characterizing genes not previously associated with bone formation. Previously, a differential analysis of gene expression was performed between the calvaria and long bones of rats of normal bone mass and their osteopetrotic (too much bone) mutant littermates (op/op mutants). The PCR amplification, cloning and DNA sequencing for one of these gene segments, designated clone 135, gave particularly interesting results. Bioinformatics analysis of the 507 bp DNA sequence for clone 135 found no significant similarity to any rat mRNAs, but did have 100% identity to a DNA sequence in the intron between exons 2 and 3 of the rat FKBP-7 gene and an 86% similarity to the same intron in the mouse FKBP-7 gene. This region of similarity was also found in a murine mRNA containing the first two exons of the FKBP-7 gene, suggesting that it may be a novel splice variant of this gene. We used RT-PCR with primers internal to our clone 135 sequence and confirmed that clone 135 is indeed differentially expressed between RNA prepared from the bones of the normal versus the op/op mutant rats. We are currently working to clone the full-length cDNA and analyze the expression of clone 135 in rat osteoblasts to elucidate the role of clone 135 in bone formation.

Diagnosis and Treatment of Dentofacial Abnormalities

Lorraine Brenner, Dr. Edward Saiff

The topic of my research for the past semester, directed by Dr. Edward Saiff, has been to understand the science of tooth movement. This was achieved by gaining experience working as a dental assistant for the orthodontic practice, Montville Orthodontics, personal interviews with board certified orthodontists, Dr. Peter Antonellis and Dr. Melissa Grieder-Roberto, and the examination of dental text books and journals. This research has resulted in the comprehension of three classes of malocclusions, class I, II, and III, as well as other dentofacial abnormalities, and learning various treatment plans for patients in every type of dental age category: primary dentition, early mixed dentition, late mixed and early permanent dentition, and permanent dentition.

Trends in Tree Species Composition Across Vertical Strata in a Mixed Hardwood Forest in the New Jersey Highlands

Kim Camargo, Andrew Collins, Steven Libert, Vincent Napolitano, Kimberly Rodgers, Dr. Eric Weiner

Tree communities in New Jersey Highland forests are in a highly dynamic state as invasive herbivores and diseases are causing population declines in many species. The purpose of this study was to examine trends in tree species composition across five vertical strata (seedlings, lower midstory, upper midstory, subcanopy, canopy/emergent) in conjunction with quantitative evidence of impacts by herbivores and fungal pathogens to predict future species composition in one mixed hardwood forest in the New Jersey Highlands. Over 8,400 seedlings, saplings and adult trees were surveyed across twenty 1,000 m² plots along a 150 m elevation transect on one southeast facing ridge. Trends among strata were used to classify the population of each tree species as either declining, stable or increasing. Four species, *Acer rubrum*, *Betula lenta*, *Liriodendron tulipifera*, and *Sassafras albidum* appear to be declining because they are being outcompeted for light. Populations of each of the four *Quercus* species are in decline due to periodic defoliation by *Lymantria dispar* and sustained seedling browsing by *Odocoileus virginianus*. *Fagus grandifolia* and *Fraxinus americana* are declining due to fungal pathogens. In contrast, populations of *Acer saccharum*, *Carya glabra*, *C. tomentosa*, *Nyssa sylvatica*, and *Prunus serotina* appear to be increasing in part because of the space that is vacated as large *Quercus* trees die after *L. dispar* outbreaks. In conclusion, mid-successional and late-successional tree species that are not currently suffering from severe herbivory or diseases appear to be increasing in abundance. All other tree species in the study plots are in decline.

The Most Horrifying Read Of The Year: The Nutritional Facts On Your Food or a Comparative Study Concerning Nutritional Knowledge in Students of Business and Nursing Majors at Ramapo College of New Jersey

Veronica Cavera, Dr. Richard Lowell

A survey of literature indicates considerable interest in determining the level of nutrition knowledge in various minute populations. Interest remains high due to the link found between nutrition knowledge, eating behavior and health. The public is exposed to consistent streams of claims about foods, diets and supplements that are often fraudulent. The purpose of this research is to construct a valid and reliable instrument for measuring general nutrition knowledge. It will also test the hypothesis that a person's undergraduate major strongly influences nutrition knowledge. Populations tested include biology, biochem, chemistry, nursing, business and English majors. The data collected will be subjected to statistic tests.

Tree Architecture and Niche of Seven Hardwood Tree Species

Manan Dalal, Melissa Giusti, Matthew Howard, Kate Brown, Dr. Eric Weiner

Tree architecture, which is defined as the overall morphology of a tree with special attention to the spatial position of its components, likely plays a major role in the growth and survival of forest trees. The purpose of this study was to compare tree architecture across a variety of tree species in a mixed hardwood deciduous forest. The specific objective was to examine if relationships among architectural variables (e. g., trunk diameter, tree height, canopy characteristics) correspond with regeneration niche as represented by species' abilities to survive and grow in the shade.

Tree height, trunk basal area, canopy height and canopy volume were measured for 20 - 28 trees per each of the study species (total n = 152 trees) in a mixed hardwood forest at the Ramapo Valley County Reservation. The seven study species span a continuum of shade tolerance. Sugar maple and American beech are highly shade-tolerant; pignut hickory, red oak and white ash exhibit intermediate shade-tolerance; black birch and tuliptree are highly intolerant of shade.

Results indicate that for each species, tree architectural variables are highly correlated with one another. Canopy volume was particularly revealing. Species' regression models are segregated by degree of shade-tolerance, with more shade-tolerant species generally having fuller canopies. In contrast, the more commonly studied relationship between trunk diameter and tree height did not segregate by niche. Therefore, further research should examine the ecological importance of canopy architecture.

Dendrochronological Analysis of Tuliptree (*Liriodendron tulipifera*) Growth and Distance from Point Source Pollution

Matthew Howard, Dr. Eric Weiner

Dendrochronology is the study of tree rings to evaluate historical trends in tree growth. The purpose of this study was to use increment cores to explore tuliptree ring growth in a mixed hardwood, wetland forest (central New Jersey) that receives point-source pollution from a road drainage system.

Growth over the past twelve years was measured for increment cores of 24 adult tuliptrees. GPS (global positioning system) and GIS (geographic information systems) mapping were used to measure the distance of each study tree from the pollution source. Results indicate that tuliptree trunk growth has generally been declining at the study site. However, no correlations between tulip tree growth and distance from the point source pollution were found. Given that tuliptrees are known to be fairly salt tolerant, they may not be the best indicator of the presence or impacts of road pollution on forest ecosystems.

Zigs-In-The-Plane Problem

Michele Jastrzembski, Ms. Sara Kuplinsky

The maximum number of regions that n lines determine in the plane is known.

Enter zigs now (Zigs? Never heard of those in my geometry courses!). We present an upper bound for the number of regions n zigs split the plane in, and discuss a preliminary result on an example for which the bound is attained.

Is cis-3-Hexen-1-ol a Plant Growth Regulator?

Kevin Kania, William Mitchell

Cis-3-Hexen-1-ol, commonly called leaf alcohol, is produced by most plants as a lipid break down product and is an attractant to many insects and other animals. The compound is used as a flavoring agent in the processed food industry and tastes “fresh”. Because of the compounds simplicity of structure, wide spread occurrence in plants and low toxicity to animals, we decided to see if this compound can function as a plant growth regulator (plant hormone). Our poster presents data on the effects of cis-3-hexen-1-ol on rooting in *Coleus hybrida* (Labiatae, mint family) cuttings and germination of *Raphanus sativus* (radish, Brassicaceae, cabbage family) seeds.

Microsatellite analysis of Three *Sphagnum* Species of the Eastern U.S.

Rebecca Lake, Melissa Giusti, Dr. Eric Karlin

Sphagnum palustre, *S. henryense*, and *S. centrale* are three morphologically-similar moss species that have been reported to occur in New Jersey. However, based on morphology alone it is unclear whether each species is indeed present in New Jersey. Therefore, a genetic study is a better approach in determining their presence. Microsatellite analysis of 27 individuals was performed in order to accomplish a number of objectives: confirm the ploidy of *S. palustre* and *S. centrale*, and establish the ploidy of *S. henryense*; if polyploid, determine whether autopolyploid or allopolyploid; determine whether the three species are genetically distinct from one another; determine if the three species occur in New Jersey.

Due to the presence of two alleles at the majority of loci, it was concluded that each of the three *Sphagnum* species have diploid gametophytes. Fixed heterozygosity was observed amongst each of the three species as well, indicating that they are allopolyploids. As no significant genetic variation was detected between *S. palustre* and *S. henryense*, it was concluded that they represent one species (*S. palustre*) in the study area. However, *S. centrale* was determined to be a genetically distinct species. Finally, it was concluded that both *S. centrale* and *S. palustre* are, in fact, present in New Jersey.

Tree Swallow (*Tachycineta bicolor*) Reproductive Success At Nine Breeding Restoration Sites In The New Jersey Meadowlands

Steven Libert, Mr. Michael Newhouse, Dr. Eric Weiner

Reproductive success of tree swallows can be impacted by a variety of environmental factors, such as presence of nest predators, abundance of food (insects) and environmental contaminants. This study examines reproductive success during the first laying period in 2008 at nine breeding restoration sites in the New Jersey Meadowlands. Specifically, occupancy, clutch size and fledging success were evaluated for a total of 255 nest boxes.

A total of 130 nest boxes were occupied by tree swallows during the study period. Results revealed that % nest occupancy and % fledging success were significantly lower at Skeetkill Marsh than at other sites. Nest occupancy was also low at Mill Creek Point and at Kearny Marsh. No significant differences among sites were found for clutch size or number of fledglings per nest. Future work will aim to help improve efforts of tree swallow restoration by examining the reasons why some sites are attracting fewer breeding pairs than other sites, and why % fledging success was so low at Skeetkill Marsh.

Microsatellite Ploidy Analysis of 3 *Sphagnum* Species

Katelyn Lukshis, Graeme Gardner, Dr. Eric Karlin

This study was done to determine the ploidy levels of 3 species of *Sphagnum* mosses (*S. mendocinum*, *S. squarrosus*, and *S. papillosum*). *S. papillosum* and *S. squarrosus* have reported ploidy history with cases of both haploid and diploid gametophytes. There are no previous reports for *S. mendocinum*. Microsatellites were used in this study; they have only recently been applied in the study of mosses. DNA extraction, PCR reactions, and sequencing were done at the Shaw Lab at Duke University. Working with the raw sequence data, we “called” the alleles using the GeneMarker® program from SoftGenetics®. We found that for every locus, all the specimens of *S. squarrosus* had only one allele, and thus were determined to be haploid. For both *S. papillosum* and *S. mendocinum*, more than half the loci examined showed fixed heterozygosity in all specimens. We thus concluded that all of the specimens of these two species in this study were gametophytically diploid ($n=2x$). The presence of fixed heterozygosity at many loci in both species is a strong indicator that they are allopolyploids. Our study shows that, in addition to Europe, gametophytically diploid cytotypes of *S. papillosum* also occur in North America. Although *S. squarrosus* has been reported to have both haploid and diploid gametophytes, it appears that the haploid form is predominant.

Catalog of *Plasmodium falciparum* Proteins For Studying Active Sites Using PERL Scripts

Rajesh Ramnanan, Dr. Ashley Stuart

When a female *Anopheles* mosquito bites a person infected with malaria, it draws the malaria parasite up with the blood. The parasite mixes with the mosquito's saliva and when the mosquito bites another human it transmits the parasite into the human's bloodstream, where it multiplies. *Plasmodium falciparum* is the infectious parasite that causes malaria, and its genome has been sequenced and posted on a designated database: PlasmoDB.org. The purpose of this project is to create a link between the published genome of *P. falciparum* and structural-functional information about its proteins. This project uses PERL scripts to take the published information regarding all *P. falciparum* protein sequences and categorizes them based on probable functions (i.e.: motifs/binding sites) and also by their structural properties according to 3-dimensional structures or models, when possible. The protein models are generated through Modeller, and the results will help in the further study of binding sites within Plasmodium proteins and may help in the development of treatments for malaria. Upon categorizing the proteins, an algorithm will be devised to determine which proteins have human homologs by measuring sequence identity. These proteins would then be scanned using Prosite for further structural analysis for generating experimental structures or homology models.

Curve-Fitting Analysis of Adsorbed Polymers

Bethany Walton, Dr. Anita Brandolini

Polymer surface adsorption has an important application in the effectiveness of adhesives and paints. The interaction between a polymer and support can be measured using infrared (IR) spectroscopy. Samples were prepared by dissolving a polymer in a suitable solvent and adding a support such as silica. The carbonyl groups of the polymer bind to the support through hydrogen bonding. The spectral range from 1550 cm^{-1} to 1800 cm^{-1} contains four peaks - two peaks from the silica, and two overlapping peaks for the bound and unbound polymer. A curve fitting program (PeakFit v.4.12) was used to determine the relative amounts polymer and silica, and of free and bound carbonyl segments of the polymer. All peaks were modeled as Gaussian functions of varying intensities and widths, but with fixed frequencies. The effects of polymer types, solvents, and supports are being investigated to assess their influence on polymer adsorption.

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