

#1 - EFFECTS OF FEEDING SERICEA LESPEDEZA AS A NATURAL DEWORMER AGAINST HAEMONCHUS CONTORTUS ON POSTPARTUM DOES. Jamie Vest, Dr. Beth Walker, Angela Boyer, Animal Science. Advisor: Dr. Beth Walker

In the United States, infection of the internal parasite *Haemonchus contortus* is the leading cause of goat mortality. *Haemonchus contortus* is difficult to control because it continues to build resistance to synthetic anthelmintics. Use of alternative parasite control methods, including forages containing condensed tannins (CT), have been found to reduce parasite load. Forty mature Boer influenced does expected to kid from mid April to late May will be divided into treatment and control groups based on fecal egg count, kidding date, and weight. Diets will be isonitrogenous and isoenergetic. The control diet will consist of alfalfa pellets while the treatment diet will consist of sericea lespedeza pellets. At 45 days prior to kidding, does will be weighed, fecal and blood samples taken, and assigned a FAMACHA score. Upon kidding body weight and gender of the kids will be obtained, and milk production and fecal and blood samples taken from the does. Goats fed CT have been found to have lower *H. contortus* fecal egg counts because of an increase in available protein to the small intestine, improving the nutritional status of the doe. Fed at kidding, does may have greater milk production and lower kid mortality.

#2 - JOURNAGAN RANCH WILL EXPAND, TRANSFORM, AND PROVIDE ECONOMIC OPPORTUNITIES FOR MISSOURI STATE AGRICULTURE STUDENTS. Jocelyn Butler, Agriculture. Faculty Advisors: Dr. Anson Elliott, Dr. Beth Walker.

Leo Journagan and family have committed to donate Journagan Ranch, the second largest gift in Missouri State history, which will expand, transform and provide economic opportunities for agriculture students at MSU. Journagan Ranch lies in Douglas County and contains more than 3,300 acres with pasture, rolling hills, creeks, trees, and ponds. The ranch has barns, equipment and working pens along with approximately 1000 head of commercial and purebred Hereford cattle. This analysis will incorporate the use of many aspects of the ranch including the registered Hereford cattle, extensive native pasture ground, creeks and ponds, and the extensive forest and tree population. These aspects of the ranch will be used as the materials portion of the studies to be conducted. Journagan Ranch can be utilized through conducting studies in grazing, genetics, water economics, wildlife biology, and animal husbandry. Through these potential studies, students will learn via hands-on teaching experiences, collecting and analysis of data, and the publication thereof. In turn, these studies and can be used as tools utilized by MSU students and faculty to provide tours to teach and educate the public about agriculture in Missouri.

#3 - TESTING PLANT EXTRACTS FOR INSECT DETERRENTS; A STEP TOWARD SUSTAINABLE PEST MANAGEMENT. Samantha L. Sellars, MSU-West Plains, General Studies and MSU-Mountain Grove, Agriculture, Faculty Advisor: Dr. Maciej Pszczolkowski

Sustainable Pest Management, the concept of Lewis et al., P.N.A.S., 94:12243 (1997), is a method of pest control that insists on understanding pest biology in order to reduce using of broad-spectrum chemical pesticides. The codling moth, *Cydia pomonella*, L., is an insect pest that does extensive damage to apple crops. Currently in many countries (including the United States), the main method of codling moth control is spraying with broad spectrum insecticides such as Azinphos-Methyl. This method of insect control is unsustainable. In order to sustain health and natural resources, a new system of codling moth management must be developed.

By testing plant extracts we are beginning to tackle the current problem of unsustainable control of codling moth. The idea behind the research with plant extracts is to find a plant-derived deterrent that would prevent apple infestation by codling moth larvae. To study and record the behavior of the codling moth in response to various plant extracts, we developed a novel bioassay. Our long-term goal is to find a combination of methods to successfully combat apple pests by taking a new approach.

#4 - ANALYZING THE CORRELATION OF VIRUS-LIKE SYMPTOMS AND VIRUSES IN GRAPEVINES. MacKenzie R. Keller, Plant Science. Faculty Advisor: Dr. Wenping Qiu.

Grapevine viruses can have a serious impact on vine health, quality, and fruit yield, and thus devastating consequences to a vineyard. So in order to control virus diseases, we have to determine if there is a correlation between virus-like symptoms on grapevines and actual viruses. By learning what symptoms are connected to specific viruses can we begin to eliminate the infected vines and stop or at least slow the spread of these viruses. For the experiment, samples were collected from vines with apparent symptoms in the field. The crude RNA was extracted and purified to acquire total RNA. After DNase treatment of total RNA, Reverse Transcription PCR (RT-PCR) was performed to obtain cDNA. The virus testing was done by PCR with primers designed on coat protein region of *Tomato ringspot virus* (ToRSV) and *Grapevine fanleaf virus* (GFLV) to test a correlation between viruses and their specific symptoms. At this time, there is no conclusive correlation between the two viruses and their symptoms, so further investigation of more viruses are currently in progress to discover the possible causal agents for the severe diseases on grapevine.

#5 - TESTING EFFECTS OF AGE ON LARVAL VIABILITY, METAMORPHOSIS, AND JUVENILE CONDITION IN FRESHWATER MUSSELS. Amy Cravens, Rowena Woode, Agriculture. Faculty Advisor: Dr. Chris Barnhart.

Freshwater mussels are the most threatened animals in the US. Seventy species are federally endangered. We are propagating mussels for population restoration and for toxicology research. Mussel larvae are brooded for months within the female, and then are briefly parasitic on fish where they metamorphose to the juvenile stage. One important question is whether older larvae and juveniles that develop from older larvae are as healthy as younger larvae and juveniles. We tested old and young larvae of mussels by placing them on host fish, recovering the juveniles, and then observing duration of survival of juveniles. We inoculated 36 largemouth bass with larvae from six females. Three females had 5-mo old larvae, and three had 18-mo old larvae. We determined the proportion of attached larvae that metamorphosed, and then observed the survival of juveniles during starvation, as a measure of their condition. Older larvae were equally able to attach to the host, but were significantly less likely to successfully metamorphose ($p=0.016$, T-test). The time to 50% mortality (LT50) of starved juveniles was 25.5 days and was similar for juveniles from old and young larvae. These data suggest that older larvae are suitable for propagation and toxicology research.

#6 - FRIGHT RESPONSES OF OZARK ZIGZAG SALAMANDERS (PLETHODON ANGUSTICLAVIUS) EXPOSED TO SUBSTRATE AND AIRBORNE CUES FROM ARMADILLOS (DASYPUS NOVEMCINCTUS). Carly McGrane and Adam Crane, Biology. Faculty Advisor: Dr. Alicia Mathis.

Amphibians often exhibit innate recognition of odors from sympatric predators. When new predators invade a habitat, either through range extensions or introductions, prey individuals may be at a high risk because they do not recognize the predators as dangerous. The armadillo forages in soil and leaf litter, and is likely a predator of forest salamanders. We tested whether Ozark zigzag salamanders (*Plethodon angusticlavius*) exhibit anti-predator behavior in the presence of armadillo chemical cues and whether they can discriminate between armadillos and a nonpredatory sympatric mammal. We conducted two laboratory experiments where salamanders were exposed to feces of armadillos, feces from a nonpredator (white-tailed deer) and a blank control; cues were placed on the substrate in one experiment and were airborne in the other. In the substrate experiment, salamanders appeared to recognize armadillos as a threat because they increased escape behaviors in the presence of armadillo stimuli relative to the controls. In tests with airborne chemical cues, salamanders spent relatively more time in an inconspicuous posture (bodies flat on substrate) when exposed to the armadillo stimuli. Whether this result is due to chemical cues that are specific to the armadillo or based on cues its diet will require further testing.

#7 - THE EFFECTS OF PRESCRIBED FIRE ON SPECIES RICHNESS AND ABUNDANCE IN OAK-HICKORY WOODLANDS. Carter Kinkead, Wildlife Conservation & Management. Faculty Advisor: Alexander Wait.

A decrease in fire frequency in Oak-Hickory woodlands has led to significant structural changes in these forest types across the Midwest, including increased tree density, basal area, and canopy cover. Implementing prescribed fire to restore and maintain these ecosystems should reverse these trends and also result in changes in species richness, and abundance. To assess this, I analyzed data from burned and unburned plots at the Dury-Mincy Conservation area that were sampled over a 3 year period. Of the 20 plots sampled, there were 6 control plots (C) in unburned degraded woodland, 6 in a burned (B) degraded woodland, and 8 reference plots (R) in a burned open woodland. The number of species in R plots was greater each year than in C or B plots, and contained a higher percentage of unique species in the understory. Burning promotes species richness within a variety of forbs, grasses, and shrubs that may result in long term composition changes. The effects of compositional transition may have variable effects on the ecosystem and included organisms over time.

#8 - PERTURBED ENDOSOME MOTILITY IN *VPS1* MUTANTS. Chad Highfill, Biology. Faculty Advisor Dr. Kyoungtae Kim.

The purpose of this research was to investigate whether Vps1 is involved in the intracellular trafficking of endocytic vesicle (endosome), a membrane bound compartment formed via endocytic pinch-off. To this end, we used a lipid binding dye FM4-64 to label the endosomes so that we could track their movement using a fluorescence microscope. We measured the degree of movement of the vesicles in wild type (WT) and mutant cells with a formula termed MSD (mean squared displacement, μm^2). First, our results demonstrate that three conserved residues of the N-terminal GTPase domain of Vps1 are required for endosome motility en route to the vacuole. Second, the C-terminal GED (GTPase effector domain) was found to be more important in endosome motility, suggesting that the GED domain is critical for GTPase activity. Representative endosome tracks revealed that endosomes move in a relatively linear fashion in WT cells, while mutant endosomes move in a relatively random fashion. Finally, we show here that the intact actin cable structure is a critical factor for endosome motility en route to the vacuole. Our results obtained in this research provide some insights for Vps1's role in intracellular vesicle trafficking.

#9 - COMPARISON OF DIFFERENT INDICATOR METHODS FOR THE DETECTION OF FECAL CONTAMINATION IN FRESHWATER STREAMS. Darin T. Dieckhoff, J. Rhy Norton, Biology. Faculty Advisor: Dr. John Steiert.

When health departments post streams as unsafe for full-body contact due to high *E. coli* levels, this indicates potential human pathogens may be present. Various indicator organisms (like *E. coli*) are used to assess fecal contamination because of the difficulty associated with assessing the streams for hundreds of different pathogens. This study compared two commonly used methods, Colilert® and Enterolert® (Idexx), to recently developed molecular methods for quantifying different indicator organism levels. Additionally, we compared two recently developed microbial source tracking methods for human fecal contamination. Water samples were collected from two sites along Wilson's Creek in southwest Missouri each week over a seven month period. Stream flow rate and monthly rainfall data was recorded for the sampling period. Each week, DNA was extracted from one of the water samples for use with bacteroides and enterococci PCR assays. The Colilert assay exhibited high correlation ($r > 0.96$) with qPCR results: AllBac, HuBac, and qEnt. Whereas, the Enterolert assay showed less correlation ($r < 0.87$) with the qPCR assays. High correlation was found between monthly rainfall ($r > 0.85$) and flow rate ($r > 0.95$) for Colilert and qPCR results; while for the Enterolert results no correlation ($r < 0.001$) was shown for flow rate and low correlation ($r = 0.62$) for monthly rainfall.

#10 – THE EFFECTS OF PRESCRIBED FIRE ON OVERWINTERING FUNGAL ABUNDANCE AND DIVERSITY: A BASELINE STUDY. Geoffrey Zahn, Biology. Faculty Advisor: Dr. Alexander Wait.

The use of prescribed fires to manage woodlands has become a common practice but many of the effects of such treatments have still not been studied. One such unstudied effect is that of fire on the composition of decomposing fungi. In a preliminary effort to observe trends in the diversity and abundance of decomposing fungi between burned and unburned sites in Ozark oak/hickory forests, three plots (30m²) in each fire treatment area were sampled for overwintering macrofungi. All observed fruiting bodies of fungi were identified and enumerated. Although the unburned woodland supported a significantly greater abundance of fungi (~104% more, P=0.038), no significant difference in fungal diversity was found using the Shannon-Weiner or Simpson indices between the sites. Greater abundance may be generally due to a greater amount of unburned downed wood, but this was not tested. Due to the clonal nature of fungi, each distinct group of fruiting bodies was listed as one encounter for the purposes of this poster. This allowed a more robust assessment of abundance and diversity. Continuing studies are recommended in order to track changes in the composition of saprobic fungal communities and to determine the cause of greater fungal abundance in the unburned sites.

#11 - CELL EATING DISORDER BY LOSS OF PIL1. Jacob E. Boxberger, Erin R. Murphy, Geoffery Zhan, Fred Loor, Biology. Faculty Advisor: Dr. Kyoungtae Kim.

Endocytosis is the process by which cells uptake extracellular materials at specific sites termed eisosomes. The protein Pil1 is known to control the assembly of these sites. The loss of Pil1 leads to defects in the cellular eating process, therefore, we hypothesized that Pil1 is required for proper endocytosis. To observe the defects caused by the loss of Pil1, we examined the actin organization in both *pil1Δ* and WT cells and found no significant actin defects in *pil1Δ* cells. Next, we found that the loss of Pil1 resulted in a significant delay in liquid-phase and receptor-mediated endocytosis, supporting our hypothesis. To find the potential mechanism of Pil1 on endocytosis, we tested whether the *PIL1* gene genetically interacts with several key genes required for endocytosis. We show here that *PIL1* interacts with *RVS161* and *RVS167* and the interactions are essential for cell viability at the non-permissive temperature. Because *Rvs161* and *Rvs167* are key components of endocytic scission machinery, it is likely that *PIL1* is involved in the membrane pinch-off. The localization of several scission markers was tested in both *pil1Δ* and *pil1Δsjl2Δ*. Results show that all tested scission markers were mistargeted in *pil1Δsjl2Δ* strain.

#12 – GENETIC INTERACTION BETWEEN *VPS1* AND *CHC1* GENES INVESTIGATED BY TETRAD ANALYSIS. Jeff E. Sletto, Daobing Wang, Biology. Faculty Advisor: Dr. Kyoungtae Kim.

Motility in migrating cells is possible by the utilization of actin assembly and disassembly. Most of the actin related genes found in *Saccharomyces cerevisiae* and their subsequent proteins are analogous to those found in cancer cells. Considering the complexity of manipulating eukaryotic cancer cells, Dr. Kim and I have been using yeast as a model for our study. I have been trying to relate the genetic/physical interaction of the Dynamin-like protein *VPS1* and Clathrin (*CHC1*) found in yeast. *VPS1* collaborates with Clathrin at exocytic events on the Golgi membrane. It is also known that *VPS1* and Clathrin are recruited to endocytic sites, however the functional synergy between them has not been tested. I have been testing the genetic deficiency of both of these genes by observing the growth defects found in double knockout mutants. The Method for obtaining a double knockout cell involved making and using single knockout strains and mating them to create progeny that contained a genome with both genes removed.

#13 - INCLUSION OF GRAPE SEED EXTRACT AS A DIETARY SUPPLEMENT REPRESSES NEURON AND GLIA ACTIVATION IN TRIGEMINAL NUCLEUS CAUDALIS IN RESPONSE TO CHRONIC TRIGEMINAL NERVE STIMULATION. Jeffrey Hirst, Ryan Cady, M.S., Paul Durham, Ph.D. Biology. Faculty Advisor: Dr. Paul Durham.

Natural products such as grape seeds represent an underutilized resource in the pursuit of safe and effective ways to treat neurological diseases. The goal of this study was to identify effects of including grape seed extract (GSE) as a dietary supplement on neurons and glia in the trigeminal nucleus caudalis (TNC) in response to chronic peripheral stimulation of trigeminal nerves. In response to GSE, expression of MKP-1 was increased in both neurons and glia within the TNC while GLAST was elevated only in glia. Rats receiving injections of CFA had increased staining for P-p38 in neurons and for OX-42 in glia. However, levels of P-p38 and OX-42 in the TNC of GSE rats injected with CFA were significantly decreased compared to levels in CFA-treated animals. Furthermore, rats on a diet supplemented with GSE showed decreased CGRP expression in TNC neurons when compared to control animals. Our data provide the first evidence that inclusion of GSE as a dietary supplement can suppress central sensitization, a key event in migraine pathology. We predict that GSE as a dietary supplement would be beneficial as a natural therapeutic option for chronic migraine as well as other chronic pain conditions involving the head and face.

#14 – OPTIMIZATION OF SALIVA COLLECTION METHOD FOR BIOMARKER ANALYSIS. Jeremiah Athmer, Ryan Cady, Paul Durham. Biology. Faculty Advisor: Dr. Paul L. Durham.

Determining the concentration of CGRP in saliva has the potential to aid in treatment of migraine and other pain disorders in the head and face. The original method for stimulating saliva release was applying a dilute citric acid solution to the tip and sides of the tongue. However, there are technical problems and compliance issues associated with this method. The goal of this study was to determine whether stimulating salivatory glands by chewing a citrus gum would yield similar biochemical changes as seen in response to citric acid stimulation. Saliva samples were collected from volunteers at three different time points during the collection procedure on three consecutive days and analyzed for total CGRP levels and levels normalized to total protein and volume. CGRP levels in the saliva samples at all time points were similar regardless of the method of stimulating saliva release. Data collected from this study will be used to aid in the setup and design of further studies focused on identifying and utilizing biomarkers in saliva to help in the diagnosis and treatment of pain conditions of the head and face.

#15 - DO PARASITE-INDUCED ENERGETIC DEMANDS AFFECT THE FORAGING AND ANTIPREDATOR BEHAVIOR OF RAINBOW DARTERS (*ETHEOSTOMA CAERULEUM*)? Adam Crane, Andrea Crownhart, John Lisek and Dr. Chris Barnhart, Biology. Faculty Advisor: Dr. Alicia Mathis.

Parasites are known to affect an array of phenotypic characteristics of their hosts including morphology, physiology and behavior. We examined the foraging and anti-predator behavior of rainbow darters (*Etheostoma caeruleum*) when they were infected with mussel (Unionidae) larvae (i.e. glochidia). These ectoparasites use specific fish species directly as their definitive hosts by attaching primarily to fish gills. The glochidia become encapsulated for a period of days and develop into free-living juveniles which disperse into the water, typically without causing any obvious harm to their fish hosts. In our experiments we found that darters infected with glochidia fed more readily than non-infected darters under threat from predation (signaled by the presence of a chemical alarm cue), indicating a possible cost of increased exposure to predators for infected darters. Although infected darters foraged more efficiently by consuming more prey/move than non-infected darters, infected darters lost more weight during the course of the experiment than non-infected darters. The use of an energy gain/conservation strategy by infected darters likely has ecological and evolutionary implications for both the host and the parasite.

#16 – DEVELOPMENT OF FUNCTIONAL UNITS WITHIN TRIGEMINAL GANGLIA CORRELATES WITH INCREASED EXPRESSION OF PROTEINS INVOLVED IN NEURON-GLIA INTERACTIONS. Jordan L. Hawkins, B.S., Filip G. Garrett, M.S, and Paul L. Durham, Ph.D., Biology. Faculty Advisor: Dr. Paul L. Durham.

Cell bodies of trigeminal nerves, which are located in the trigeminal ganglion, are completely surrounded by satellite glial cells and together form a functional unit that regulates neuronal excitability. The goals of this study were to investigate the cellular organization of the rat trigeminal ganglia during postnatal development and correlate those findings with expression of proteins implicated in neuron-glia interactions. During postnatal development there was an increase in the volume of the neuronal cell body, which correlated with a steady increase in the number of glial cells associated with an individual neuron from an average of 2.16 at birth to 7.35 on day 56 in young adults. Interestingly, while the levels of the inwardly rectifying K⁺ channel Kir4.1 were barely detectable during the first week, its expression in satellite glial cells increased by day 9 and correlated with initial formation of functional units. Similarly, expression of the vesicle docking protein SNAP-25 and neuropeptide calcitonin gene-related peptide was readily detected beginning on day 9 and remained elevated throughout postnatal development. Based on our findings, we propose that the expression of proteins involved in facilitating neuron-glia interactions temporally correlates with the formation of mature functional units during postnatal development of trigeminal ganglion.

#17 - USING MOLECULAR MARKERS TO BREED DISEASE-RESISTANT GRAPEVINES FOR SUSTAINABLE VITICULTURE. Alex Mann, Jos Glasson, Alyssa Higgins, and Courtney Coleman. Faculty Advisor: Dr. Laszlo Kovacs.

Powdery mildew is the most serious fungal pathogen of grapevine. It is controlled by large quantities of fungicides which pose a risk to human health and the environment. To avoid the heavy use of chemicals in vineyards, we are developing grape varieties with innate biological resistance to powdery mildew. A resistance gene, named *RENI* has recently been mapped in grapevine as a result of collaborative efforts between Missouri State University and the University of Udine, Italy (Coleman *et al.*, BMC Genetics 10:89; 2009) . This work identified several new microsatellite markers near the *RENI* gene. In the current project, we have tested these new markers to determine if they can be used for DNA-based selection for grape seedlings that inherited *RENI* in a breeding population. In the first step, we have determined which *RENI*-linked markers are most informative for selection in this population. In the second step, we have searched the population for plants that inherited *RENI*. This work is the first phase in a breeding scheme to develop grape varieties that will combine three different powdery mildew resistance genes (*RENI* plus two others) and will facilitate sustainable grape cultivation with reduced or no fungicide application.

#18 - DEVELOPING BIOSENSOR TECHNOLOGY FOR THE DETECTION OF BIOLOGICAL SUBSTANCES. Logan Q. Sullivan, Ryan Cady, M.S., Paul Durham, Ph.D. Biology. Faculty Advisor: Dr. Paul Durham.

Current systems for detecting and measuring proteins and bacteria are limited in capability and scope. The goal of this study was to develop novel ways to meet the need for portable real-time systems capable of detecting and identifying biological and chemical substances in solution. Towards this end, device platforms including single wall carbon nanotubes (SWNTs) and gold-embedded polymer (Au/PSA) layered on glass slides were utilized to determine binding efficiency of fluorescently labeled *Bacillus atrophaeus* spores, thiolated D-DNA, or L-DNA (Spiegelmer) specifically created to bind the neuropeptide CGRP. The binding of *B. aptophaeus* spores was dependent on the substrate thickness and type, with 45Å Au/PSA achieving the highest binding and SWNTs exhibiting the lowest binding efficiency. Au/PSA coated slides were also found to have an affinity for thiolated D-DNA. Finally, data from our spiegelmer study demonstrate that this type of methodology could be used to rapidly quantify the amount of CGRP in biological samples. In summary, our findings provide evidence that Au/PSA platform and fluorescently tagged spiegelmers have the potential to be used in the development of a biosensor device to selectively detect various biological and chemical solutions.

#19 - THE EFFECT OF HUMIDITY ON SURVIVORSHIP OF AN EXOTIC FRESHWATER SNAIL EXPOSED TO AIR. Meghan Lenhardt, Biology. Faculty Advisor: Dr. John Havel

The exotic Chinese Mystery Snail (*Cipangopaludina chinensis*, CMS) has invaded lakes and rivers across North America. Besides deliberate and accidental introductions, CMS may be carried overland by boats. Preliminary experiments, under humid outdoor conditions, suggested that CMS may survive 2 weeks out of water, whereas an experiment repeated indoors found survivorship to be much poorer. In the current study, I examined the effect of humidity on desiccation tolerance. CMS were cultured in the laboratory, and 10 d-old juveniles (5.34-8.68mm) were removed for experiments, tested in two incubators at 20°C and manipulated to different relative humidity levels (64 and 34%). Snails were held in 20 mesh bags and one snail was removed from each bag after 3, 7, and 14 d. Survivorship was considerably higher in the higher humidity treatment at 3 d (60 and 30%, respectively) and at 7 d (25 and 0%). Few snails survived to 14 d (15 and 0%). This experiment suggests that snails reintroduced to water after a week exposed to air have a high likelihood of survival, and dispersal by this process should be more likely when conditions are humid.

#20 - IL-10 SYNERGIZES WITH LPS TO INDUCE TRANSCRIPTION OF THE SECONDARY RESPONSE GENE ABIN-3. Brian A. Peterson, Brad D. Grope, Nathan T. Traw, Katherine A. Rhodes, Biology. Faculty Advisor: Dr. Brian Weaver

Macrophages play an important role in the response to microbial infection. Activation of macrophages involves transcriptional responses for genes that function to promote inflammation. In contrast, induction of anti-inflammatory gene expression in response to the cytokine interleukin-10 (IL-10) is able to control the duration and severity of inflammation. The mechanisms by which IL-10 acts to suppress pro-inflammatory signaling remain incompletely defined. Previously, we identified the gene ABIN-3 as an IL-10-induced gene and an inhibitor of NF- κ B activation in human macrophages. Herein, we present studies into the mechanisms by which IL-10 signaling leads to ABIN-3 gene expression. ABIN-3 is a secondary response gene requiring new protein synthesis for its induction in response to IL-10. Interestingly, maximum expression of ABIN-3 in macrophages requires coordinate signals from both the anti-inflammatory IL-10 and a pro-inflammatory stimulus such as lipopolysaccharide (LPS). First, we examined whether the induction of ABIN-3 expression is regulated at the level of transcription or post-transcriptionally at the level of mRNA stability. Our data indicate that IL-10 synergizes with LPS to induce ABIN-3 gene transcription as opposed to inducing its mRNA stabilization. These studies should ultimately lead to a better understanding of the crosstalk mechanisms between IL-10 and pro-inflammatory signaling pathways.

#21 - THE DIVERSITY OF ARTHROPODS: COMPARED IN MATURE AND CLEAR CUT FORESTS. Reed Very, Biology department; advised by Tom Tomasi.

In the forested mountains of Wyoming, any capitalists have taken advantage of the plentiful pine trees by clear-cutting them for commercial use. Even though the harvested patch of land has been given new life in the form of pine saplings, lodgepole pine in this case, there is no doubt that clear-cutting to any degree will have an adverse impact on the food web throughout the entire forest. Once two areas had been identified, one in a young sapling patch that had been clear-cut three years prior and one in an adjacent mature forest, two 5m x 5m plots in each area were marked off and examined. Specimens were collected from the ground and preserved in rubbing alcohol to be identified later. After applying the Shannon-Wiener diversity index and abundance formulas, it was found that the mean abundance in the disturbed site was 43.5 and 30.0 in the undisturbed site. The mean diversity indices were .994 in the disturbed site and 1.285 in the undisturbed site. Knowing how clear-cutting forests affects ground arthropods will help us understand food web changes and maybe in the future help to improve logging techniques.

#22 - IDENTIFICATION OF IL-10 AND LPS-INDUCED PRIMARY AND SECONDARY RESPONSE GENES. Vinh Q. Duong, Katherine A. Rhodes, and Christina Molumby, Biology.

Faculty Advisor: Dr. Brian Weaver

Monocytes/macrophages responding to microorganisms through Toll-like receptors (TLRs) induce numerous pro-inflammatory genes in a selective and temporal fashion. This response is tightly controlled through the actions of the anti-inflammatory cytokine IL-10. Our understanding of the mechanisms by which IL-10 limits TLR responses remains incomplete. Previously, we identified ABIN-3 as an IL-10-inducible gene in macrophages responding to TLR ligands. ABIN-3 is a prototype for what we hypothesize will be a set of genes induced by IL-10 synergistically with TLR signals. Herein, we show that ABIN-3 is a secondary response gene whose induction depends on new protein synthesis in response to IL-10/TLR stimulation. To characterize the mechanisms underlying the crosstalk between IL-10 and TLRs, we are screening and categorizing candidates as primary or secondary response genes. Once these gene subsets are defined, we can then characterize induction mechanisms shared within each group and those distinct between the groups. To this end, we have generated RNA samples from monocytes stimulated with IL-10 and LPS in the absence or presence of the translation inhibitor cycloheximide. Thus far, we have identified the chemokine CXCL13 as an IL-10/TLR-induced secondary response gene like ABIN-3, while SOCS3, I κ BNS, and IL-1RA are primary response genes.

#23 - INTERLEUKINS IL-1B AND IL-6 MODULATE TRIGEMINAL GANGLION NEURONAL ACTIVITY: IMPLICATIONS FOR UNDERSTANDING THEIR ROLE IN MIGRAINE PATHOLOGY. Zachary L. Durham, Biology. Faculty Advisor: Dr. Paul Durham.

The levels of the pro-inflammatory cytokines, IL-1 β and IL-6, which correlate with increased inflammatory and nociceptive responses, are increased during migraine attacks. The goal of this study was to determine the effect of IL-1 β and IL-6 in the trigeminal ganglion. To accomplish this, rats were either left untreated, injected with IL-1 β /IL-6 alone, or with IL-1 β /IL-6 prior to a subthreshold concentration of capsaicin. Both ganglia and the TNC were stained for pro-inflammatory proteins. While subthreshold capsaicin did not cause increased expression, injection of IL-1 β /IL-6 prior resulted in significant increases in levels of Cx-26, Cx-43, PKA, and NF-kB in trigeminal ganglion. Cx-26 was increased in neurons and glia while Cx-43 was increased in glia. Similarly, levels of NF-kB, regulates nociceptive genes, and PKA, pro-inflammatory protein, were increased in response to cotreatment. Within the TNC, treatment with IL-6 resulted in elevated levels of c-Fos, marker of neuronal activation, GFAP, marker of glial activation, and GLAST, removes excess glutamate. Based on our findings, we propose that elevated levels of IL-1 β and IL-6 function to facilitate increased expression of signaling proteins within the ganglia and TNC that contribute to peripheral and central sensitization, respectively, and thus, play important roles in migraine pathology.

#24 - INVESTIGATION OF THE FUNCTION OF DNA BASE REPAIR PROTEINS USING SOLID-STATE 2H NMR. Amos R. Hale, Chemistry. Faculty Advisor: Dr. Gary Meints.

Research has shown that cancer is caused by damaged DNA. Thus, one of the major steps in combating cancer is the ability to repair the damaged DNA. The body has DNA base repair proteins that can identify damaged DNA base pairs, remove them from the helical pattern, cut the damaged base from the DNA strand, and replace the damaged base. However it is not currently understood exactly how these proteins identify the damaged DNA bases. We will use the special properties of the deuterium isotope of hydrogen to investigate the local flexibility of DNA at damaged sites. Through deuteration synthesis we are able to change a specific hydrogen atom site on a DNA nucleoside into deuterium, in order to observe how the base repair proteins identify damaged sections of DNA. Our synthesis has successfully incorporated the deuterium into the monomeric unit deoxyadenosine, which will subsequently be placed into a full DNA sequence for analysis. By use of phosphoric NMR we can then study the phosphorus atoms in the DNA backbone in order to confirm any changes.

#25 - CARBON NANOTUBE-BASED GLUCOSE BIOSENSOR FOR THE UNDERGRADUATE LABORATORY. J. Mark Hobbs, Niral Patel, and Daniel Kim, Chemistry. Faculty Advisor: Dr. Adam Wanekaya.

An undergraduate laboratory experiment involving glucose determination in beverages by carbon nanotube-modified electrodes is presented. The determination of glucose is one of the key analytical problems in clinical chemistry or food science. In our approach, conventional electrodes were modified with carbon nanotubes and with glucose oxidase enzyme via the layer-by-layer procedure. Chronoamperometric experiments using a simple 3-electrode cell arrangement enabled sensitive and selective determination of glucose in various beverages. The method was optimized with respect to various parameters. The results compared very well with standard methods used for glucose determination. The procedure is simple and versatile and can be performed by sophomores and juniors using simple galvanostats/potentiostats. It can easily be integrated in laboratory classes for chemistry, biotechnology, or biochemistry students to demonstrate the important principles and techniques of nanoscale science, materials science, biochemistry, electrochemistry and sensor technology.

#26 - DNA REPAIR PROTEIN EXPRESSION: PYRIMIDINE DIMER GLYCOSYLASE CODED BY CHLORELLA VIRUS PBCV-1. Melissa N. Hayes, Chemistry. Faculty Advisor: Dr. Gary Meints.

The *Paramecium bursaria chlorella virus-1* (PBCV-1) is the prototype algae virus that contains one gene, A50L, that codes for a DNA repair protein. This protein is called Chlorella Virus-pyrimidine dimer glycosylase (CV-pdg) and initiates nucleotide excision repair when in the presence of a thymine dimer DNA mutation. When the dimer is formed, it changes the overall structure of the DNA molecule and will inhibit polymerases and stop replication. The mutation takes 3 different isomeric forms. CV-pdg specializes in fixing 2 of the isomers: cis-syn (the most prevalent isomer) and trans-syn-II forms. Expression and purification of this protein was completed by transforming BL21-DE3-RIPL E. Coli cells with a plasmid containing the A50L gene with a his-tag. The cells were grown in Lysogeny Broth with ampicillin and induced with 1mM of IPTG at 14°C for a total of 12 hours. The protein was then purified using Ni-NTA beads. The purified protein was eluted from the beads with a 400mM imidazole buffer. SDS-page analysis showed successful expression and few impurities in the purified protein solution. CV-pdg will be used in further studies to determine how DNA and repair proteins interact and what signals are present that allow the protein to recognize mutation sites.

#27 – SUPRAMOLECULAR ASSEMBLY OF NUCLEIC ACIDS INTO THERMOEVERSIBLE AGGREGATES. Ashley Egan, Pazong Vang; Faculty Advisor: Dr. Bhaskar Datta

The Watson-Crick base-pairing of DNA forms an essential component of preservation and propagation of life. Amazingly enough for the past two decades, the principles underlying DNA structure have also been exploited for creation of materials far removed from biomolecules, and for development of cutting edge analytical methods and assays. We are interested in using the programmable character of DNA base-pairing to create microgels whose assembly can be controlled in a thermoreversible fashion. In this work we use the Watson-Crick hydrogen-bonded base-pairing of DNA to create cross-links stabilizing a supramolecular assembly. The core unit comprising this supramolecular assembly is made up by four-way junctions. We have synthesized DNA sequences and characterized the four-way junctions by UV-visible spectrophotometry and gel electrophoresis. We observe that variation in the DNA sequences can be used to tune the aggregation temperature of the four-way junctions. Also, as expected the assembly of four-way junctions is found to be dependent on ionic strength of the solution. We hope to use these features of the four-way junction to create physical thermoreversible microgels.

#28 - ZINC OXIDE NANOPARTICLES: HYDROTHERMAL SYNTHESIS AND CHARACTERIZATION. Ryan Spidle, Dr. Charles C. Chusuei, Chemistry. Dr. Kartik Ghosh, Physics. Dr. Robert K. Delong, Biomedical Science. Faculty Advisor: Dr. Adam Wanekaya.

Zinc oxide (ZnO) is a chemically and thermally stable n-type semiconducting material with extremely high sensitivity to combustible and reducing gases. It has therefore been successfully used as a transducer in gas sensing devices. In this respect, nanoparticles of ZnO have lately been attracting a lot of attention due to their flexible use in chemical sensing, biosensing, solar cells, piezoelectrics and fuel cells devices. Thus, there is need for continued research and development of protocols that could be used in the synthesis ZnO nanoparticles of tunable size, morphology and low particle size distribution. Here, we hydrothermally synthesized ZnO nanoparticles at low temperature conditions. Solvent, precursor, and reaction temperatures as well as reaction times were varied with a view of controlling the size, morphology and properties of the particles. The nanoparticles were characterized by scanning electron microscopy (SEM), scanning transmission electron microscopy (STEM), ultraviolet (UV) spectrophotometry, fluorescence spectrophotometry, dynamic laser light spectroscopy (DLS), energy dispersive X-ray spectroscopy (EDS) and X-ray photoelectron spectroscopy (XPS) techniques. The properties, characteristics and applications of the nanoparticles prepared at these conditions will be discussed in depth.

#29 - REAL-TIME GPS TRACKING AND DISPLAY OF MSU SHUTTLE BUSES. Jeffrey Thomas, Computer Science. Faculty Advisor: Dr. Richard Martin.

Missouri State University utilizes 15 different shuttles running 7 different routes every weekday around campus. Each shuttle is equipped with a Sprint BlackBerry 8830 smartphone running a custom application that sends Global Positioning System (GPS) and route information to be stored on a server. Utilizing the Google Maps Application Programming Interface (API), the location of each shuttle is displayed on a map of campus. Each shuttles location is updated live in real-time to a campus map that is viewable on the Missouri State website, Android or iPhone application, or using the Opera browser on other smartphones.

#30 - TRANSITIONING SPRINGFIELD TO WITHSTAND THE TRIPLE CRISIS OF PEAK OIL, ECONOMIC COLLAPSE, AND CLIMATE CHANGE. Jason Ray, Community and Regional Planning. Faculty Advisor: Dr. Paul Rollinson

“Sustainability” is about reducing the impacts of what comes out of the tailpipe of industrial society, but that assumes that industrial society will continue to run. **Transition** is about “building resiliency” – putting new systems in place to make our community as self-sufficient as possible, bracing it to withstand the shocks that will come as oil grows astronomically expensive, climate change intensifies and, industrial society frays or collapses entirely. This paper promotes three concepts that would lead to a ‘Transitioned Springfield:’ 1) Urban Intensification; more dense development and mass transit. 2) Re-localize food and artisan; Springfield can be self-sustaining in food production, “food miles” can be reduced, and artistry can be more localized. 3) Write an Energy Descent Plan; a plan that sets out a vision of a powered-down, resilient, relocalized future, and provides practical steps to get there. This paper focuses on existing data and research to develop a strategy of incorporating and interweaving all three concepts to create a Transitioned Springfield.

#31 – CUSTOM NON-CONTIGUOUS CARTOGRAM CREATION. Ryan Jaspering, Geography, Geology & Planning. Faculty Advisor: Jun Luo

Cartograms are a geographic tool used to display multivariate data in a geographic setting. In a cartogram, the shape or size of polygon features are distorted to display descriptive attributes, such as the population of States or votes received in counties. Unfortunately, there are no standard tools in most mapping programs, such as ArcMap, to create customized cartograms. However, I have developed a method which allows any user with basic knowledge of ArcMap to create a cartogram using any dataset they choose.

For my project, I chose to use the enrollment for high school zoning boundaries for St. Charles County, Missouri as my dataset. For my project, I chose to create a cartogram for high school enrollment for each high school St. Charles County, Missouri. I used the zoning area for each high school as the polygons which would be distorted. These particular zoning boundaries are ideal for cartograms because their sizes are not positively related with their enrollment value. The result allowed for a new outlook and understanding of the education system in St. Charles County. By using this new process for creating customizable cartograms, an increased understanding of data in other geographic realms may be obtained as well.

#32 - PHYSICAL AND CHEMICAL PROPERTIES OF TOPSOIL SAMPLES FROM COMMERCIAL, NURSERY, AND NATURAL SOURCES. Sarah Morris. Faculty Advisor: Dr. Robert Pavlowsky.

Soil is one of our most important natural resources. The composition of surface soils or “topsoil” layers affects management plans to improve fertility, control drainage, decrease erosion, and reduce potential toxic exposure. Few studies have compared the composition of commercially-available soil materials to those typically occurring naturally on the landscape. Springfield, Missouri is located in the Ozark Highlands region where soils are thin and are not often considered fertile for gardens. Given that Springfield’s population is one of the fastest growing in the state, relatively large amounts of soil materials are needed for residential developments and gardening. This study measures and compares the properties of topsoil materials in the Springfield area based on fertility and geochemical composition. Topsoil samples were analyzed from four commercial brands of bagged topsoil and two local nurseries. In addition, natural surface soils were analyzed from five areas: highway right-of-way, hay field, two residential lawns, and forest. Larger particles in the soil were composed of pebbles, organic materials, or human artifacts. Commercial topsoil contained less nitrogen and more phosphorus compared to natural soils. Organic carbon (OC) content decreased in the following order: (i) two specially-mixed commercial soils, 14 to 18 % C; (ii) natural soils, 3 to 6 % C; and (iii) two commercial and both nursery soils (<2%). Interestingly, high lead concentrations were found at two sites: one nursery stock soil and highway right-of-way. In general, soil materials purchased from other commercial sources were not always more fertile than natural soils.

#33 - STUDIES IN SEDIMENTARY PETROLOGY: A LOOK INTO LOCAL SPRINGFIELD STREAMS. Tessa Huckaba, Josh Bowling, and Alicia Metzger. Geography, Geology and Planning. Faculty Advisor: Dr. Melida Gutierrez

An in-depth knowledge of sedimentary petrology is important in any study concerning stream analysis. In our study we analyzed samples from three different sources: the Dry Sac, located in southwest Springfield, Galloway Creek, located in south east Springfield and Ritter Spring, located in north west Springfield. We purposefully chose two urban and one rural stream in order to vary our field of study. We collected several samples from each stream, carefully documenting the location of each sample. We then dried and sieved them, separating each sample into sizes ranging from -4ϕ to 0ϕ , each size weighed and documented. We then took each sample grains sizing $<0\phi$, dispersed them, and wet sieved the $<0\phi$ processed samples through a 200-mesh sieve. Wet sieving allows for the separation of sand from clay. We determined the percent clay, sand and silt. With the dried sand samples we removed all carbonated by washing each sample with an acetic acid-acetate solution. These procedures allowed us to use statistics to infer depositional environment, texture, petrology and lithology. Our conclusions are documented in histograms, probability plots and tables. Our samples of Ritter Spring were upstream from the facility but we were very interested in doing analysis downstream from the discharge area. These preliminary studies will aid in further geochemical studies on Springfield streams, including clay studies in point-source pollution.

#34 - DIOPHANTINE EQUATIONS WITH CONSTRAINTS (CLICK AND CLACK'S CLOCK). Caleb Bennett, General Mathematics. Faculty Advisor: Dr. Les Reid.

Tom and Ray Magliozzi, known for their popular "Car Talk" radio show on National Public Radio and more commonly referred to as "Click and Clack", posed the following question over the air to their readers: How may a person make two cuts through a normal 12-faced clock in such a way that the numbers in each segment that is formed sum to the same total? This project solves Click and Clack's Clock then proceeds to ask what conclusions can be drawn if an arbitrary n-faced clock is used instead of the traditional 12-faced clock. Properties of the hyperboloid lead to systems of Diophantine equations that provide solutions families to the generalized problem. Existence of solutions is proven for roughly half of the natural numbers, while the impossibility of solution is shown for one-third of the natural numbers.

#35 - INVESTIGATING A NEW MODEL OF DETERMINING A GLOBAL POPULATION CENSUS. Christopher Maghas, Mathematics. Faculty Advisor: Reid Leslie F.

Technology devices such as Google Earth, Radio-frequency identification (RFID), Channel Handshake Authentication Protocol (C.H.A.P), merged with statistical models, Areas and mapping, Kondratiev cycles, a Population Computerized Model could be created to determine a population census. The Stock Market Model was developed through statistical models to create a model by which people can monitor the performance of trading markets in real time. Similarly, we can estimate a regional population by creating a computerized model based on Stock Market model that could to report such information as the Death rate, the mortality rate thus reflecting a population count in real time. This could be done by the improvement of current Death /Mortality Rate Databases in stable regions such as U.S.A. The use of this model could have an estimated disparity of more than 50% of the Global Population due to unstable regions such Somalia. This disparity could be minimized by incorporation of Satellite Technology, attached to sensor beam from a Thermal Imaging Instrument (TII) projected at a defined region to determine a population count. This could increase the accuracy of determining a Global Population Census to nearly 97%. Channel Handshake Authentication Protocol could be attached to this model linked to a Global Population Database for identification of different regions and persons.

#36 – ASTEROSEISMOLOGY USING NASA'S KEPLER SATELLITE. Amanda Quint, Physics, Astronomy and Materials Science. Faculty Advisor: Dr. Mike Reed

In March of 2009, NASA launched Kepler, a solar-orbiting telescope with the main mission of detecting and classifying planets around other stars. By measuring minute changes in a star's brightness (down to nearly 100 parts in a million), Kepler is able to detect planets transiting in front of their stars. This sensitivity in measuring a star's brightness allows Kepler to record the transits of planets as small as half the size of the Earth, and can determine if they are in or near the habitable zone of their star. However, due to both the preciseness of the equipment onboard and lack of noise in the observations, Kepler is also able to contribute to Asteroseismology, which is the study of the internal structure of stars through observing their oscillations. By measuring these oscillations over time, Kepler is able to provide new data on a variety of different stellar types, including but not limited to: Cepheids, RR Lyrae, white dwarfs and subdwarf B stars.

#37 - A STRATEGY BEHIND THE SEARCH FOR EXTRASOLAR WATER. Aron McCart,
Physics. Faculty Advisor: Dr. Melissa A. Morris.

The techniques used in infrared astronomy allow us to examine the properties of dust in young extrasolar systems where planets are believed to be forming. In systems such as these, dust in the upper layers of the protoplanetary disk absorbs radiation from the central young star, heats up, and re-emits the radiation at infrared wavelengths. We are examining the infrared spectrum of these young extrasolar systems looking for the unique, mid-infrared signal of phyllosilicates. These special properties of phyllosilicates—hydrous minerals that almost always require liquid water for their formation—will give astronomers the first clues about the existence of water in extrasolar systems. It may even be possible to test the proposed waterworlds hypothesis. A current theoretical model shows that phyllosilicates should be detectable by instruments like NASA's Spitzer Space Telescope. We are in the process of comparing theoretical predictions made by this model to data obtained with the Spitzer Space Telescope to determine whether phyllosilicates are present in the observed systems.

#38 – EFFECT OF GROWTH CONDITION ON PROPERTIES OF Cr- DOPED In₂O₃ FILMS. N. Ukah, R. K. Gupta, G. Aboagge-Asare, K. Ghosh, P. K. Kahol, Materials Science. Faculty Advisor: Prof. Kartik Ghosh

Dilute Magnetic Semiconductors (DMS) have attracted considerable research attention due to their potential applications in spintronic devices. Several hosts such as ZnO, TiO₂, SnO₂, and In₂O₃ are popular for doping with transition metals. Among them In₂O₃ is a highly transparent opto-electronic material, which is a potential candidate for its realization as DMS. We have deposited high quality Cr-doped In₂O₃ diluted magnetic semiconductor thin films using pulsed laser deposition technique. The effect of growth parameters on structural, optical, and electro-magnetic properties of these films has been studied. These films exhibit cubic In₂O₃ single phase with (222) preferred orientation with no characteristics peaks due to the addition of chromium. The observed electrical properties such as resistivity, carrier concentration, and mobility are found to strongly depend on growth conditions.

#39 - THE LOCAL STRUCTURE OF ZINC ADSORBED ON Fe₃O₄ NANOPARTICLES IN AQUEOUS SOLUTIONS TO 500 °C. Joseph Demster, Physics. Faculty Advisor: Dr. Robert Mayanovic.

Data on the chemical reactivity and structural coordination of metal oxide nanoparticles with zinc and other metal species in aqueous fluids at high temperatures and pressures are presently scarce. Such data are necessary to gain a better understanding of corrosion-related processes in supercritical-water-cooled reactors and of the catalytic properties of metal oxide nanoparticles used in fuel cell and other energy applications. We used the hydrothermal diamond anvil cell to make *in situ* x-ray absorption spectroscopy (XAS) measurements of Fe₃O₄ nanoparticles (20 nm dia.) added to an 0.05 *m* Zn(NO₃)₂ aqueous solution to 500 °C at the Advanced Photon Source synchrotron. The XAS data show no chemical reactivity of the Fe₃O₄ nanoparticles with the Zn²⁺ aqua ion from 25 to 300 °C. The Zn *K*-edge extended x-ray absorption fine structure (EXAFS) data were analyzed using a spinel-motif structure to model the Fe₃O₄ nanoparticles. The results from these analyses show that Zn²⁺ adsorbs on tetrahedral sites of the surface of the Fe₃O₄ nanoparticles in aqueous fluids at 400 to 500 °C.

#40 – BAKER OBSERVATORY SUBMINUTE SURVEY. Justin T Gilker, Astronomy. Faculty Advisor: Dr. Michael Reed.

We are conducting a small-scale survey searching for variability using our 16-inch telescope at Baker Observatory. The goal is to search for previously unknown types of variability and to increase membership of known pulsation classes. Finding new variable stars, particularly those undergoing pulsation, will increase the available number of tools for astronomers to study stellar interiors and stellar evolution. Compact variable stars which are undergoing helium fusion in their cores are ideal for asteroseismology, which can be used to obtain helium cross-sections to study the fusion process. Studying the pulsations of these stars can also lead to the discovery of new planets. Massive objects revolving around pulsating variable stars will distort the pulsations in a way apparent to astronomers.

#41 – AUTOMATION & STREAMLINE OF IMAGE PROCESSING. Lee Hicks, Physics. Faculty Advisor: Mike Reed, Lloyd Smith

In recent years, sky surveys have provided astronomers with a wealth of data that can be used for such activities as studying stellar evolution and finding extrasolar planets. Unfortunately, such surveys produce more data than astronomers can analyze—a typical observation run of the Baker Observatory Sky (BOS) Survey, for example, yields approximately 3000 images. The goal of the work described here is to automate the initial data processing stages of the BOS Survey, taking raw images from the telescope and producing normalized and synchronized images that are suitable for further analysis. The initial process required manual intervention at each stage of processing, with specialized operating systems and execution of numerous software commands on each image. At this point, a new graphical user interface (GUI) has been built to ease the use of the processing software and to lower the learning curve for new users. The GUI is written in Qt depending on scripts written in Perl and C Shell under Linux. The scripts largely automate the process of writing files and executing commands. Human intervention is still required to provide several parameters controlling the process, but the user can now accomplish the task with a few clicks of a mouse.

#42 - *IN SITU* XAS INVESTIGATIONS OF THE ADSORPTION OF NICKEL ON Fe_3O_4 NANOPARTICLES IN SUPERCRITICAL AQUEOUS FLUIDS. Manelich Luna, Physics. Faculty Advisor: Dr. Robert Mayanovic.

The adsorption of metal ions on metal oxide nanoparticles is relevant to several facets of energy application. New experimental data on the chemical reactivity of metal oxide nanoparticles with various metal species in supercritical aqueous fluids are required to develop a more thorough understanding of corrosion-related processes in supercritical-water-cooled reactors. *In situ* x-ray absorption spectroscopy (XAS) made on 0.05 *m* $\text{Ni}(\text{NO}_3)_2 + \text{Fe}_3\text{O}_4$ nanoparticles (20 nm dia.) aqueous sample to 500 °C at the Advanced Photon Source synchrotron show that the Ni^{2+} ion does not react with the Fe_3O_4 nanoparticles to 300 °C. Analysis of the Ni *K*-edge extended x-ray absorption fine structure (EXAFS) using a spinel-motif structure to model the Fe_3O_4 nanoparticles shows that Ni^{2+} adsorbs on octahedral sites of the surface of the nanoparticles in supercritical aqueous solution from 400 to 500 °C. Our study has direct relevance to the modelling and control of corrosion in supercritical-water-cooled nuclear and conventional reactors and may lead to new insights in the hydrothermal synthesis of nano-materials.

#43 - CARBON NANOTUBE THIN FILMS OF DIFFERENT CHIRALITY. Patrick M. Margavio, Physics, Astronomy, & Materials Science. Faculty Advisor: Dr. Lifeng Dong.

Previous studies of thin film solar cells have concluded that the addition of single-walled carbon nanotubes (SWCNTs) can result in improved efficiency. The effect of different chirality nanotubes on efficiency has not been studied to date. With an aim on this application, we employ a density-gradient ultracentrifugation procedure to separate out metallic nanotubes from the SWCNT solution. The SWCNTs were dispersed in 2% w/v sodium cholate, subjected to sonication, placed in a density gradient, and ultracentrifuged at 41,000 rpm for 30 minutes. Semiconducting nanotubes were removed from the top of the visible nanotube layer in the gradient. SWCNT solution is placed on a mixed cellulose ester (MCE) filter for 15 minutes, the filter is rinsed with 2-propanol and then with deionized water, then it is dipped in ethanol and pressed onto the substrate. The substrate is suspended over boiling acetone for one hour before being placed into a bath of acetone, and of methanol, to remove the MCE filter. We then use the same procedure to place un-separated SWCNTs and multi-walled carbon nanotubes onto the same substrates for comparison.

#44 – HIGH QUALITY Co-DOPED In₂O₃ DILUTE MAGNETIC SEMICONDUCTORS FOR SPINTRONIC APPLICATIONS. A. Ghosh, R. K. Gupta, T. Williams, K. Ghosh, P. K. Kahol, Materials Science. Faculty Advisor: Dr. R.K. Gupta

Dilute Magnetic Semiconductors (DMS) have attracted considerable attention by the scientific community due to their potential application in spintronics. Small amount of a magnetic material is incorporated into non magnetic host for DMS. In₂O₃ is a popular non magnetic host because of its wideband gap and excellent optical and electrical properties. We have studied the effect of Co doping on properties of In₂O₃ films. These films were grown along c-plane of a sapphire substrate using Pulsed Laser Deposition. Structural properties, which largely depend on growth conditions, were studied using X-ray Diffraction and Atomic Force Microscopy. The magneto-transport properties were also studied. It was found that films grown at high temperature have preferred orientation along the (222) direction, while films grown at low temperature show amorphous nature. The effect of growth conditions on electrical properties show that resistivity decreases with an increase in growth temperature while mobility increases with increases in growth temperature.