Berea College

Journal of Undergraduate

Research Abstracts

Science Division

2006

Introduction

During the Fall 2006 Science Retreat, the science faculty at Berea College approved a student initiative proposed by Emilie Throop (Biology - Class of 2007) to publish abstracts of undergraduate research on an annual basis. The following publication is a compilation of abstracts from research conducted by Berea College undergraduates in the Science Division during 2006. An on-line version is accessible at http://chemistry.berea.edu under "Students" and "Abstracts & Presentations." These abstracts represent on-campus projects funded by Berea College's Undergraduate Research and Creative Projects Program (URCPP), and off-campus research at various universities. Most of this collaborative work was presented at scientific meetings including the Annual Meeting of the Kentucky Academy of Science. Presentations and awards are listed below each particular abstract. Hopefully this publication will serve as a resource for: (1) Berea College's efforts in admissions, development, and departmental self-studies and (2) students to locate interesting programs for future research and acknowledge their accomplishments. Though difficult to define, some on-campus work is classified under a single department but actually represents a combined, interdisciplinary effort between several departments.

Acknowledgements (Emilie Throop)

This first journal of Berea College student abstracts would not have been possible without the generous support of many people. In particular, I would like to thank Ron Rosen (Department of Biology) for his assistance and enthusiasm regarding all aspects of the project, and Jay Baltisberger (Department of Chemistry) for arranging the on-line publication. I acknowledge Carolyn Newton, Academic Vice-President/Provost, for providing the funds to print hard copies of these abstracts. Also, many thanks to the science departments for their contributions, and of course to the students for whose hard work this journal is a reflection. Finally, we would like to thank all the off-campus mentors at the following universities for supporting Berea undergraduates: University of Kentucky, Vanderbilt University, University of Wisconsin: Madison, Kansas State University, University of Louisville, Massachusetts Institute of Technology, University of California: Santa Cruz, and the University of Minnesota.

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Farrowing in outside lots increases piglet mortality and decreases sow and piglet tractability.
RENEEN MINCY, QUINN HUSTON-MILLER, G. NEIL DOUGLAS, and DIANNE H. HELLWIG, Department of Agriculture and Natural Resources, Berea College, Berea, KY 40404

Confinement farrowing facilities are commonly used in North America. They can reduce neonatal piglet mortality, improve tractability of sows and piglets, and provide consistent year round environmental conditions. Alternatively, outdoor farrowing may allow expansion of production facilities without significant capital investment and may alleviate the animal welfare concerns associated with confinement farrowing. Sows were farrowed in either conventional facilities or in outdoor lots containing farrowing huts at the Berea College Farm to determine the viability of expanding production with outdoor farrowing lots. Sows were moved to the facilities two weeks before the expected farrowing date and remained there with their litters until weaning at four weeks postpartum. Sow behavior, piglet viability, neonatal mortality, and labor inputs were compared between groups. During the first 24 hours postpartum, a higher proportion of piglets (26.2%) were crushed by sows in outside lots compared to those crushed in confinement facilities (5.7 %). Sow and piglet tractability was greatly reduced. Time spent apprehending piglets in outside lots for routine handling and working was significantly increased. Husbandman safety was also compromised in outdoor facilities. Further research should explore alternative designs for outdoor facilities to decrease peripartal piglet mortality and improve animal tractability. Finally, genetic selection for sow temperament should also be considered when farrowing outdoors.

Effect of land use on spring carabid assemblages in central Kentucky. CRISTIAN AHAMAD and EMILIE THROOP, Department of Biology, Berea College, Berea, KY 40404, and SEAN CLARK, Department of Agriculture and Natural Resources, Berea College, Berea, KY 40404

Insects may be useful tools for monitoring the ecological effects of human land management practices. Ground beetles (Coleoptera: Carabidae) are among the most common arthropods found living on the soil surface in temperate ecosystems, including forests and agricultural systems. Their ecological role as part of a complex of generalist predators has been demonstrated by numerous studies in North America and Europe. The objective of this study was to document the effects of land management practices common to central Kentucky on the ground-beetle faunal composition. Twelve sites in central Kentucky, representing forest, recently clear-cut forest, and agricultural habitats, were sampled in the springs of 2005 and 2006. A total of 45 species were collected, 13 of which were not previously reported from Kentucky. Only one non-native species, *Amara aenea*, was collected. No statistical differences in species richness or diversity among the land-use treatments were found; however, cluster and principal components analyses indicated that species composition was influenced by land use and distinguishable among treatments.

92nd Annual Meeting of the Kentucky Acadmeny of Science, November 9-11, 2006, Morehead State University, Morehead, Kentucky.

Annual Meeting of the Entomological Society of America, December 10-13, 2006, Indianapolis, Indiana.

Deletion and epitope-tagging of cell cycle genes using uncloned PCR fusion products and homologous recombination in *Aspergillus nidulans*. MARLENA MATTINGLY, MEGAN JACKSON, Department of Biology, Berea College, Berea, KY 40403, DAVID TUCK, and PETER MIRABITO, Kentucky Biomedical Research Infrastructure Network Summer Research Program and KYSS Research Program, Department of Biology, University of Kentucky, Lexington, KY 40506.

Three standard approaches to investigate gene function are 1) inactivate the gene (e.g. gene knockouts) and determine the effect on the organism; 2) determine the cellular and subcellular location of the protein; and 3) determine with which other proteins the protein of interest physically interacts. The key to all three approaches is the ability to replace the endogenous gene with altered forms created *in vitro* (gene replacement). Although gene replacements are the "industry standard", they have been laborious and time consuming in all eukaryotes except budding yeast (*Saccharomyces cerevisiae*). Recent technological advances have made gene replacements in several fungi as facile as with yeast. Here we apply this technology to initiate the investigation of six *Aspergillus nidulans* genes implicated in cell cycle regulation. Five are hypothesized to function with the Anaphase Promoting Complex/ Cyclosome (aka APC/C), which is an ubiquitin ligase that regulates multiple cell cycle events. Two, *afrA* and *afrB*, are implicated as cell cycle-stage-specific activators of the APC/C. Three, *ubc3*, *ubc4*, and *ubc11*, are implicated as ubiquitin conjugating enzyme required for APC/C function. The last, *sv9*, was originally identified as required for nuclear division but has since been implicated in lipid metabolism. We report the successful deletion (knock-out) of all six genes, three of which are essential (*afrA, ubc4*, and *sv9*). We also report the isolation of *A. nidulans* strains that probably contain epitope-tagged versions of the genes for use in future cytological localization and protein-interaction studies.

92nd Annual Meeting of the Kentucky Academy of Science, November 9-11, 2006, Moorehead State University, Moorehead, Kentucky.

Increased epithelial cell proliferation and apoptosis by c-myc in the prostatic stroma cells.

LEANNE JENKINS, Department of Biology, Berea College, Berea, KY 40404, XIAOBONG LI and NEIL A. BHOWMICK, Department of Urology, Vanderbilt University, Nashville, TN 37232

The importance of stromal-epithelial cell interaction in prostate tumorigenesis is well established. Many factors, including the members of the TGF beta protein family, are involved in the interactions. Upon knocking out the TGF beta type II receptor in fibroblasts in mice (FßIIKO), fibroblastic hyperplasia, accompanied by pre-neoplastic PIN (prostatic intraepithelial neoplasia) lesions in epithelial cells, were observed where c-myc oncogene expression was elevated in both fibroblast and epithelial cells. Thus we hypothesized that over-expression of c-myc in stromal fibroblasts mediates the developments of PIN lesions in FßIIKO mice. We demonstrated that cell proliferation is elevated in prostate fibroblasts (PF) over-expressing c-myc (myc-PF) compared to both wild type (wt-PF) and FßIIKO (KO-PF) cells. In contrast to wt-PF, myc-PF and KO-PF were found to proliferate in an androgen-independent manner *in vitro*. *In vivo* experiments recombining wild type prostatic epithelial cells with (wt- or myc-) fibroblasts in a xenograft model demonstrated that the prostatic graft from the myc-PF was not different from the wt-PF graft morphologically. However, there were more epithelial proliferative and apoptotic cells in the grafts containing myc-PF, compared to those containing wt-PF cells. This suggests that the c-myc expression in the fibroblasts was likely part of the reason that the FßIIKO prostate developed PIN.

92nd Annual Meeting of the Kentucky Academy of Science, November 9-11, 2006, Morehead State University, Morehead, Kentucky.

PBEF/Visfatin: A link to type 2 diabetes and cardiovascular disease? RACHEL SAUNDERS, Department of Biology, Berea College, Berea KY, 40404, ALFONSO TORQUATI, Department of Surgery, Vanderbilt University, Nashville TN, and ANNA SPAGNOLI, Department of Pediatric Endocrinology, Vanderbilt University, Nashville TN

Visfatin, a protein previously known as Pre B-Cell Enhancing Factor (PBEF), is secreted by lymphocytes. Recent discoveries suggest that this protein is secreted by the adipose tissue as well. Although the role of visfatin is still largely unknown, it does appear to have insulin mimetic properties, binding to the insulin receptor and stimulating glucose uptake. This study investigates the effect of gastric bypass surgery on Type 2 diabetes mellitus (T2DM) and on the risk of cardiovascular disease (CVD) by measuring visfatin levels in adipose tissue. Adipose tissue samples of 30 patients were homogenized, and RNA and protein were extracted. Extracted RNA was subjected to real time PCR to determine visfatin gene expression. Data show increased visfatin levels in the omentum as compared to the subcutaneous tissue of obese Type 2 diabetic and non-diabetic patients. In the normal controls and post-gastric bypass patients, visfatin levels were decreased in the omentum tissue as compared to the subcutaneous tissue. It cannot be determined at this time whether weight loss, caused by gastric bypass surgery, eliminates T2DM and therefore reduces CVD risk.

92nd Annual Meeting of the Kentucky Academy of Science, November 9-11, 2006, Morehead State University, Morehead, Kentucky.

Isolation of suppressor mutations that rescue the developmental block caused by mis-expression of the *Drosophila* CRMP protein. FLETCHER BELL, Department of Biology, Berea College, Berea, KY 40404, and SANTHI CHILIKURI, Kentucky State University, JILLIAN KRAJEWSKI, Western Kentucky University, and DEANNA MORRIS and JOHN RAWLS, Kentucky Biomedical Research Infrastructure Network Summer Research Program, Department of Biology, University of Kentucky, Lexington, KY 40506

The CRMP protein has been extensively studied in mammals and has been implicated in control of neuronal growth cone dynamics. Originally identified as a mediator of semphorin repulsion signalling in cultured neurons (1), it has been shown by numerous studies to physically associate with a variety of intracellular signal transduction and cytoskeletal elements (2,3,4). However, the exact function of CRMP remains entirely unknown. In vertebrates, there are multiple CRMPs that are neuron-limited in their expression and that arise from a duplicated gene family. Our lab's interest focuses upon using the powerful genetic capabilities of *Drosophila* to better understand how the CRMP protein functions in neurogenesis. The sole *Drosophila* CRMP protein is one of two proteins encoded by the *crmp* gene; the other protein, DHP, is the second enzymatic step of pyrimidine catabolism and apparently the ancestral protein in this protein family. These two proteins arise from differential splicing of the *crmp* primary transcript in non-neuronal and neuronal cells (5). At the protein sequence level, *Drosophila* CRMP and DHP are 91% identical, suggesting that the 9% divergent portion of the proteins accounts for the completely divergent functions of these proteins. Null, loss-of-function *crmp* mutations destroy DHP activity, but produce no developmental or distinct neurological phenotypes (6). Thus, we have turned to mis-expression of the CRMP and DHP proteins to detect gain-of-function phenotypes for these proteins and to further study their role in development.

92nd Annual Meeting of the Kentucky Academy of Science, November 9-11, Morehead State University, Morehead, Kentucky.

The roles of phospholipases on reduced phosphatidylcholine (PC) levels after oxygen and glucose deprivation in PC12 cells treated with Tricyclodecan-9-yl-xanthogenate (D609). SAMUEL ADEDIRAN, Department of Biology, Berea College, Berea, KY 40404, and ERIC LARSEN, JIM HATCHER, and RAO ADIBHATLA, Department of Neurosurgery, University of Wisconsin: Madison, Madison, WI 53792

Loss of phosphatidylcholine (PC) is a metabolic response to stroke/ischemia. PC loss compromises the integrity of cell membrane and disrupts cell ionic gradient. *In vivo* models of stroke have shown PC loss to result from increase in the activity of three phospholipases namely, PC-PLC, PLA_2 and PC-PLD. However, in PC12 cells, used as *in vitro* model for ischemia, activity of PLA_2 does not increase after oxygen and glucose deprivation (OGD). Only the activities of PC-PLC and PC-PLD increase. In order to reduce PC hydrolysis and maintain PC levels, D609 was used to inhibit PC-PLC in OGD PC12 cells. D609, however, increased PC hydrolysis, cell death, and the levels of free fatty acids in PC12 cells after OGD. In this study, we investigated whether D609 increased PC hydrolysis by increasing the activity of PLA_2 or the activity of PC-PLD. We found that D609 did not increase PLA_2 activity, and that the increase in free fatty acids levels did not result from elevated PLD activity. Also, D609 induced apoptosis in PC12 cells after OGD and triggered the externalization of phosphatidylserine in the membrane. Lastly, D609 was found to increase the release of cytochrome C from the mitochondria.

92nd Annual Meeting of the Kentucky Academy of Science, November 9-11, 2006, Morehead State University, Morehead, Kentucky. (1st Place – Oral Presentation – Health Sciences Section)

Recruitment of myeloid immune suppressor cells (MISCs) to TGF-β rII ko tumors promotes tumor progression and metastasis. LEIGH MOBERLY, Department of Biology, Berea College, Berea, KY 40404, and LI CHEN and HAROLD MOSES, The Vanderbilt-Ingram Cancer Center, Vanderbilt University Medical Center, 652 Preston Research Building, Nashville, TN 37232-0146

Host inflammatory cells are recruited to tumor sites and contribute to tumor progression. Myeloid Immune Suppressor Cell (MISC) is one such cell type involved in this process. The deletion of TGF-Beta type II receptor (TGF-β rII) in mammary tumor virus-polyomavirus middle T antigen (MMTV-PyVmT) transgenic mice showed shortened tumor latency and decreased survival. Interestingly, increased number of MISCs was found in tumors derived from MMTV-PyVmT TGF-β rII ko mice. This suggests that deletion of TGF-β is involved in the recruitment of MISCs in mammary tumors. The goal of this study was to 1) investigate the recruitment of MISCs to TGF-β rII ko breast tumors by chemokine CXCL5 and 2) understand the role of MISCs in tumor progression and metastasis. Preliminary data indicate an increased CXCL5 production in TGF-β rII ko tumors when compared with controls, a possible mechanism for the recruitment of MISCs. We are currently using western blots and ELISAs to confirm this result. MISCs in tumor microenvironments must provide certain advantages for tumors to progress. Using real time PCR (rtPCR), we found MISCs in tumor microenvironments produce metalloproteinase (MMPs), important enzymes in degrading cellular matrix for tumors to invade. In addition, 4T1 breast cancer cells co-cultured with MISCs form significantly more colonies in Anchorage Independent Colony Formation Assays. Together, these data suggest MISCs contribute to tumor progression and metastasis by providing degrading enzymes and helping establish metastasis colonies. Understanding the recruitment of MISCs to tumor sites and their impact on tumor progression could lead to new opportunities for anti-cancer treatments in the near future.

Oral Presentation, Summer Science Academy Symposium, August 4, 2006, Vanderbilt University, Nashville, Tennesee.

p63 transcriptional regulation of AMPK-Related Kinase-5. JESSE MCCLAIN, Department of Biology, Berea College, Berea, KY, 40404, CHRISTOPHER BARTON, KRISTY SCHAVOLT, and JENNIFER PIETENPOL, Department of Biochemistry, The Vanderbilt-Ingram Cancer Center, and The Center for Molecular Toxicology, Vanderbilt University Medical Center, Nashville, TN 37232-0146, and CHRIS BARBIERI Department of Biochemistry and The Vanderbilt-Ingram Cancer Center, Nashville, TN 37232-0146

p63 is a homologue of the tumor-suppressor p53 and can exist as one of at least six different isoforms. p53-/- mice develop normally but are particularly susceptible to tumor growth. p63-/- mice experience severe developmental problems and lack stratified epithelia and all of its derivatives. Both microarray and Chromatin Immunoprecipitation (ChIP) have been used to determine possible genes regulated by p63. AMPK-Related Kinase-5 (ARK5) has been identified as one of the possible target genes. During nutrient starvation, it has been observed that ARK5 promotes cell survival. It has also been discovered that ARK5 transcript levels increase following application of DNA-damaging agents. We hypothesized that ARK5 may cause an increase in survival when cells were subjected to DNA-damaging agents. Experiments show that over-expression of ARK5 does not alter the sensitivity of HEK293 cells to DNA-damage-induced apoptosis. Other cell lines may however be susceptible to ARK5 apoptosis influence following DNA-damage. ChIP analyses have shown that p63 is bound to a specific sequence within the ARK5 gene. A luciferase reporter assay indicates that TAp63g is able to activate transcription from this site. Studies are currently underway to establish a link between p63 and ARK5 signaling.

2006 Vanderbilt Summer Science Academy Symposium, August 4, Vanderbilt University, Nashville, Tennessee.

Examination of the role of CG 14011 in Testis-Specific Gene Expression. JENNIFER MILLS, Department of Biology, Berea College, Berea, KY 40403, BEN THORNTON, Bellarmine University, Louisville, KY, MOLLY VOLZ, Western Kentucky University, Bowling Green, KY, and HU LI, University of Kentucky, Lexington, KY.

Chromatin packaging of a gene plays a major role in regulating its access by the transcription and DNA replication enzymatic machinery. A repressive form of chromatin that functions in epigenetic regulation known as heterochromatin is formed through binding of specific proteins to specific histone modifications. Our studies of heterochromatin focus on a highly conserved heterochromatin protein (HP1) and its interaction partner (HOAP). Microarry expression profiling studies comparing mutants for HOAP to wild type showed the majority of down-regulated genes to be testes-specific genes. The testes-specific CG14011 protein was identified as a HOAP interacting protein in a genome-wide protein-protein interaction screen. During the summer of 2006, we attempt to generate mutations in the CG14011 gene to examine its role regulating testes-specific gene expression. A PCR assay was used to characterize deficiencies reported to lack the gene CG14011. This assay showed four deficiencies to lack the CG14011 gene. EMS (ethyl methansulfonate) was used to generate mutations in males which were crossed to bTft/CyO females. The progeny were then crossed to 7724/CyO deficiency females. The F2 progeny of these crosses were then screened for lethal mutations that were not complemented by the 7724 deficiency. Any mutation/7724 F2 males that were not recovered were crossed with wild type (yw) females to test for sterility. Four lethal and zero sterile mutations were not complemented by the 7724 deficiency. However, each of them was complemented by the other deficiencies that also lacked CG14011. Therefore we did not recover any CG14011 mutants.

The effects of nest, local and landscape scale habitat features on snake predation of grassland birds. EMILIE THROOP, Department of Biology, Berea College, Berea, KY 40404, and PAGE KLUG, Department of Biology, Kansas State University, Manhattan, KS 66506

In grassland ecosystems, snakes may play an important role in the nesting success of songbirds. The objectives of this study were to determine if grassland birds and snakes share preferred habitat and if nesting success can be modeled through relationships between nest sites and preferred snake habitat features. Yellow-bellied racers (*Coluber constrictor*) were radiotracked on the Konza Prairie and location information, including treatment type and immediate habitat cover, was recorded. Nests of the Dickcissel, Grasshopper Sparrow, Lark Sparrow, Field Sparrow, and Eastern Meadowlark were recorded. Nest success as well as failure that may have been due to snake predation were recorded, and habitat variables at the nest site, local scale, and landscape scale were measured. Principal components analysis was run for habitat features such as litter depth, Robel pole readings, distance to shrubs, forest, rock outcrops, treatment edges, and draws for Dickcissels, then for all species combined. MARK analysis for Dickcissels revealed that shrubby habitat features positively influence nest success. This may be due to the occurrence of both Dickcissels and snakes in shrubby areas, as well as snake foraging strategy (i.e. incidental predation). MARK analysis for all species combined revealed that an overall heterogeneous habitat positively influences nest success. Because the birds monitored have different nesting strategies, the increased nest success due to heterogeneous habitat may be influenced more by nest site preferences than snake predation. These habitat features describe a complex relationship between grassland songbirds and the snake predator community with regards to habitat characteristics.

92nd Annual Meeting of the Kentucky Academy of Science, November 9-11, Morehead State University, Morehead, Kentucky. (1ST Place - Oral Presentation - Ecology And Environmental Science Section)

Behavioral and autonomic measures of motor and emotional factors affecting performance of patients with bipolar disorder in cognitive tasks. ENRIQUE GARCIA, Department of Biology, Berea College, Berea, Kentucky 40404, and TATO SOKHADZE, Department of Psychiatry, University of Louisville, Louisville, KY

Many psychiatric disorders affecting mood such as bipolar disorder (BD) are associated with distinct patterns of cognitive impairments that can be revealed during behavioral tests. This project used the autonomic nervous system (ANS) activity measurement techniques to study central and peripheral neural mechanisms of emotional dysfunctions in BD patients. BD patients and control subjects were tested in two tasks. This included an emotional gender categorization task (faces with neutral and emotional expressions were used as stimuli) and a visual oddball task (subject identifies rare target "X" letter and ignores frequent "O" letter, then responds by pressing key to target or by silently counting targets). A C-2 J&J Engineering, Inc. monitoring system was used to record skin conductance levels, heart rate, thoracic pneumogram, and temperature. Results indicate that BD patients made fewer errors in blocks with targets which displayed sad expressions ($F = 48.8$, $p < 0.001$). Heart rate in sad conditions had tendency to be lower than in happy and neutral conditions ($F = 4.49$, $p = 0.09$). Skin conductance levels tended to be lower in happy conditions than in sad conditions ($F = 4.46$, $p = 0.08$). Motor task compared to silent count resulted in a higher number of errors in BD patients ($F = 13.88$, $p = 0.001$). These preliminary findings suggest that slow speed of response-related processes, along with the slow and more demanding emotional stimulus-evaluation processes, might be important components of the psychomotor impairments even in asymptomatic (remitted) patients with BD.

92nd Annual Meeting of the Kentucky Academy of Science, November 9-11, 2006, Morehead State University, Morehead, Kentucky.

Investigation of hippocampal learning and memory using transgenic and behavioral approaches. NI JI, Department of Biology, Berea College, Berea, KY 40404, and EMILY HUESKE, ARVIND GOVINDARAJAN, and SUSUMU TONEGAWA, The Picower Institute for Learning and Memory, Massachusetts Institute of Technology, Cambridge, MA 02139

Alteration of behavior after exposure to addictive drugs provides a striking example of how chemical changes in the nervous system can influence behavior. Previous research implies that drug-induced long-term potentiation (LTP) of excitatory synapses on dopamine (DA) neurons in the ventral tegmental area (VTA) may enhance the reward sensation after drug intake, leading to the development of addiction. To test this hypothesis, the study sought to achieve temporal and spatial control of the expression of the NMDA receptor subunit 1 (NR1), an obligatory receptor subunit for LTP induction, in the mouse VTA. A transgenic mouse line in which Cre recombinase was knocked into the dopamine transporter locus (DAT-Cre mice) was previously established. To achieve temporal control of NR1 expression, a lentiviral construct containing a Cre-dependent miRNA against NR1 was designed to be packaged into lentiviral particles and for subsequent injection into adult DAT- mice. Currently the key components of the miRNA construct have been cloned into *E. coli* cells. Five variants of the NR1-specific miRNA were transformed into HEK cells and their efficacies assayed using Western blotting and quantitative PCR. The rest of the construct were ligated and transformed into cultured neurons. Expression of the reporter fluorescent proteins in the construct was visualized by confocal imaging. The results show that three of the siRNA sequences effectively silence NR1 expression, and the rest of the construct can be expressed in neuronal culture. It is concluded the lentiviral construct shows promise in generating cell-type- and tissue-specific transgenic mouse models for drug addiction.

Annual Biomedical Research Conference for Minority Students, November 8-11, 2006, Anaheim, California. (1st Place – Research Poster Competition)

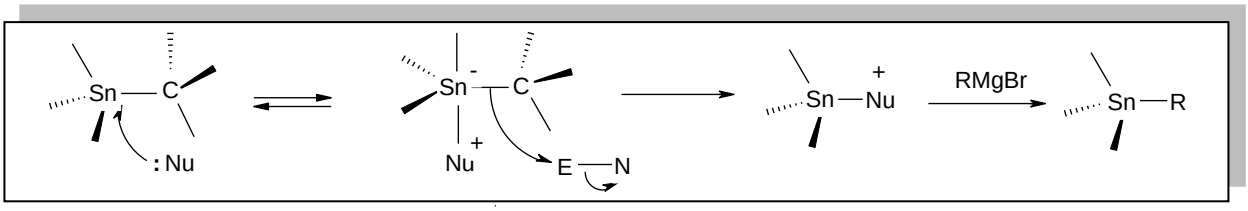
Systematic exploration of drug synergy in haploid *Saccharomyces cerevisiae*. JESSICA FAGAN, Departments of Biology & Chemistry, Berea College, Berea, KY 40404, and VLADIMIR GELEV and SCOTT LOKEY, Departments of Chemistry and Biochemistry, University of California: Santa Cruz, Santa Cruz, CA 95064

The use of drug combinations is becoming increasingly important in the treatment of viral, bacterial, and parasitic infections. While some of the therapeutic cocktails in use today consist of drugs that are also effective individually, therapies consisting of compounds that only act in synergy might provide useful benefits. Benefits could include a decrease in pathogen mutation rate and a reduction in side effects due to lower drug dosage. We describe an efficient screening approach aimed at the systematic exploration of drug synergy effects in fungi. A commercially available collection of 15,136 drug-like molecules was screened in a liquid culture assay for activity against haploid *Saccharomyces cerevisiae*. In this library, compound C239-0032 was found to be the most potent antifungal agent with an IC50 of 20 uM. The liquid culture screen was repeated in the presence of a sub-lethal dose of C239-0032 (10 uM) to identify molecules which synergize with C239-0032 to produce a synthetically lethal effect. We identified 41 compounds that are toxic to yeast only in combination with C239-0032 under the conditions of the assay. The most potent combinations identified in this study will be tested at various concentrations on *Candida albicans* or other pathogenic strains of yeast.

92nd Annual Meeting of the Kentucky Academy of Science, November 9-11, 2006, Morehead State University, Morehead, Kentucky.

Mechanistic studies and synthesis of chiral tin compounds. LAXMAN GURUNG and MARK A. CUNNINGHAM, Department of Chemistry, Berea College, Berea, KY 40404

This research involves mechanistic studies and the synthesis of chiral tin compounds. Because the C-Sn cleavage reaction by electrophiles is selective in nucleophilic solvents such as methanol, but non-selective in non-nucleophilic solvents, it is feasible to synthesize tetrahedral asymmetrical tin compounds. We have synthesized a series of tetrahedrally substituted chiral tin compounds for the purpose of testing the limits of this reaction for sterically diverse ligands. The S_E2 mechanism (shown below) for this reaction provides the potential for expanding its scope to asymmetric synthesis.



Results show that this reaction is tolerant of a wide range of sterically demanding ligands (R) and that yields are typically > 90%, with short reaction times.

92nd Annual Meeting of the Kentucky Academy of Science, November 9-11, 2006, Morehead State University, Morehead, Kentucky.

Electrochemical detection of dopamine from murine retinal amacrine cells. VIRGINIA SENKOMAGO, Department of Chemistry, Berea College, Berea, KY, 40404, and SHENCHENG GE and CHRISTY L. HAYNES, Department of Chemistry, University of Minnesota, MN, 55455

Dopamine is a key neurotransmitter in the retina that is known to play a role in retinal light adaptation, the size of the receptive field and chromatic processing. The abnormal release of dopamine in the retina has been implicated in triggering retinal degeneration. The dopamine trigger hypothesis has not been tested due to insufficient analytical methods for intact cellular or whole retinal studies. Dopamine is an electroactive neurotransmitter; thus, single cell amperometry may be the appropriate tool to complete these studies. However, dopaminergic amacrine cells constitute a minute percentage of retinal cells and, hence, are a challenge to culture for electrochemical studies. Several experiments were done to improve the protocol for culturing and isolating these cells. Firstly, the concentration and time for the dissociation of retinal cells with papain was adjusted. Secondly, retinal cells were plated on cover slips coated with an antibody to the extracellular loop of the dopamine transporter instead of poly-L-lysine. Both of these protocol changes increased the yield of intact dopaminergic amacrine cells. Carbon-fiber microelectrode amperometry was used to measure dopamine release from cells following stimulation with K^+-enriched buffer. Further work is necessary to precisely analyze the characteristics of dopamine release from amacrine cells.

Excess phosphorus in soils receiving swine waste inputs. KRISTINA KECK, JAQUELINE GREENWALDT, LAXMAN GURUNG, DANIEL JORDAN, THABISO MUSAPELO, GENESIS SONG and PAUL SMITHSON, Department of Chemistry, Berea College, Berea, KY 40404

Waste spills from confined animal feeding operations (CAFOs) have had serious water quality impacts in eastern North Carolina and elsewhere. Berea College in east central Kentucky, USA operates a small (400 animal units per year) swine production facility, managed according to standard industry practice. Accidental lagoon overflows have negatively impacted water quality in a stock watering pond downslope from the swine facility. We collected soil samples from 100 georeferenced points in two small watersheds, one that receives lagoon overflow and an adjacent control watershed that receives no swine waste inputs. Soils were analyzed for available phosphorus (Mehlich-3 extractant), and the data analyzed using ArcGIS software (ESRI International). Water samples from the degraded stock watering pond and a nearby unaffected pond were also analyzed for molybdate reactive P. Soils in the drainage path of the affected watershed had significantly higher soil P than adjacent upland samples ($P < 0.0001$), and higher P than in the control watershed's drainage path ($P = 0.0006$). Soil P in the control drain path was modestly higher than in upland samples ($P = 0.035$). Soil P approached or exceeded levels causing elevated P in runoff water in other studies. Water from the degraded pond also had higher levels of molybdate reactive P than the unaffected pond. Farm managers now avoid lagoon overflows by pumping waste onto a pasture outside the pond's watershed. We are monitoring the receiving soils to document soil P build-up and to avoid excess P loading in the application area.

92nd Annual Meeting of the Kentucky Academy of Science, November 9-11, 2006, Morehead State University, Morehead, Kentucky. (3rd Place – Oral Presentation – Chemistry Section)

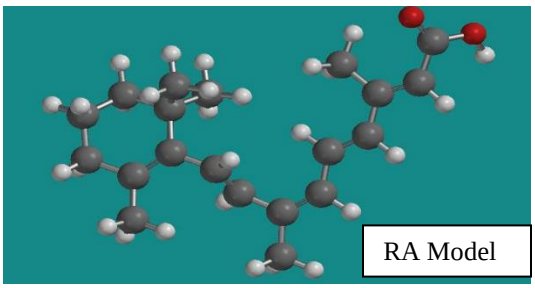
Ammonium and nitrate nitrogen in soils receiving swine waste inputs. JAQUELINE GREENWALDT, LAXMAN GURUNG, DANIEL JORDAN, KRISTINA KECK, THABISO MUSAPELO, GENESIS SONG and PAUL SMITHSON, Department of Chemistry, Berea College, Berea, KY 40404

Confined animal feeding operations (CAFOs) produce large volumes of waste that can have serious water quality impacts. Berea College operates a swine production facility whose waste lagoon overflows have negatively impacted water quality in a nearby stock watering pond. We collected soil samples from 100 georeferenced points in two small watersheds, one that receives lagoon overflow and an adjacent control watershed that receives no swine waste inputs. Field-moist soils were analyzed for inorganic N (ammonium and nitrate) in 1 M KCl extracts, using the indophenol blue method for ammonium and cadmium reduction for nitrate. The data were analyzed using ArcGIS software (ESRI International). Water samples from the degraded stock watering pond and a nearby unaffected pond were also analyzed for ammonium- and nitrate-N. Soils in the drainage path of the affected watershed had significantly higher soil ammonium-N ($P = 0.038$) and total inorganic N (ammonium + nitrate) ($P = 0.003$) than adjacent upland samples, and higher ammonium-N ($P = 0.026$) and total inorganic N ($P = 0.008$) than in the control watershed's drainage path. All inorganic N parameters in the control drain path were not significantly different from upland samples ($P > 0.05$). Water from the degraded pond had higher levels of ammonium-N than the unaffected pond, but there was no significant difference in nitrate-N levels. Farm managers now avoid lagoon overflows by pumping waste onto a pasture outside the pond's watershed. We are monitoring the receiving soils to document changes and avoid excess N loading in the application area.

92nd Annual Meeting of the Kentucky Academy of Science, November 9-11, 2006, Morehead State University, Morehead, Kentucky.

Design and synthesis of retinoid anti-cancer drugs. TAMIRA COUSETT and MARK A. CUNNINGHAM, Department of Chemistry, Berea College, Berea, KY 40404

The focus of this research is to design and synthesize anti-cancer drugs that arrest tumor cell growth through activating retinoic acid (RA) receptors. Approximately 50% of lung cancer cells and comparable percentages of breast cancer cells have low expression of the retinoic acid receptor-beta2 (RAR-β2). Studies show that decreased RAR-β2 expression is a necessary event leading to cancinogenesis, especially in breast, lung, prostate and various other solid tumors. The natural ligand (agonist) that activates RAR-β2 is retinoic acid, a metabolite of retinol (vitamin A). RAR-β2 activation results in increased levels of p27 , a known tumor suppressor protein, which controls cell growth through apoptosis of cells that lack self-control. High toxicity significantly limits the effectiveness of existing market anti-cancer retinoids. Through docking studies, we have designed RA agonists to improve upon the toxicity and efficacy drawbacks of current anti-cancer drugs. In addition, docking studies were employed for screening drug leads and optimizing steric factors and favorable non-covalent interactions. We have found that the most effective drug prospects are those that maintain a similar protein bound conformation as that of the endogenous retinoic acid, but with increased rigidity, obtained by reducing the number of rotatable bonds and enhancing the number of hydrogen bond donors/acceptors. Increased rigidity and more favorable non-covalent interactions along the isoprene moiety (indicated by the arrow in the figure) are expected to reduce toxicity and enhance binding when compared to current market drugs. It was verified through docking studies that the terminal carboxyl group (represented by red balls in the above figure) of the isoprene sidechain is necessary for salt bridge interactions between RA agonist and the RAR-β receptor. The syntheses of a series of analogs are underway, to be followed by biological testing for anti-cancer activity.



RA Model

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The influence of the inhibitor caloxin on the PMCA pump in organ cultured porcine lenses and human lens cell cultures. KATIE CLARK, Department of Chemistry, Berea College, Berea, Kentucky 40404, and D. BORCHMAN and D. TANG, Department of Ophthalmology and Visual Science, University of Louisville, Louisville, KY

Calcium homeostasis is essential to lens clarity. Calcium is elevated in all cataractous lenses. A plasma membrane calcium pump, PMCA, is essential for removing calcium from the cytoplasm. My study focuses on the impact of PMCA on calcium homeostasis. The PMCA specific inhibitor, caloxin, was used to determine if the inhibition of PMCA causes lens calcium to rise in organ cultured porcine lenses and cell cultured human lens epithelium. Caloxin caused the levels of calcium to increase in organ cultured porcine lenses. H_2O_2 and caloxin treatment also caused calcium levels to rise in cell cultured epithelium. This confirms that PMCA viability is a factor in maintaining calcium homeostasis in the lens. Therapies to keep PMCA viable could potentially prevent the onset of cataracts in humans.

92nd Annual Meeting of the Kentucky Academy of Science, November 9-11, 2006, Morehead State University, Morehead, Kentucky. (1st Place - Poster Competition – Health Sciences Section)

Analysis of local ginseng samples by electrospray ionization mass spectrometry. JUSTIN POAG and MATTHEW SADERHOLM, Department of Chemistry, Berea College, Berea, Kentucky 40404

Ginseng's therapeutic qualities have been known throughout the eastern world for thousands of years. During the past 300 years, knowledge of ginseng's benefits spread to the west, but insight into its biological activity were slow to follow. Recent studies have shown that this activity is most likely due to a group of 20 steroidal saponins known as ginsenosides. Many of these structures have unique mechanisms of action in the human body, with effects ranging from possible anticarcinogenicity to increased energy and memory uptake. While several studies have focused on identifying ginsenosides, fewer have made it a point to quantify the relative amounts of each, especially within the subsets of North American ginseng, *Panax quinquefolius*. This study sought to compare the abundance of specific ginsenosides in Appalachian wild and wild-cultivated ginseng with that of commercially cultivated ginseng and ginseng extract pills using liquid chromatography mass spectrometry (LC-MS) and tandem mass spectrometry (MS-MS). The study showed that Appalachian ginsenoside levels were constant regardless of whether the sample was wild or wild-cultivated and that levels generally corresponded to commercially cultivated American ginseng.

Synthesis of deformylflustrabromine b analogs. SAY-LEE TEH, SARAH KIM, MARK CUNNINGHAM AND SAMUEL DAVID, Department of Chemistry, Berea College, Berea, KY 40404

Deformylflustrabromine B is a recently discovered (2004) marine natural product from the benthic North Sea bryozoan *Flustra foliacea*. Deformylflustrabromine B was found to bind and inhibit the alpha 7 subtype of the Nicotinic receptor in the micromolar range. In order to increase binding to the alpha 7 receptor, we used the docking program, ICH MOLSOFT to design various analogs of Deformylflustrabromine B. We present here the synthesis of one analog, Analog 3. This and other analogs will be used in assays to test for increased biological activity compared to the lead compound.

Half metallic ferromagnetics. AMER S. LAHAMER and PATRICK MONO, Department of Physics, Berea College, Berea, KY 40404

Half metals are defined by a particular spin of the conduction charge carriers. To have a 100% spin polarized charge carriers of one particular spin requires that a band gap between the two spin states exists and one of the spin states falls on the Fermi energy level. In other words one spin channel becomes conducting while the other becomes insulating. Band gaps can be covalent, or as a result of charge transfer, or a d-d band gaps. Covalent band gaps exist in semiconductors and Heusler alloys where the crystal structure and site occupation are essential. Most of the known half metals in this category are oxides or Heusler alloys which turned out to be weak magnets. In reality there is no direct measurement of the degree of half metalicity in compounds. Hence, most of the experimental work relies on the predictions of numerical band calculations. NiMnSb and $Fe_{1-x}Co_xSi$ were predicted to be half metals. Half metalicity (100% spin polarization) is difficult to achieve at finite temperatures and also is affected by crystal defects. In addition bulk properties can be very different from surface and interface properties. So the search is on for half metals with as high spin polarization as possible as they hold the potential of great breakthroughs in the electronic world. These half metals hold the promise for spintronics. The half Heusler NiMnSb and the $Fe_{1-x}Co_xSi$ compounds were synthesized using the solid state method and X-ray diffraction was used to identify their crystal structures. Resistivity and the Hall-effect measurements at two temperatures were undertaken. Our results will be discussed.

Calculation of conductivity of thin wires using Boltzmann transport equation. KANNATASSEN APPAVOO and KINGSHUK MAJUMDAR, Department of Physics, Berea College, Berea, KY 40404

We calculated the conductivities of a thin rectangular wire with specular and diffusive surfaces using the Boltzmann transport equation. We found the conductivity of the wire increased as we increased the aspect ratio (width/thickness) of the wire. For perfectly specular scattering, the conductivity is the same as with the bulk conductivity. Finally, we compared the conductivity of thin wires with thin films and found that the conductivity of thin wires decreased faster than that of the films due to lateral confinement.

92nd Annual Meeting of the Kentucky Academy of Science, November 9-11, 2006, Morehead State University, Morehead, Kentucky. (1st Place – Oral Presentation – Physics And Astronomy Section)

A study of optical rotation and linear polarization. MICHAELA CONLEY and A. S. LAHAMER, Department of Physics, Berea College, Berea, KY 40404

The capability to measure polarization properties of multiply scattered light yields several experimental observables such as optical rotation and the degree of (linear, circular) polarization. These can be used to characterize turbid media such as noninvasive detection of chiral glucose molecules in turbid biological tissues. Our experiment was to quantify the surviving linear polarization fraction and the optical rotation imposed upon a linearly polarized light beam which was passed through a reference solution of polystyrene microspheres and (l(-), d(+)) arabinose (chiral), mixture (racemic), and glycerol (achiral) substances. A chopped unpolarized HeNe laser beam of light was passed through a linear polarizer situated at 45° to the vertical. The ray then passed through a photoelastic modulator (PEM) with its modulation axis horizontal, a modulation frequency of 50 kHz, and a retardation of 3.469 rad. The light then passed through the sample solution. A pinhole aperture was placed at 90° to the incident beam. This aperture was then followed by another linear polarizer also called an analyzer set at θ which varied from 30° to 150° in 15° intervals. Another pinhole aperture was placed between the analyzer and the photomultiplier tube (PMT). The signal detected at the PMT was then sent through a pre-amplifier to the lock-in amplifier where it was compared to a reference signal from the chopper. A plot of the 2f/dc ratio (the lock-in 2f reading divided by the reference dc reading) versus the analyzer angle θ was made for each substance. The surviving linear polarization was extracted from the fits of the data for each of the substances. The optical rotation was found to be $(-3.60 \pm .87)^\circ$ for the chiral l-arabinose. The polystyrene and glycerol solutions produced an optical rotation of $(1.97 \pm .81)^\circ$ and $(2.70 \pm 1.57)^\circ$ respectively. This technique has the potential to allow for the extraction of the effect of the chiral constituent from depolarizing backgrounds. These preliminary values are in relatively good agreement with the values found in literature (Journal of Biomedical Optics July 2002).