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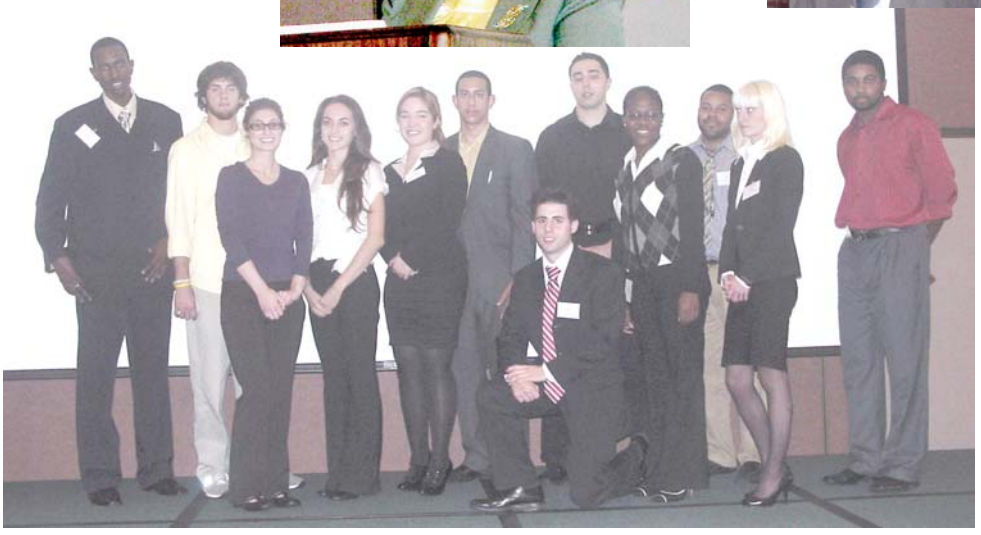

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Effects of Potential Therapeutic Agents on Copper Accumulations in Gill of *Crassostrea virginica*

by

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ABSTRACT

Copper is an essential trace element for organisms, but when in excess, copper's redox potential enhances oxyradical formation and increases cellular oxidative stress. Copper is a major pollutant in Jamaica Bay and other aquatic areas. Bivalves are filter feeders that accumulate heavy metals and other pollutants from their environment. Previously it was determined that seed from the bivalve *Crassostrea virginica*, transplanted from an oyster farm to Jamaica Bay readily accumulated copper and other pollutants into their tissues. In the present study we utilized Atomic Absorption Spectrometry to measure the uptake of copper into *C. virginica* gill in the presence and absence of three potential copper-blocking agents: diltiazem, lanthanum, and p-aminosalicyclic acid. Diltiazem and lanthanum are known calcium-channel blockers and p-aminosalicylic acid is an anti-infammarory agent with possible metal chelating properties. We also used the DMAB-Rhodanine histochemistry staining technique to confirm that copper was entering gill cells. Our result showed that diltiazem and p-aminosalicyclic acid reduced copper accumulations in the gill, while lanthanum did not. DMAB-Rhodanine histochemistry showed enhanced cellular copper staining in copper-treated samples and further demonstrated that diltiazem was able to reduce copper uptake. The accumulation of copper into oyster gill and its potential toxic effects could be of physiological significance to the growth and long-term health of oysters and other marine animals living in a copper polluted environment. Identifying agents that block cellular copper uptake will further the understanding of metal transport mechanisms and may be beneficial in the therapeutic treatment of copper toxicity in humans.

Introduction

Jamaica Bay, a 26 square mile estuarial embayment situated between southern Brooklyn and Queens, NY and a major inlet opening to the Atlantic Ocean, lies just east of the entrance to NY Harbor and the mouth of the Hudson River. Copper is a major pollutant in Jamaica Bay and other aquatic areas. Sediment is an important sink and reservoir for metal contaminants and Jamaica Bay sediment is reported to be contaminated with various metal pollutants[1-3] including copper at levels higher than 10 ppm[4]. Bivalves are particularly good accumulators of heavy metals[5-7] and being sessile, tend to reflect local contaminant concentrations more accurately than crustaceans and free swimming finfish. Historically the Eastern Oyster, *Crassostrea virginica,* flourished in Jamaica Bay and the NY/NJ Harbor area as either self-sustaining or farmed populations[8,9], but pollution and other problems caused a steady decline in the oyster industry after its peak in the early 1900=s[10-12]. Today very few wild oysters are found in Jamaica Bay and studies are being done to look at the rehabitation potention of *C. virginica* to Jamaica Bay. Previously it was determined that *C. virginica* seed, transplanted from an oyster farm in Oyster Bay, NY to Jamaica Bay, grew well[13] despite accumulating significant amounts of copper and other pollutants in their tissues[14].

Copper is an essential micronutrient. In addition to its role in activation or repression of transcription of various genes, copper is required as an integral component of at least 12 major proteins involved in such processes as cellular respiration, catecholamine production, connective tissue biosynthesis, superoxide dismutation, iron metabolism and blood coagulation[15,16]. In humans about one-third of all the copper in the body is contained in the liver and brain, another third is in the muscles, and the rest is dispersed in other tissues[17]. Adverse health effects are related to copper deficiency as well as excess.

Excess copper can cause both structural and functional impairment due to displacement

of ions at metal binding sites or non-specific binding to enzymes, DNA, or other biomolecules[18]. Alternatively, free copper ions can cause oxidative damage by catalyzing reactions that generate oxyradicals[19]. The 2 most common oxidation states for copper are Cu (I) and Cu (II) and the easy exchange between these two oxidation states endows copper with redox properties that may be of an essential or deleterious nature in biological systems. Figure 1 shows how soluble copper ions can increase oxidative stress by substituting for iron in the Fenton reaction[20] which catalyzes the conversion of hydrogen peroxide and superoxide into the highly cytotoxic hydroxyl radical[21, 22]. Indeed, the oxidative damage caused by hydroxyl radicals and other reactive oxygen species are thought to be major contributing factors to the development of cancer, diseases of the nervous system and aging[23]. Mitochondria are particularly sensitive to oxidative damage and depend upon various antioxidants and anti-oxidizing systems to defend against oxidative stress. As the major site of O_2 utilization, mitochondria are not only a source of reactive oxygen species[24] but are improtant targets for oxidative damage. The presence of excess copper and resulting oxyradicals can overwhelm cellular defensive mechanisms, especially in mitochondrial, compromising respiratory function and further impairing cellular health and survival. Previously, our lab found that oyster gill mitochondrial treated with high doses of copper had impaired O_2 utilization[25].

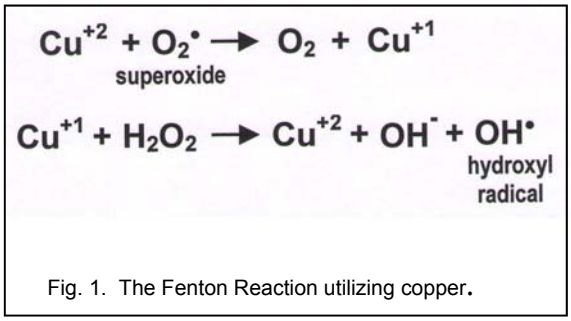

Fig. 1. The Fenton Reaction utilizing copper.

In the present study we used atomic absorption spectrometry and histological methods to study copper accumulation in gilll of *C. virginica* and to compare the therapeutic actions of three potential copper-blocking agents: diltiazem, lanthanum and p-aminosalicylic acid. We also used a p-dimethylaminobenzylidene (DMAB) rhodanine staining technique to histologically localize copper in copper-treated gill sections in the presence and absence of diltiazem.

Lanthanum and diltiazem are well known calcium channel blockers. Lanthanum is an element that forms a trivalent cation that strongly reacts with calcium binding sites and affects most membrane transport processes involving Ca^{2+} ions[26-30]. Diltiazem is a benzothiazepine that acts selectively on the voltage-dependent L-type Ca^{2+} channels[31] and is used therapeutically in the treatment of angina pectoris, hypertension and supraventricular arrhythmias[32]. Previously, our lab found that treatments with diltiazem but not lanthanum were able to protect oyster gill from the deleterious effects of copper additions on mitochondrial respiration[33]. However, the mechanism of action on how diltiazem blocked the negative effects of copper on mitochondrial respiration is unknown. While these two calcium channel blocker acted differently in our respiration experiments, they both may have the potential of reducing copper accumulations in oyster gill. p-aminosalicyclic acid (PAS), an analogue of aminobenzoic acid, is another potential copper-blocking agent. PAS has antibacterial properties and has been used to inhibit the growth and multiplication of the tubercle bacillus[34,35]. Recently PAS has been used in the successful treatment of Manganism[36], a disease of manganese toxicity, which is clinically similar to Parkinson=s disease. While the mechanism by which PAS alleviates symptoms of Manganism remains unknown, evidence is accumulating that PAS is acting as a manganese chelator[37,38]. Previous studies of our lab found that PAS reduced manganese accumulations in oysters[39] and also protected manganese treated gill mitochondria from a dose dependent decrease in O_2 consumption[40]. The present study examined the potential of PAS as a copper-blocking agent.

Materials and Methods

Instant Ocean Artificial Seawater (ASW) was obtained from Aquarium Systems Inc. (Mentor, OH). Lanthanum chloride, diltiazem, PAS, copper sulfate, DMAB-Rhodanine, nitric acid (trace-metal grade) and all other chemicals were obtained from Fisher Scientific (Pittsburgh, PA). Adult *C. virginica* of approximately 80 mm shell length were obtained from Frank M. Flower and Sons Oyster Farm in Oyster Bay, NY. They were maintained in the lab for up to two weeks in

temperature-regulated aquaria in ASW at 16 - 18° C, specific gravity of 1.024 " 0.001 and pH of 7.2 " 0.2. Each animal was tested for health prior to experimentation by the resistance it offered to being opened. Animals that fully closed in response to tactile stimulation and required at least moderate hand pressure to being opened were used for the experiments.

Copper Treatments of Oyster Gill Tissue in the Presence of Therapeutic Agents

Prior to tissue isolation, all glassware was acid-washed in dilute (5%, wt/wt) nitric acid in deionized water to removed bound metals. Washing was followed by thorough rinses with deionized water. Healthy oysters were shucked by removing their right shells. Gills were dissected using stainless steel instruments and cut into uniform-size pieces (approximately 0.30 wet weights). Gill segments were placed in containers of ASW containing 0.5 mM copper with or without various concentrations (0.5, 1.0 and 2.0 mM) of lanthanum, diltiazem or PAS for 3 days at 151C. Control animals were similarly prepared without exposure to copper or test agents. After 3 days, gill segments were removed from the containers, weighed, washed 3 times with ASW, and prepared for metal analysis.

Analysis of Copper Accumulation by Atomic Absorption Spectrometry

Gill sections were placed in an oven at 200°C for 2 hours and dry weight of each sample determined. Dried gill sections were digested with concentrated nitric acid on hot plates in a fume hood. Digested samples were adjusted to a final volume of 10 ml in dilute (0.2 %, wt/wt) nitric acid. Aliquots of each sample were analyzed for copper by electrothermal vaporization with deuterium lamp background correction in a Perkin Elmer AAnalyst 800 Atomic Absorption Spectrophotometer with a THGA Graphite Furnace. Copper levels are reported as µg/g dry weight. Statistical significance was determined by two-way ANOVA with Tukey Post test.

The Histological Staining of Copper in Copper-Treated Gill

Gills were dissected from animals and sectioned into uniform smaller pieces. Gill sections were placed in containers of ASW containing 0.5 mM copper, or 0.5 mM copper and 2.0 mM of diltiazem for 3 days at 15°C. Control animals were similarly treated without exposure to copper and test agents. After 3 days the gill sections were removed, washed 3 times with ASW and prepared for fixation. Gill sections were fixed by placing them in containers containing 4% paraformaldehyde in ASW for 20 minutes, and then washed 3 times with ASW. The gills sections were then dehydrated in an alcohol series (70%, 95%, 100% (3Xs) alcohol for 5 minutes each). After dehydration, gill sections were placed in xylene, xylene/paraffin (50/50) and paraffin in a paraffin oven for 4 hours. After 2 days, embedded gill were sectioned with a microtome at 10 microns, placed on warm microscope slides to flatten, deparaffinized in xylene and rehydrated in an alcohol series (absolutely alcohol, 100%, 95%, 70%, distilled water) for 5 minutes.

A stock of 0.1% 5-DMAB-rhodanine was prepared by mixing 0.1g in 100ml absolute ethanol and allowing to stand overnight. A working solution of 4% paraformaldehyde in phosphate buffer was prepared by adding 4.0 g of the DMAB-rhodanine stock to 100 ml of deionized water. DMAB-Rhodanine solution was placed on the slides at 601C for 1 hour. Gills sections were then rinsed 4 times in distilled water, and then 0.5% of sodium borate solution was briefly added and rinsed off. The sections were washed 3 times in distilled water. The slides were viewed for copper staining with a Zeiss microscope under bright field and phase contrast. Sections were photographed with a ProgRes C3 Peltier cooled camera.

Results

Gill copper levels were determined by Atomic Absortion Spectrometry in gill sections from 20 different specimens of *C. virginica*, treated under various conditions. Gill samples that were not exposed to copper treatments in the lab had base-line copper levels that ranged from 197-217 ug/g dry weight (dwt).

Effects of Lanthanum, Diltiazem, and PAS on Copper Accumulations in Gill

Gill samples that were incubated for 3 days in ASW containing 0.5 mM $CuSO_4$ readily accumulated significant amounts of copper, exceeding 300%, compared to base-line controls. This increase was not reduced when co-treated with up to 2 mM of lanthanum (Fig. 2). However,

both diltiazem and PAS demonstrated copper-blocking activity when gill samples were similarly treated. There was a dose dependent decrease in copper accumulations in gill tissue of up to 64% with the 2 mM dose of diltiazem (Fig. 3). Similar results were obtained when gill samples were co-treated with PAS. The presence of PAS produced a dose dependent decrease in copper accumulations of up to 75% with the 1 mM and 2 mM doses of PAS (Fig. 4).

The Histochemical Staining of Copper in Gill

The widely used DMAB-Rhodanine staining for copper is a histochemistry technique that localizes copper in cells as reddish spots. Excess copper accumulates in the cytoplasm of cells and binds to copper- associated protein. DMAB-Rhodanine is a bidentate chelating agent which has a strong affinity for proteinaceous copper deposits in tissues section[41-44]. Figure 5a,b,c are photomicrographs of control gill sections prepared for DMAB-Rhodanine staining. The sections were viewed with phase contrast microscopy and show slight staining indicating low amounts of endogenous copper within the cells.

Treating gills for 3 days with 0.5 mM copper resulted in observable copper accumulations in the gills. DMAB-Rhodanine staining revealed massive accumulations of copper within the cytoplasm of the gill cells and copper pigments in the sections (Fig. 6a,b,c). When gills were co-treated with 0.5 mM of copper plus 2 mM of diltiazem for 3 days, DMAB-Rhodanine staining revealed significantly less copper accumulations in the co-treated gill cells, compared to those treated with copper alone (Fig. 7a,b,c).

Discussion

Copper is an essential micronutrient needed as an integral component in a large number of enzymatic and structural proteins. However, the potential for toxicity exists and copper homeostasis must be tightly regulated so that the concentration of free copper remains extremely low. When in excess, copper is a potent cytotoxin, binding and impairing the function of various biomolecules, displacing other metals from their normal binding sites, or causing oxidative damage by catalyzing the conversion of hydrogen peroxide and superoxide into hydroxyl radicals. It is noteworthy that the generation of hydroxyl radicals from hydrogen peroxide and

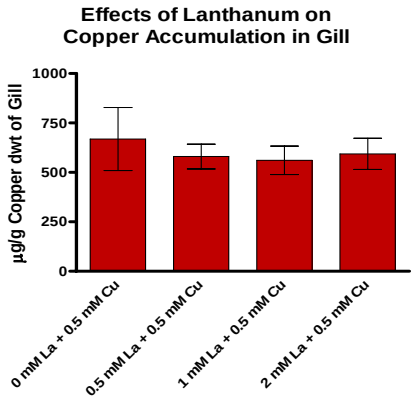

Figure 2. Gills were dissected from adult oysters and treated for 3 days with 0.5 mM copper or varying amounts of lanthanum at 15°C in individual containers of ASW, after which time they were washed 3 times with ASW and prepared for Atomic Absorption Spectrometry. N = 6. There were no statistical difference among the treatments.

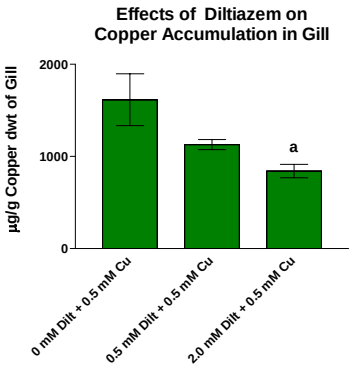

Figure 3. Gills were dissected from adult oysters and treated for 3 days 0.5 mM copper or varying amounts of diltiazem at 15°C in individual containers of ASW, after which time they were washed 3 times with ASW and prepared for Atomic Absorption Spectrometry. N = 6. ap<0.05 for comparison to 0 mM Dilt, 0.5 mM Cu.

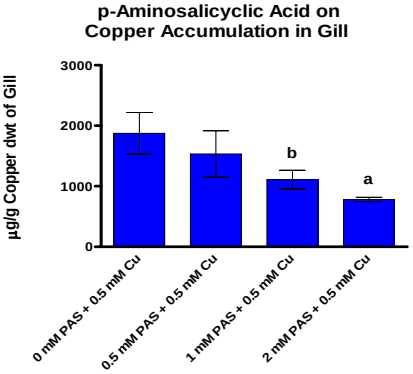

Figure 4. Gills were dissected from adult oysters and treated for 3 days with 0.5 mM copper or varying amounts of PAS at 15°C in individual containers of ASW, after which time they were washed 3 times with ASW and prepared for Atomic Absorption Spectrometry. N = 6. ap<0.01, bp<0.05 for comparison to 0 mM PAS, 0.5 mM Cu.

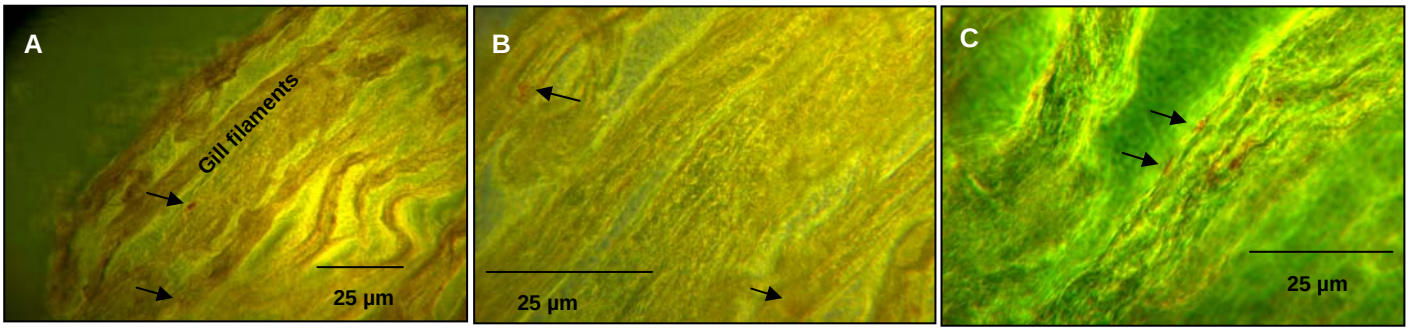

Figure 5. A: Control gill without additional copper treatments, phase contrast, 200x, Arrows point to endogenous copper deposits. B: Control gill without additional copper treatments, phase contrast, 500x, Arrows point to endogenous copper deposits. C: Control gill without additional copper treatments, phase contrast, 1250x, Arrows point to endogenous copper deposits.

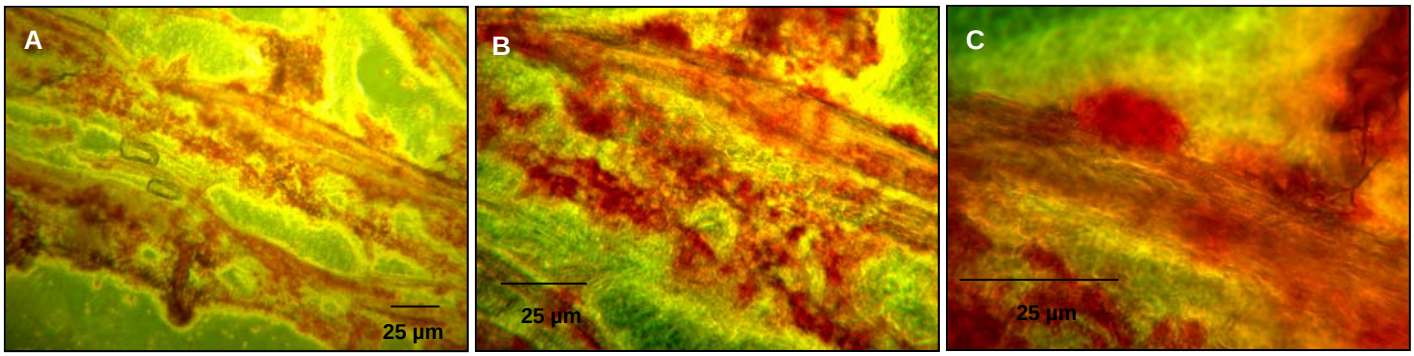

Figure 6. A: Copper (0.5 mM) treated for 3 days, phase contrast 200x. Numerous red copper deposits are present. B: Copper (0.5 mM) treated for 3 days, phase contrast 500x. Numerous red copper deposits are present. C: Copper (0.5 mM) treated for 3 days, phase contrast 1250x. Numerous red copper deposits are present.

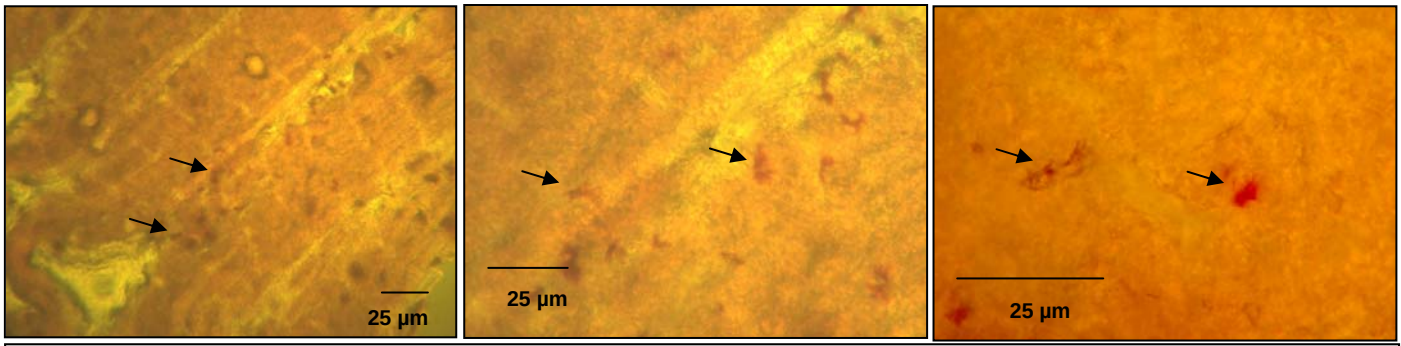

Figure 7. A: Copper (0.5 mM) treated plus diltiazem (2.0 mM), phase contrast 200x. Arrows point to copper deposits. B: Copper (0.5 mM) treated plus diltiazem (2.0 mM), phase contrast 500x. Arrows point to copper deposits. C: Copper (0.5 mM) treated plus diltiazem (2.0 mM), phase contrast 1250x. Arrows point to copper deposits.

superoxide via the Haber-Weiss reaction can only take place when catalytic concentrations of transition metals like iron or copper are present[45].

Marine bivalves are filter feeders that take up and accumulate metals and other pollutants from the water column. They also can ingest metal contaminants adsorbed to phytoplankton, detritus and sediment particles. Because they are sessile, they reflect local concentrations more accurately than crustaceans and free swimming finfish. Marine bivalves such as oysters and mussels have been extensively used as model organisms in environmental studies of water quality[46-48]. Trace metals are taken up and accumulated by oysters and many other marine invertebrates to tissue and body concentrations usually much higher on a wet weight basis than concentrations in the surrounding seawater[49-51].

Copper is a major aquatic pollutant. Nriagu reported average copper levels in seawater ranging from 0.15 µg/liter in open ocean to 1.0 µg/liter in polluted near-shore waters[52] but other studies show a much wider variation especially in polluted waters with reports as high as 40 µg/liter in estuaries in southwest Spain[53].

Previous works of our lab showed that C. virginica growing in Jamaica Bay, a copper polluted environment, readily accumulated copper[14]. Atomic absorption spectrometry revealed that the soft tissues accumulated copper in the ug/g dwt range, which was comparable to other published reports for *C. virginica* growing in other areas[6,54]. Copper accumulations were not homogeneously distributed throughout the oyster=s soft

tissues with greater amounts accumulating in the gill, heart and palps; shell tissues also accumulated copper, but to a lesser extent[14].

The present study confirmed that isolated gill quickly accumulates high levels of copper and demonstrates that this copper analysis and staining technique is useful in testing chemicals and drugs that may be effective in reducing copper accumulations. Subjecting oyster gill to 0.5 mM copper for 3 days increased gill copper by more than 300%. Lanthanum, a calcium channel blocker, was tested for its ability to reduce copper accumulations in the gill. Lanthanum was not effective in reducing copper accumulations. Diltiazem, which is another calcium channel blocker, was effective in reducing copper accumulations in the gill. This was shown by both atomic absorption spectrometry and by histochemical staining. Earlier works also showed that diltiazem was effective in reducing the deleterious effects of copper on mitochondrial respiration while lanthanum was not[33]. Diltiazem reduced the cellular accumulations of copper. PAS, which is an anti-inflammatory agent with suspected chelating abilities, is being shown as a possible therapeutic drug for Manganism[36]. PAS reduced copper accumulations into gill as effectively as did diltiazem.

The DMAB-Rhodanine staining for copper histochemistry technique confirmed that copper was entering gill cells and that diltiazem greatly reduced the cellular uptake of copper. In light of the mitochondrial studies, it appears that the protective actions of the known calcium channel blocker, diltiazem, against the deleterious effects of copper on respiration are likely due to blocking copper accumulations. Lanthanum did not protect mitochondria against copper toxicity, and it did not reduce copper accumulations in oyster gill. PAS is not believed to act as a channel blocker and the mechanism by which PAS reduced copper accumulations is not yet known, but may involve copper chelation. The accumulation of copper into gill and the toxic effects of copper on gill mitochondria could be of physiological significance to the growth and long-term health of oysters and other marine animals living in a copper polluted environment. The toxic effects of copper on oysters in particular and animals in general, can be of physiological and medical significance for humans with copper toxicity or exposed to high copper levels. In humans a number of disorders in copper homoeostasis exist such as Wilson Disease[55-57], a condition leading to progressive accumulation of copper with resulting cirrhotic and neurological damage. Identifying agents and mechanisms which reduce copper accumulation and protect mitochondria is beneficial for understanding and therapeutic treatment of copper toxicity in humans.

Acknowledgments

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Hormesis: A Possible Mechanism of the Anti-Aging Process

by

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Introduction

Hormesis is defined as the beneficial action resulting from the response of a biological organism to a low-intensity stressor. Caloric restriction (CR) in rats and mice meets the criteria of hormesis[1]. It causes a daily moderate elevation of blood glucocorticoid level, a characteristic action of a low-intensity stressor, and, in regard to beneficial action, it increases the ability of rats and mice to cope with the damaging actions of acute, intense stressors such as surgery, toxic chemicals, and high environmental temperature. The concept of biological hormesis is as important as that of homeostasis for the survival of the organism. Since aging appears to be the result of the accumulation of unrepaired damage due to intrinsic processes, as well as environmental agents and their interactions, this increased ability to cope with stressors may well be the basis for the retardation of aging by CR. The increased daily levels of blood glucocorticoids may well play a major role in the increased resistance to acute, intense stressors and, in the antiaging action[1]. CR also enhances expression of stress response genes, thereby increasing the production of proteins that protect cells against damaging agents, possibly including agents that promote aging. Although many actions of caloric restriction fall within the realm of hormesis, this hypothesis has yet to be rigorously tested.

Most research on the life-extending effects of long-term dietary restriction has been tested on rats and mice[1]. These studies have shown that the effects on longevity do not relate to a decrease in the intake of a specific nutrient, such as vitamins, minerals, and protein, or a dietary contaminant, but rather result from a decrease in intake of calories. It is for this reason that this phenomenon is referred to as caloric restriction.

CR has been found to increase the length of life when initiated in the young adult[2]. It also does so when started as late as early middle age, but less markedly than in younger animals. With increasing age, there is an increase in mortality. Analysis of age-specific mortality (the fraction of the population that dies during a specific age interval) reveals that caloric restriction reduces the age-associated increase in age-specific mortality of adult rats and mice[2]. This finding strongly suggests that caloric restriction extends the length of life by slowing the rate of aging, a conclusion supported by the fact that it retards the age-associated deterioration of physiological functions. These functions range from fundamental cellular processes, such as DNA repair, apoptosis, proteolysis, signal transduction, gene expression, and many others, to integrated organismic functions. Caloric restriction also delays the occurrence or slows the progression of most age-associated diseases in rodents, including many different cancers, as well as degenerative diseases, such as nephropathy, cardiomyopathy, cataracts, and autoimmune diseases[3].

Several laboratories investigate the mechanisms underlying the antiaging action of CR. Such knowledge would provide insights in the quest to understand the basic nature of aging and to develop interventions. In their 1935 publication, McCay and his colleagues proposed that food restriction extended the length of life in rats by retarding development and growth[4]. It was the first CR study to show longevity improvements when started soon after weaning. Later, it was found that CR works independently of growth retardation[2,4]. Therefore, this hypothesis was disproved.

Biological molecules, such as DNA, proteins, and lipids, are damaged by reactive oxygen molecules such as hydroxyl and superoxide radicals. Reactive oxygen molecules are generated by intrinsic living processes as well as environmental factors. In 1996, Rajindar Sohal and Richard Weindruch suggested that caloric restriction retards aging by decreasing oxidative damage[5]. CR does, indeed, retard the age-associated accumulation of oxidatively damaged molecules. It is often stated that this protective

action results from a lowered specific metabolic rate (metabolic rate per unit of body mass); however, studies on both rats and mice have shown that caloric restriction can have life-extending and antiaging actions without decreasing the specific metabolic rate[6,7]. Of course, a decreased production of reactive oxygen molecules is not dependent on a reduction in metabolic rate. Furthermore, enhancement of antioxidant defenses would also protect against damage from reactive oxygen molecules even if their rate of production did not change[8,9].

CR may well decrease the rate of production of reactive oxygen molecules, and/or increase the level of protection against their damaging effect, but there are not yet sufficient data to judge the importance of either. Indeed, the fact that CR increases the repair or removal and replacement of damaged molecules may play the major role in its ability to reduce the accumulation of oxidatively damaged molecules[8,9]. However, the question of whether CR increases human longevity, by reducing the accumulation of oxidative damage, cannot be answered until the importance of oxidative damage in aging has been fully elucidated.

Another hypothesis states that CR lengthens life through reducing body fat. Studies on fat content vs. longevity in both ad libitum-fed (AL) and CR mice report no significant relationship[10]. However, body fat is unquestionably bad for human longevity. It could be that fat is a factor in humans, but not in rodents[11]. It could also be that fat is not involved in aging, only disease, and the type of fat that counts for longevity; subcutaneous or visceral fat. If you knock out insulin receptors in fat cells in rodents, they have less fat mass and live longer. Masoro is critical of the several recent researchers suggesting that body fat is important for the mechanism of CR[12,13].

The next hypothesis for how calorie reduction works is related to the rate of living hypothesis - high metabolic rate "used up" your lifetime calorie allotment faster, so you die sooner. Masoro actually found that lifetime food/calorie intake per gram of body weight (or gram of lean body mass) is higher in calorie restricted animals than AL animals (e.g. 133.5 vs. 91.5 calories/gram body weight)[12]. These results indicate that a reduction in metabolic rate is not a factor for CR to increase longevity.

It is interesting; however, that the free radical theory of aging is somewhat related to metabolic rate hypothesis, but calorie restricted animals may have less oxidative damage because of reasons other than reduction of metabolic rate. Some evidence from isolated mitochondria indicates oxidative stress, but properties of isolated mitochondria are hard to measure reliably[14]. Therefore, is free radical damage really associated with aging? Evidence against the free radical theory of aging are supported by the fact that mice lacking endogenous enzymatic anti-oxidants suffer more oxidative damage, but do not live shorter lives[14]. However, since there is some evidence that favors the free radical theory of aging, the importance of oxidative stress is still an open question[14].

Masoro *et al.*, reported that, plasma glucose levels are lower and plasma insulin levels are markedly lower in CR rats than in AL animals; yet rats on the CR regimen utilize glucose as fuel per unit of metabolic mass at the same rate as AL rats[13]. More specifically, the plasma glucose exposure of calorie restricted animals was a lot lower throughout the day, and throughout their lifetime[13]. The same study reports similar results for insulin. Furthermore, both CR and AL animals were burning exactly the fuel mixture they were being fed, no preferential burning of fat, but glucose burning per gram of body mass was the same for CR and AL[13]. Both hyperglycemia and hyperinsulinemia are known to cause aging-like damage[13]. Because of its mitogenic action, insulin is recognized as damaging. In 1992, Kristal and Yu proposed that the damaging action of glucose has been linked to glycation and/or glycoxidation, but other mechanisms may also be in involved[15]. So is it low insulin, rather than low glucose, that cause all of the CR benefits? This question is certainly true in regards to the latter statements[1,12].

The hormesis hypothesis is described as the beneficial action(s) resulting from the response of an organism to a low intensity stressor. The possible mechanism that is involved is that the low intensity stressors upregulate defenses without damaging the animal, and as a result "harden" the animal, (put it in "protective mode"), and help them live longer. But the real problem is whether CR should be considered a low intensity stressor. The only evidence that is apparent is the Corticosterone (stress marker), which is higher in CR rodents. This indicates that CR is in fact a long-term, low-intensity stressor[1,16].

A review of the literature reveals that CR does increase the ability of mice and rats to cope with a wide range of intense, acute stressors such as surgery, inflammatory agents, markedly elevated ambient temperature, and toxic drugs[1]. More

evidence suggests that heat shock protein (hsp 70) induction, which help animals deal with stress, drops with age, and CR inhibits this decline[16]. CR animals are more readily able to combat stress by releasing heat shock proteins than AL animals. The hormesis hypothesis has shown that it has evolved to enable animals to survive in the wild due to unpredictable and relatively short term food shortages. The anti-aging action happens via long-term CR because this mechanism is constantly active, and the mechanisms may be fine explanations for how hormesis exerts its effects[16].

Masoro supports the hormesis hypothesis because it appears to encompass several of the other hypotheses[12]. However, other studies suggest hormesis does not impact aging, like CR does[17]. But, if in fact we do accept that aging is primarily the result of the accumulation of unrepaired damage due to long-term intrinsic and extrinsic stressors, then hormesis is central to the anti-aging action of CR[18]. In addition to hormesis, the diverting of energy to maintenance probably drives the decrease in insulinemia and possibly other mitogenic agents. It seems that the latter might be the factor that enables the CR to slow-down or inhibit neoplasia, a major aspect of its antiaging action. Of course, further research will need to be done in order to elucidate a role for these and other mechanisms in the retardation of aging.

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42nd Annual MACUB Conference Poster Presentation Winners

Community College

First Place

Correlation of Membrane Potential and Ciliary Activity of the Lateral Ciliated Cells of Gill of the Bivalve Mollusc Crassostra virginica and the Neurotoxic Effects of Manganese
Trevon Adams[1], [2]Michael Nelson, Margaret A. Carroll and Edward J. Catapane
[1]Kingsborough Community College, Brooklyn, NY and [2]Medgar Evers College, Brooklyn, NY

Second Place

In search for the truth in food labeling - "Organic" or "Genetically Modified"?
Athanasia Pavlou and Nidhi Gadura, Queensborough Community College, Bayside, NY

and

Analysis Of Antibiotic Induced Evolutionary Changes In E.coli
Elana Santos[1], Omid Khalpari[2], Todd Holden[1] and Nidhi Gadura[1]
[1]Queensborough Community College, Bayside, NY and [2]Queens College, Flushing, NY

Third Place

Anionic Affects on Ionic Liquid Toxicity
Joely Guzman[1], Catherine McEntee[1], Placide Bisangwa[2], Xing Li[3], Sharon Lall-Ramnarine[3], James Wishart[4]
[1]Kingsborough Community College, Brooklyn, NY, [2]Brooklyn College, Brooklyn, NY, [3]Queensborough Community College, Queens, NY and [4]Brookhaven National Laboratories, Upton, NY

Senior College

First Place

Characterizing the Anaphase-Promoting Complex: Protein-Protein Interactions and Localization of Apc5p, Cdc23p, and Cdc20p in Budding Yeast
Nicole Aiello and Patricia Melloym, Fairleigh Dickinson University, Madison, NJ

and

Scanning Electron Microscopic Characterization of Structural Reorganization of the Adult Zebrafish Optic Tectum in Organotypic Culture
Michael C. Gutkin, Christopher P. Corbo, Linda A. Raths and Zoltan L. Fulop, Wagner College, Staten Island, NY

Second Place

Using the Scanning Electron Microscope to Document Sperm Head Morphology Among Fruit Flies in the Genus Drosophila
Stefan Barone[1], Valerie Schawaroch[1,2] and Angela V. Klaus[3]
[1]Baruch College, New York, NY, [2]Division of Invertebrate Zoology American Museum of Natural History, NY and [3]Seton Hall University, South Orange, NJ

Third Place

Role of G-Quadruplexes in the 5' and 3' Untranslated Regions in Regulation of the NF1 Gene
Rami Alrabaa, Paramjeet Bagga and Lawrence D'Antonio, Ramapo College of New Jersey, Mahwah, NJ

and

Myelin basic protein stimulates chemokine secretion in human astrocytes: importance in the pathogenesis multiple sclerosis
Courtney Peloso, Joe Matarloandand and Teresa G. D'Aversa, Iona College, New Rochelle, NY

Graduate

First Place

The effects of insulin on Drosophila spermatogonial growth in vitro
Peta-Gay Ricketts and Angela V. Klaus, Seton Hall University, South Orange, NJ

Second Place

Optimization of Fatty Acid and Cholera Toxin Concentrations for Treatments of Epithelial Cells: Can Fatty Acids Provide Mucosal Immunity against Cholera Infections?
Joanna Tychowski[1], Paula Cobos[2], Laura Lorentzen[1]and Farshad Tamari[3]
[1]New Jersey Center for Science Technology Mathematics Education, Kean University, Union, NJ, and [3]Kingsborough Community College, Brooklyn, NY

Third Place

Study on the Effect of Cupric Chloride and Cadmium Chloride on Cyanobacteria Synechococcus sp. IU 625
Vico Viggiano[1], Shyam Patel[1], Jose L. Perez[1], Tin-Chun Chu[2] and Lee H. Lee[1]
[1]Montclair State University, Montclair, NJ, [2]Seton Hall University, South Orange, NJ

Correlation of Membrane Potential and Ciliary Activity of the Lateral Ciliated Cells of Gill of the Bivalve Mollusc *Crassostra virginica* and the Neurotoxic Effects of Manganese. Trevon Adams[1], Michael Nelson, Margaret A. Carroll and Edward J. Catapane, [1]Kingsborough Community College and Medgar Evers College, Brooklyn, NY.

Cilia of lateral cells of gill of *Crassostrea virginica* are innervated by serotonin and dopamine which cause cilioexcitation and cilioinhibition, respectively. The pharmacology is well studied but the fast ciliary movement prevents microelectrode studies of membrane potentials. Voltage sensitive probes have been developed that change fluorescent intensity according to membrane potential. We observed membrane potentials of lateral cells while measuring beating rates. Serotonin applied to gill or 5 Hz electrical stimulation (ES) to the branchial nerve caused membrane depolarizations and increased beating. Applying dopamine or 20 Hz ES after exciting cilia repolarized the membrane and decreased beating. Manganese, a neurotoxin causing Manganism, a Parkinsons-like disorder, disrupted the cilio-inhibitory innervation and prevented the cilio-inhibitory response and membrane repolarization when dopamine was applied to gill or the branchial nerve stimulated. The effects of manganese were prevented by co-treatments with p-Aminosalicylic Acid, a potential therapeutic drug for Manganism. The study shows correlation between membrane potential of lateral ciliated cells and actions of serotonin and dopamine. It helps elucidate the mechanism of action of manganese, showing the site of action is postsynaptic at the dopamine receptors. This information is helpful to understand causes and potential therapeutic treatments of Manganism.

Characterizing the Anaphase-Promoting Complex: Protein-Protein Interactions and Localization of Apc5p, Cdc23p, and Cdc20p in Budding Yeast. Nicole Aiello and Patricia Melloy, Fairleigh Dickinson University, Madison, NJ.

The anaphase promoting complex (APC) is a highly conserved complex of proteins that acts as a ubiquitin ligase and is involved in sister chromatid separation and cell cycle progression. It is suspected that the misregulation of this complex may contribute to aneuploidy, the formation of tumors, and genetic instability. In this study, a yeast two-hybrid system was utilized to identify protein interactions with Cdc23p, a protein that is part of the APC. We also began work on a new yeast two-hybrid bait construct containing Apc5p. In order to determine the localization of the APC relative to its regulators within the cell, the APC subunit Cdc23p and APC regulator Cdc20p were tagged with green fluorescent protein (GFP) and the strains were observed under a fluorescence microscope. To further characterize the localization of Cdc20p, an experiment was carried out in which a Cdc20-GFP yeast strain was treated with nocodazole, a drug that interferes with microtubule polymerization and causes metaphase arrest. The effect of the drug on Cdc20p localization was then observed using fluorescence microscopy. This work will hopefully lead to a new understanding of what proteins are involved in chromatid separation and cell cycle regulation, and how these processes can be disrupted.

Role of G-Quadruplexes in the 5' and 3' Untranslated Regions in Regulation of the NF1 Gene. Rami Alrabaa, Dr. Paramjeet Bagga, Dr. Lawrence D'Antonio, Ramapo College of New Jersey, 505 Ramapo Valley Road, Mahwah, New Jersey.

The NF1 gene codes for a tumor suppressor neurofibromin 1 protein which is found in different types of cells including nerve cells such as oligodendrocytes and Schwann cells that insulate and protect certain neurons. Neurofibromin is known to repress the *Ras* protein, which normally stimulates cell growth and division. Mutations in the NF1 gene produce a corrupt neurofibromin protein resulting in a disease characterized by soft noncancerous tumors called neurofibromas and by patches of skin pigmentation called café-au-lait spots. This condition is known as Neurofibromatosis Type 1 or von Recklinghausen Disease. Previous studies in our lab have suggested that G-Quadruplex motifs may play a regulatory role in mammalian gene expression. The goal of this research project has been to explore the role of G-Quadruplexes in regulation of the NF1 gene expression at the post-transcriptional level. We have used indigenously designed software to map conserved G-Quadruplexes in the untranslated regions of NF1 gene orthologues from five mammalian species. We discovered several highly conserved G-Quadruplexes in both, the 5'- as well as 3'-untranslated regions across the orthologues. Our findings strongly suggest that these sequences are biologically functional and most likely play a role in the regulation of the NF1 gene expression.

BLAST analysis of putative protamine sequences in genomes of 12 *Drosophila* species and image analysis of condensing *Drosophila* spermatids Zain Alvi and Angela V. Klaus, Department of Biological Science, Seton Hall University, South Orange, NJ

During sperm development, the sperm nucleus transforms from a spherical structure into a flattened, elongate structure. This remarkable re-shaping is accompanied by extreme condensation of the sperm DNA. Collectively, these events are referred to as nuclear transformation. Recent studies indicate that DNA condensation pattern differences, and some striking similarities, exist among distantly related species of animals. Likewise, there is evidence that closely related species exhibit marked differences in chromatin condensation patterns. The mechanisms which control nuclear transformation are not well-understood. Additionally, it is not known exactly how the species-specific shape of the sperm nucleus is generated. Some evidence in mammals indicates that a perinuclear, microtubule-based structure called the manchette generates external forces that contribute to nuclear shaping. We hypothesize that internal forces generated by specific chromatin condensation patterns also contributes to the final shape of the sperm nucleus. Moreover, we suggest that species-specific protamine proteins contribute to unique chromatin condensation patterns. Our aims in the current work are to (1) systematically analyze DNA condensation patterns among species within the genus *Drosophila* whose genomes have been sequenced, and (2) use BLAST to analyze the putative protamine sequences for these species using the published protamine sequences for *D. melanogaster* as a template.

Is Chelation the Mechanism of Action of p-Aminosalicylic Acid (PAS) in the Treatment of Manganism. Augustus Augustin, Jose Rios, Nadeen Blackwood, Patrice Smith, Ahmed Nuhar, Orson Noel, Dwyane G. Skeete, Karl Ruddock and Dereck Skeete, Medgar Evers College, Brooklyn, NY.

Manganese is a naturally occurring element, essential for living organisms, but potentially toxic in high concentrations. Certain occupations including mining, welding and steel manufacturing can expose workers to high levels of manganese, leading to the clinical condition Manganism, a Parkinson like disorder. The mechanism of manganese toxicity is not fully understood and effective treatments are still being developed. Studies have shown the metal chelator, ethylenediaminetetraacetic acid (EDTA), is effective in alleviating symptoms of Manganism. More recently the drug, p-aminosalicylic acid (PAS) is showing promise in treatment of Manganism but the mechanism of action is unclear. It is debated whether the effects of PAS are due to anti-inflammatory or metal chelation properties. We used a spectrophotometric assay to determine manganese chelating properties of PAS, compared to EDTA. Manganese (Mn^{+2}) containing solutions were exposed to different concentrations of EDTA or PAS, followed by an oxidation reaction that converts remaining free Mn^{+2} into permanganate ions (MnO_{4-}). Levels of MnO_{4-} were then measured spectrophotometrically and compared to controls. Our results indicate that PAS is much more efficient than EDTA as a chelator of Mn^{+2} ions. These results help to clarify the mechanism of action of PAS in alleviating the symptoms of Manganism.

Sub-Cloning *GAL1* Promoter To Drive The Expression Of Mammalian *PKC Alpha* Gene. Muhammad Awan[1], Nidhi Gadura[2], [1]Queens College, CUNY, Flushing, NY, [2]Queensborough Community College, Bayside, NY.

Hsp90 is a molecular chaperone essential to the folding, activation and maturation of small number of distinct client proteins. Elevated *PKCα* activity increases the motility of human breast and melanoma cells. We hypothesize that *PKCα* is a possible client protein of Hsp90. Our data indicates that mammalian *PKCα* overexpression in the *Saccharomyces* strain W303 significantly slows the growth rate. Overexpression was achieved using the constitutive GPD promoter carried by a yeast CEN vector. Consistent with this finding, transformants carrying the GPD - *PKCα* gene vary up to 3 times larger than normal. To study this phenotype further, mammalian PKCα will be expressed under control of the easily regulated *GAL1* promoter. Our project is to amplify the *GAL1* promoter sequence from plasmid pFJ44 (provided by J. Brodsky) and insert the resulting fragment into sites upstream of the triple HA-tagged *PKCα* ORF in plasmid p413, a CEN plasmid.

Using the Scanning Electron Microscope to Document Sperm Head Morphology Among Fruit Flies in the Genus *Drosophila*. Stefan Barone[1], Valerie Schawaroch[1,2] and Angela V. Klaus[3], [1]Baruch College of CUNY, NY, USA, [2]American Museum of Natural History, New York, NY, [3]Seton Hall University, South Orange, NJ.

Morphological features (characters) are compared among species to hypothesize their evolutionary relationships. This paper is the first to report on efforts to employ scanning electron microscopy (SEM) to document the ultrastructural morphology of sperm heads among fruit fly species in the genus *Drosophila*. Previous investigations report that the mature sperm head takes on the form of a "needle-like" structure. However, these studies have utilized bright field, fluorescence, and/or confocal microscopy which lack the fine resolution needed to identify any ultrastructural differences in the surface morphology of sperm heads among species. Representative species within the genus *Drosophila* were chosen based on their relative taxonomic position and on the fact that their genomes have been sequenced. Mature sperm were collected and fixed in either glutaraldehyde alone or glutaraldehyde followed by post-fixation with osmium tetroxide. The samples were then dehydrated in an ethanol series, critical point dried, sputter coated with gold/palladium, and imaged using a Hitachi S 4700 cold field-emission scanning electron microscope. Images obtained using the SEM provide fine details of surface morphology that may be useful for proposing hypotheses of evolutionary relationships among species.

Oxygen Uptake (VO_2) in Guppies. David I. Basaly, D.A. Hodge, J.L. Kinard, R. Lazzara, D. Nikoonezhad, M.L. Pontoriero, K.A. Seiverd and D. Dorfman, Monmouth University West Long Branch, NJ.

Most fishes are believed to have color vision. The respiration rate of fishes may be affected by the color background of their holding tanks. To examine respiration and color, female guppies, *Poecilia reticulata*, were selected as the test fish. Fish were maintained in the laboratory then tested, singly, in closed 395 ml vessels, with different colored backgrounds, including green, blue, red, gray, white, black, brown, yellow, and clear. A duplicate set of vessels had either clear colored tops (covers) or tops the same color of their container. Test water temperatures were approximately 20^0 C±1. After two hours in the test vessels Dissolved Oxygen was determined by the Winkler method. In red test vessels with clear tops the average VO_2 (mls O_2/gm/hr) was 0.1373. In colored top vessels the lowest VO_2 occurred in blue vessels (0.1019). Overall, the mean value for VO_2 in clear top vessels was 0.2095, and colored tops 0.1600. These rates generally are greater than those reported for larger fishes. However, smaller fishes tend to have higher metabolic rates. This data may be of value in selecting backgrounds for maintaining and/or transporting fishes. Note that different fish species may not respond alike.

Role of Timing of Administration in Synergistic Killing of Malignant Histiocytosis Cells by Clodronate and Vincristine. Lotfi M. Bassa[1], S. Hafeman[2], S. W. Dow[2], [1]Montclair State University, NJ, [2]Colorado State University, CO.

Malignant Histiocytosis (MH) is an unusual neoplasmic disease that occurs in dogs. In humans, Langerhans cell histiocytosis shows the same characteristics. MH is rapidly metastasized and is fatal in most cases. Response failure is high and survival rates are low which leads to the search of a better more responsive treatment method. Clodronate is a drug of the biphosphonates family which have been investigated for their antitumor effects on different types of cancer cells. Vincristine is a chemotherapeutic drug for cancer treatment, but their success rates with MH were not satisfactory. Synergistic effects between biphosphonates and chemotherapeutic drugs have been studied by several research groups and have shown higher killing rates on different tumor cells *In vitro* and *In vivo* (Webbe et al,2005) (Ottewel et al, 2008). In our experiments, we show a synergy between clodronate and vincristine in the killing of 3 different MH cell lines. The administration time was studied to see if there was an effect, also the mechanism of the killing in this synergy was studied by a preliminary apoptosis test.

Determination of Subspeciation of the Eastern oyster (*Crassostrea virginica*) Along the East Coast of the United States. Jennifer Beaugé, Craig Hinkley, Gary Sarinsky. Kingsborough Community College, Brooklyn, NY.

Eastern oysters (*Crassostrea virginica*) used to inhabit Jamaica Bay, NY but are believed to have disappeared due to disease, overharvesting, and poor water quality. As a first step toward possibly reintroducing them to Jamaica Bay, we examined Eastern oysters from locations along the east coast of the U.S. to determine whether there is evidence for subspeciation. We hypothesized that since there are environmental differences in these locations, there would be subspeciation amongst the Eastern oysters. To identify possible subspecies we produced DNA barcodes for the mitochondrial cytochrome c oxidase I gene (COI) from oysters grown in Florida, South Carolina, Virginia, Maryland and Jamaica Bay, NY. Comparisons of the barcodes indicate that the portion of the COI gene we sequenced contains two polymorphisms. The first polymorphism is at nucleotide 213 which is adenine in oysters from South Carolina and Florida and thymine in oysters from Virginia, Maryland and Jamaica Bay. The second polymorphism is at nucleotide 261 which is guanine in the Maryland oyster but thymine in the other oysters. These results show that there are differences in Eastern oysters from the northeast and southeast coasts of the U.S. and suggest that there may be subspeciation in the Eastern oyster population.

Inhibition of strong midgut alkalinization in larval yellow fever mosquitoes (*Aedes aegypti*) with HEPES buffer. Lynsey Brandwein[1], Julianna Maniscalco[1], Medije Mashkulli[1], Stacia B. Moffett[2], David F. Moffett[2] and Horst Onken[1,2], [1]Wagner College, Staten Island, NY, [2]Washington State University, Pullman, Washington.

Like some other larval insects, larval mosquitoes generate an extremely alkaline (pH 10-12) compartment in their anterior midgut. The mechanisms of midgut alkalinization are not completely understood. However, digestive enzymes are adapted to this high pH and it is believed that the alkaline environment increases nutrient assimilation. Because larval mosquitoes drink the medium, it could be anticipated that buffering the medium could prevent the animals from alkalinizing the anterior midgut. Alkalinization of the midgut can be studied by addition of the pH indicator m-cresol purple to the medium and observing the color of the midgut. In larvae raised under control conditions the midguts showed a purple color, indicating midgut alkalinization. When maintained in water containing 25 mmol/l HEPES buffer midgut alkalinization was hardly detectable. When raising larvae in water containing 50 mmol/l HEPES, no alkalinization was observed. Interestingly, the development of larvae through the four instar stages, to pupae and adults was not affected by the presence of buffer in the ambient water used to raise the animals. Financial support by the NIH (1R01AI063463-01A2) and by a Wagner College Faculty Research Grant is gratefully acknowledged.

The Toxic Effects of Manganese on Mitochondrial Catalase in the Gill of the Bivalve *Crassostrea virginica*. Kaydean Brown, Margaret A. Carroll and Edward J. Catapane, Medgar Evers College, Brooklyn, NY.

Excess environmental manganese (Mn) causes Manganism, a Parkinson's-like disorder. The mechanism of Mn neurotoxicity is largely unknown. Excess Mn may cause oxidative damage by elevating reactive oxygen species (ROS) or by impairing mechanisms that defend against oxidative stress. Mn accumulates in mitochondria, an important source of ROS. Bivalves serve as bioindicators of environmental metal contamination, and also as animal models to study metal toxicity. We examined the effects of Mn on mitochondrial catalase (CAT), an enzyme that protects against oxidative stress by degrading H_2O_2. Present primarily in the cytosol or peroxisomes, much less has been reported on mitochondrial CAT, especially in bivalves. To determine the effects of Mn treatments on gill mitochondrial CAT activity, right shells of *Crassostrea virginica* were removed before placement in individual containers with or without Mn for 3 days. CAT activity was determined spectrophotometrically using H_2O_2 and methanol as substrates. We found CAT to be present in gill mitochondria, and treatment with Mn (1 mM) caused a 50% loss in activity. These results corroborate our previous findings that Mn toxicity targets mitochondrial function in oyster gill and demonstrate how Mn can cause oxidative damage by inhibiting mitochondrial CAT, a key enzyme that protects against oxidative stress.

Antubiotic-resistant *Salmonella* Containiantion of Mute Swan (*Cygnus olor*) Eggs in the Jamaica Bay Wildlife Refuge, Brooklyn and Queens, New York. Jessica Browning[1] and Adam Houlihan[1], [1]Wagner College, Staten Island, NY.

Antibiotic resistant bacteria have been a growing concern among the scientific community for a number of years. While bacteria are kept under close surveillance in health care settings, it is difficult to observe the spread and abundance of bacteria in wild animals, particularly birds. Avian species may be responsible for contamination of fruit and vegetable crops, as well as food animals such as cattle, pigs and domestic chicken and duck with antibacterial resistant strains of bacteria. Mute swan (*Cygnus olor*), while not considered a migratory species due to their short migration distances, come into contact with a number of migratory birds that may act to ferry these bacteria to other locations. Samples were obtained by swabbing freshly lain eggs and processed to detect the presence or absence of *Salmonella* species as well as to determine the susceptibility of recovered organisms to six clinically-significant antibiotics. Laboratory methods included the use of selective enrichment by selenite-cystine and tetrationate broths followed by plating on brilliant green agar and bismuth sulfite agar. Confirmation that *Salmonella* species had been recovered was accomplished using triple sugar iron slants. Antibacterial resistance was determined via disc diffusion on Mueller-Hinton agar plates. A total of 23% of the eggs sampled contained *Salmonella,* and 100% of the isolates were found to be resistant to Oxacillin (1 µg).

Identification of Three Novel Genes Potentially Involved in the Regulation of Bone Mass. Sarah Carrante[2], Caitlin Nacamuli[2], Narges Sarrafan[2], Fayez Safadi[1], Steve Popoff[1] and Tom Owen[2], [1]Temple University School of Medicine, Philadelphia, PA and [2]Ramapo College of NJ, Mahwah, NJ.

Osteoporosis is characterized by the progressive loss of bone mass resulting in decreased mechanical strength and increased fracture risk. Our goal is to characterize novel genes in order to identify signaling pathways leading to new therapeutic targets for restoring lost bone mass. We previously identified 160 genes whose expression may be related to the increased bone mass in osteopetrotic rats. We have cloned and sequenced a number of these genes and are currently focusing on three: sit-1, niban, and clone 135. Sit-1 is part of a family of transmembrane adapter proteins which function is to recruit other signaling proteins to the cell membrane. Niban was originally reported as a gene whose expression is increased during renal carcinogenesis and has been suggested as a marker for renal tumor development. Clone 135 is a novel mRNA sequence encoded in the middle of the gene for FKBP-7, possibly representing an alternative splice form. While we know that each of these genes is expressed in bone and in osteoblasts in culture, we plan to confirm the differential expression of each gene between high and low bone mass states, clone their full length cDNAs, and pursue their roles in the regulation of bone mass.

Investigating the Protein Partners of FnTm2. Yan Mei Chan[1], Peter James Baker[1], Robert Agate[2], Fernando Nottebohm[2], and Jin Kim Montclare[1,3], [1]Polytechnic Institute of NYU, Brooklyn, NY, [2]The Rockefeller University, Millbrook, NY and [3]SUNY-Downstate Medical Center, Brooklyn, NY.

Fibronectin Transmembrane (FnTm) is a novel transmembrane protein found to be up-regulated in the learning system in birds and other mammals. Identifying FnTm protein partners will allow us to clarify the FnTm signaling pathway in the brain. However, identifying protein pairs is often limited because the weak forces by which proteins interact are not sufficient to preserve the proteinmacromolecule complex. To circumvent this limitation we are working towards introducing the photocross-linkable non-natural analogs *para*-azidophenylalanine and photoleucine in a residue-specific manner into FnTm. Based on preliminary pull-down data, we have identified myelin basic protein (MBP) as one of the strong interacting partners to FN3 and performed biophysical characterization of this interaction. Here we demonstrate the progress of our efforts to discover the proteinprotein interactions involved in learning.

SPR Based Immunosensors for Medical Diagnosis of Genital Pathogens. Huldah Charles, Sade Peter, Kleedy St. Surin, Tetyana Delaney, St. Joseph's College, Brooklyn, NY.

The purpose of our research is to effectively detect the presence of genital pathogens using the Surface Plasmon Resonance Immunosensor. The pathogens of interest are *Candida albicans, Human Papillomavirus,* and *Gardnerella Vaginalis*, which is associated with Bacterial Vaginosis. Biosensors are devices that convert biological signals into a physical signal. Immunosensors is one such device and is often used for medical diagnosis. A Surface Plasmon Resonance (SPR) Immunosensor uses the principle of antibody- antigen binding and the compounds' respectable refractive index, to provide quantitative information on the presence of the antibody or the antigen in the sample. Chicken IgG(as an antigen), anti-chicken rabbit IgG (as a primary antibody), and anti- rabbit goat IgG (as the secondary antibody), have been used in the preliminary experiments. The SPR Immunosensor is an effective method for the detection of our pathogens; the data received from the SPR Immunosensors has been compared to other immunoassays, namely the ELISA and the UV spectrometry. It demonstrates that the developed SPR Immunosensor will provide better sensitivity and selectivity. Moreover, SPR based Immunosensor proved to be more fast and cost effective.

Histoimmunofluorescence Demonstration of Dopamine D2 Receptors in the Lateral Ciliated Cells of the Gill of the Bivalve Mollusc *Crassostra virginica.* Noelia Cilli[1], Samuel Anador, Renee Fleming, Margaret A. Carroll and Edward J. Catapane, [1]Kingsborough Community College and Medgar Evers College, Brooklyn, NY.

Lateral cilia of the gill of *Crassostrea virginica* are controlled by a reciprocal dopaminergic- serotonergic innervation from their ganglia. Dopamine slows down beating and serotonin accelerates beating. We undertook a histoimmunofluorescence study of dopamine receptors. Dopamine receptors are classified as D1-like and D2-like, each with respective subtypes. We employed antibody-antigen histoimmunofluorescence to visualize dopamine receptors in gill of *C. virginica* using a primary antibody against D2 receptors followed by FITC linked secondary antibody to visualize receptors. Gills were exposed to primary and secondary antibodies and prepared for light microscope. Control sections without primary antibody exposure were similarly treated and viewed. Antibody treated sections demonstrated bright FITC fluorescence in the lateral ciliated cells as well as other areas of the gill, while control sections did not. Bright field and phase contrast showed the fluorescence corresponded to lateral cells and other gill cells, including cells lining the blood channels. The study shows the postsynaptic dopamine receptors involved in the cilio-inhibitory response of lateral cells of gill are of the D2 type. The study also shows this preparation is a good model for pharmacological studies of dopamine function as well as the pharmacology of drugs affecting biogenic amines in nervous systems.

Conductivity Studies of Biocompatible Microemulsion Formulations. Tierra S. Cochran, Debbie C. Crans[1] and Jackie Harding[1], Medgar Evers College Brooklyn, NY and [1]Colorado State University, Fort Collins, CO.

The toxicity of many cancer drugs is pronounced. Recent studies show biocompatible microemulsion formulations can reduce toxicity and improve quality of life. Conductivity is used to determine whether microemulsion solutions form reverse micelles. Reverse micelle formation needs to be confirmed to aid in supportive background essential for implementing a biocompatible-targeted drug delivery system. We prepared biocompatable microemulsions using a surfactant, co-surfactant, organic solvent and aqueous phases. The surfactants were sodium bis(2-ethylhexyl)sulfosuccinate (AOT) and phosphatidylcholine (Lecithin). The co-surfactant was polyoxyethylene sorbitan ester (Tween 80). The organic solvents were Captex 200®, Captex 300®, and Ethyl Oleate. The aqueous phase was distilled water. Microemulsion systems composed of lecithin and AOT in ethyl oleate, lecithin and AOT in Captex 200®, and lecithin and Tween 80 in Captex 300® were prepared in a range of W0 sizes of 2-20 in increments of 2, W0=[H2O]/[surfactant]. Conductivity was measured on each microemulsion system using a VWR International 2052-B Conductivity Meter with platinum probe. The conductivity increased from W0=2 to a maximum at W0=8 and slowly decreased until W0=20. We found the microemulsion systems are reverse micelles. Our findings are congruent with literature data of reverse micelle conductivity and will aid in understanding how to construct biocompatible microemulsions.

Comparison of testicular architecture and spermatogenesis in six species of *Drosophila*. Rashay Cooper, Pranav Desai, Israel Saintil, and Angela V. Klaus, Seton Hall University, South Orange, NJ.

Species within the genus *Drosophila* are small flies that vary widely in their reproductive capacities. Spermatogenesis is the process by which male spermatogenic stem cells develop into mature spermatozoa. In fruit flies, this process occurs within paired blind-ended tubes called testes. Our lab is focused on characterizing spermatogenesis in twelve species of *Drosophila* whose genomes have been sequenced. In the current work, we report on the testicular architecture of six of these species: *D. ananassae*, *D. willistoni*, *D. simulans*, *D. erecta*, *D. yacuba* and *D. sechelia.* The goal of this study is to characterize the differences among male reproductive structures using a variety of microscopic techniques, including phase contrast and fluorescence microscopy. Additionally, we will present the details of the life cycles of these species when grown under laboratory culture conditions.

Impact of Stress on Periodontal Disease. Aldo Cotrina, Raji Subramaniam and Patricia Schneider, Queensborough Community College, Bayside, N.Y.

Severe forms of adult periodontal disease are associated with anaerobic gram-negative bacteria, in particular *Prophyromonas gingivalis, Treponema denticola*, and *Tannerella forsythensis.* Recent findings suggest that stress is a risk factor for adult periodontal disease. This study examined the relationship between salivary alpha-amylase levels and the distribution of the three pathogens in periodontal patients at a private dental clinic. The BANA (N-benzoyl-DL-arginine-2-napthyamide) enzyme assay was performed on subgingival plaque samples taken during routine scaling. DNA was extracted from paper points used by the dentist to collect samples of subgingival fluid. The polymerase chain reaction (PCR) detected specific pathogens based on the amplification of signature sequences of the small subunit16S rRNA genes. We examined the relationship between alpha-amylase, bacterial distribution, BANA score, demographic factors and clinical parameters. Preliminary results indicate that disease progression is associated with high stress. This suggests that alpha-amylase activity may be useful in identifying patients at risk and in predicting the course of the disease. Aldo Cotrina is a participant in the QCC NIH Bridges to Baccalaureate Program.

Modified Green Tea Polyphenols as a Novel Approach to Inhibit Herpes Simplex Viral Infections. Aline de Oliveira, Sandra Adams, Lee Lee, Montclair State University, Montclair, New Jersey.

Green tea polyphenols are antioxidants known to possess antiviral properties, including HSV (Herpes Simplex Virus). There is no cure for the diseases caused by HSV infections. More importantly, HSV infection could be significantly reduced if effective agents for prevention are developed. Three different green tea extracts have been isolated and modified, EGCG and GTP are water-soluble and LTP is fat-soluble. These extracts with concentration of 12.5, 25, 50, 75 and 100 uM were used on vero cells to determine the cytotoxicity, and wound healing effect. Cell viability was determined by the trypan blue reagent, which stains only non-viable cells. The preliminary results of this study suggested that EGCG and GTP with concentration of 25uM, and LTP with concentration of 12.5 uM provided the best results on Vero cells. There are no significant morphological and proliferation changes seen in the treated cells. The maximum non-toxic concentration of each extract will be used to study its effect on HSV by plaque forming unit (PFU) assay and GFP expression. The results from the wound healing study suggested that all the extracts with different concentrations have helped the cells to recover.

Health Implications of a Longitudinal Study of Eelgrass and Algae Epiphytes at Two Coastal New York Sites. Rachelle Desroches and Mary T. Ortiz, Kingsborough Community College, Brooklyn, NY.

Zostera marina (eelgrass), a marine angiosperm, once grew in Jamaica Bay (JB), NY. In the 1930's it disappeared from US coasts, and reappeared in areas like Shinnecock Bay (SB), NY, but not JB. Our study (2008, 2009) compared algae epiphytes from JB and algae and eelgrass epiphytes from SB to determine similarities/differences. We collected algae from both locations, eelgrass from SB, scraped equal surface areas, added methylene blue, and examined the specimens using a microscope. The hypothesis was: epiphytes in JB will be similar to those from SB. 2008 results indicated similar epiphytes on JB algae JB and on SB eelgrass. Epiphytes identified included members of the *Dimerogramma*, *Ulothrix*, *Rhoicosphenia*, and other species. In 2009 organisms from the Phylum *Chrysophyta* were identified on algae and eelgrass from both locations. Climate differences may attribute findings, since 2009 was cooler than 2008. In both years, some similar species (ex. *Ulotrix*, *Dimerogramma, Nitzschiaceae*) were identified at both locations, indicating, the potential for eelgrass survival in JB is positive. JB eelgrass remediation would help restore a healthy coastal environment to this heavily used area. Supported by Grant 1R25GM62003, Bridges to the Baccalaureate Program (NIGMS) and Grant 0516051091, CSTEP Program (NYS Dept. of Educ.).

ICER Phosphorylation by Cdc2 During Mitosis Promotes its Monoubiquitination. Elisabeth Mémin[1], Megan Genzale[1], Erik Dickerson[2] and Carlos Molina[1,2], [1]University of Medicine and Dentistry of New Jersey, Newark and [2]Montclair State University, Montclair, NJ.

In contrast to normal prostatic cells, the transcriptional repressor and functional tumor suppressor ICER is undetected in the nuclei of prostate cancer cells. Until now, the molecular mechanisms for ICER deregulation remained largely unknown. In this paper, we discovered that ICER is post-translationally modified by phosphorylation and monoubiquitination. Western-blot analyses show that the expression of modified ICER was inversely correlated with the expression of ICER *per se* during the cell cycle. *In vitro* and *in vivo* experiments lead to the conclusion that ICER is a target for the cyclin dependent kinase Cdc2. As seen by mutational experiments and mass spectrometry, Cdc2 phosphorylates ICER on serine 35 or 41 during mitosis and ICER phosphorylation on serine 35 is a prerequisite for its monoubiquitination therefore leading to a decrease of ICER *per se*.

Measurements of Oxygen Uptake. Dr. Donald Dorfman, Monmouth University, West Long Branch, NJ.

Measurements of oxygen uptake are useful to determine metabolic needs in natural and altered environments. Oxygen consumption rate is the conventional metabolic measure for fishes because dissolved oxygen (D.O.) can be determined by several methods (Cech, in Schreck and Moyle, 1990). The following methods and materials are for the standard metabolic rate using a static (non-flow) system, and the Winkler for O_2 determination. The system employs a 395 ml chamber, adequate for small fishes (>3 gm). The chamber has a drain, with a screen that prevents the fish from being drawn into the drain during drawdown. The chamber cover has an opening for excess water and is plugged during the test. A wood rack holds the test chambers. A clamp on the drain tube is removed at the conclusion of the test. Water drains into a BOD bottle, and the D.O. determined. The fish is wet weighed at the test conclusion, and VO_2 ml/gm/time determined, and compared with other data (e.g. Proesser, and Brown, 1973). Various spray painted chambers are shown in the example for a study to examine the effect of color, if any, on O_2 uptake/gm/time on goldfish.

Steroid Measurements in Ether Extracts of the Hemolymph and Tissues of the Bivalve Oyster *Crassostrea virginica.* Latoya Duncanson, Ronald Peaster, Ebere Nduka and Alam NUR-E-Kamel. Medgar Evers College, Brooklyn, NY.

Invertebrates have open circulatory systems. The hemolymph transports nutrients, gases and other materials to tissues. We measured steroid hormones in hemolymph of oysters from two sites, Oyster Bay Long Island, and Jamaica Bay Brooklyn. Previously we measured steroids in oysters from Oyster Bay using acid and methanol extractions. In this study we used ether to extract 17b-esrtadiol, progesterone and testosterone. We compared steroid levels in hemolymph and other tissues using a 17b-Estradiol, Progesterone and Testosterone standards in an ELISA method and a plate reader. We analyzed hemolymph, gonads, adductor muscle, gills and mantle. We found levels of estradiol in hemolymph of samples from Jamaica Bay were higher than samples from Oyster Bay. Progesterone in hemolymph of samples from Oyster Bay was higher than from Jamaica Bay. There was no difference in levels of testosterone between Jamaica Bay and Oyster Bay samples. The higher concentrations of estradiol of oysters from Jamaica Bay may be due to high levels of pollutants in its waters. We will continue this study and use TRIzol reagent to isolate RNA to determine effects that biogenic amines and steroids have on the hemocysts and also the type of parasitic species derived from oysters in different estuaries.

A Small Colony Variant of *Escherichia coli* that is Highly Resistant to Acid and Oxidative Stress. Kanta Dutta and Irvin. N. Hirshfield, St. Johns University, Jamaica NY.

There has been extensive study of aminoglycoside resistant *Staphylococcus aureus* small colony variants (SCVs) but little has been done with *Escherichia coli.* In recent years our lab has been studying small colony variants of *E. coli.* This project focuses on SCV IH9, which was selected upon exposure of its parental strain BW7261 to apple cider. We are the first to isolate SCVs by acid resistance rather than resistance to aminoglycoside antibiotics. Normal strains of *E. coli K 12* are highly susceptible to killing by acid at pH3 or by oxidative stress in the log phase. But in a survival assay at log phase, IH9 is 2-3 logs more resistant to acid killing, and also 3-4 logs more resistant to killing by hydrogen peroxide (oxidative stress) than BW7261. Morphologically the colonies of SCV IH9 are significantly smaller than the parental strain having round smooth margins with a convex glossy form. Gas chromatographic analysis of whole cells revealed that SCV IH9 has a significantly higher concentration of cyclopropane fatty acids in log-phase cells compared to BW7261.This acid has been reported to be involved with acid resistance in *E.coli.* This result may explain one of the mechanisms responsible for the extreme resistance of the SCV.

Comparison of Urinary Androgen Metabolites in Normal Men and Prostate Cancer Patients. Lilian Ekwealor[1], Ozgu Muneyyrici, Vijay Nacharaju, Richard Macchia and Ivan Colon, [1]Medgar Evers College and SUNY Downstate Medical Center at Brooklyn, Brooklyn, NY.

The National Cancer Institute reports about 192,280 new cases of prostate cancer diagnosis and 27,360 estimated deaths in the US as of 2009. It is a common cancer, usually occurring in men over 40 years of age. African American males are most affected. Early stages are generally asymptomatic making early diagnosis difficult which results in the cancer being beyond the prostatic capsule at the time of diagnosis. The PSA (protein-specific antigen) and the digital rectal examination (DRE) are used for screening. Recent research shows testosterone and its metabolite Dihydrotetosterone are potential risk factors for prostate cancer due to the high activity of the 5 α-reductase enzyme. We used GC/MS to determine androgen metabolites in urine and to understand the role of androgen in the disease process. We compared urinary androgen metabolites of normal men to that of prostate cancer patient. We chromatographically separated several compounds. Peaks were identified quantitatively using automatic GC-MS quantification. Androsterone and Etiocholanolone peaks were identified, their quantities were determined and ratios were calculated. We found Androsterone/Etiocholanolone ratio is significantly higher in prostate cancer patient showing high 5 α-reductase activity. The significance of the Androsterone/ Etiocholanolone ratio should be further evaluated in BPH and prostate cancer patient.

The Role of Atotransporter Protein Lav in Autoaggregation and Adherence by Non-typeable *Haemophilus influenzae.* Linda Ekwealor[1], Miriam Golomb, Kate Rhodes, [1]Medgar Evers College, Brooklyn, NY and University of Missouri, Columbia, Columbia, MO.

Non-typeable *Haemophilus influenzae* (NTHi) is an un-encapsulated, gram-negative coccobacillus which can cause diseases. Our lab is investigating a protein termed Lav, found in diseases associated NTHi but not commensal isolates. We showed mutants with disrupted Lav genes are less adherent to lung tissue culture cells than wild type and display rapid autoaggregation. We wanted to ensure these phenotypes were due to Lav expression and not cis effects of chromosomal Lav disruption. We wanted to create shuttle plasmids and NTHi strains to tag bacteria with visual markers (green and red fluorescent protein) allowing distinction between Lav-expressing and non-expressing bacteria in mixtures for autoaggregation and adhesion assays, and to construct plasmids to complement Lav expression in the assays. As our previously constructed Lav mutants contained kanamycin-resistance cassettes, an additional antibiotic resistance cassette was needed for selection of complementing plasmids. We constructed the necessary shuttle plasmids, and adapted the vectors to express phase-locked ON Lav under its natural promoter. We successfully created shuttle plasmids with green and red fluorescence tags. The constructs were electroporated into NTHi, and will be valuable to examine the behavior of mixtures of aggregating and non-aggregating mutants as well as to complement Lav expression in trans.

Contributions of Actin Binding Proteins to the Structure and Dynamics of the Phagocytic Cup in Dictyostelium. Oluwafemi Fakayode[1] and David Knecht, [1]Medgar Evers College, Brooklyn, NY and University of Connecticut, Storrs, Storrs, CT.

Two major cellular components responsible for phagocytosis are the cytoskeleton and cell membrane. There are other regulators controling the structure and behavior of the cytoskeleton and cell membrane. The polymerization of F-actin from G-actin is regulated by actin-binding proteins (ABP). During phagocytosis, *dictyostelium* forms actin rings of filamin around prey before engulfing them. Actin filaments are arranged in three arrays and are facilitated by different ABP. Orthogonal arrays are facilitated by filamin, coronin. Parallel arrays are facilitated by fimbrin and dynacortin. Anti-parallel arrays are facilitated by alpha-actinin. ABP play major roles in cytoskeletal localization around the phagocytic cup in *dictyostelium*, but little is known about which ABP's are responsible for building the cup since there are more than 20 ABP's. Using a confocal microscope and fluorescence staining, we found GFP-filamin, GFP-fimbrin A, GFP-dynacortin, GFP-coronin, GFP-filaminABD, GFP-fimbrinABD1, marsfim A and marslim are ABP's are localized at the phagocytic cup during phagocytosis while RFP-alpha actininABD showed a very faint localization or in some cases no localization at the phagosome during phagocytosis. The intensity of the localizations at the phagosome helps to know how well each ABP is involved during phagocytosis.
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Ultrastructural Characterization of Formed Elements in Peripheral Blood of Adult Zebrafish (*Danio rerio*). Zulmarie Franco, Marlene Streisinger, Christopher Corbo, Linda Raths and Zoltan Fulop, Wagner College, Staten Island, NY.

Zebrafish (*Danio rerio*) a small and hardy tropical freshwater fish, which is easily available in all pet stores, has become a favoritised laboratory animal in genetics and developmental biology. As such it is also becoming widely used for other types of research, for example in studying neuronal degenerative and regenerative processes, a primary focus in our laboratory. Neuroregeneration is aided by different, specific non-neuronal cells like glial cells. However, other non-neuronal cells, such as different white blood cells and their derivatives also appear concentrated in the field of degeneration/regeneration. In order to be able to recognize the activated *in situ* blood derived cells under transmission electron microscope, ultrastructural characterization of such cells became a necessity. Accordingly, in this work we describe all classes of the formed elements of the peripheral blood in adult zebrafish using light and transmission electron microscopy, compared to mammalian (human) formed elements. This presentation is a partial fulfillment of the requirements for a master's thesis of the first author and supported by a grant from an anonymous donor to Wagner College.

Electrophysiology of the isolated and perfused midgut of adult yellow fever mosquitoes (*Aedes aegypti*): First results. Yolana Fuks[1], *Melanie Valencia[1], Stacia B. Moffett[2], David F. Moffett[2] and Horst Onken[1,2], [1]Wagner College, Staten Island, NY and [2]Washington State University, Pullman, WA.

The midgut of adult, female mosquitoes receives the blood meal. Salt and water are rapidly absorbed and secreted by the Malpighian tubules. Later, nutrients are digested and absorbed. Transport in the midgut of adult mosquitoes has never been studied with isolated midguts. Isolated midguts were transferred into a bath with mosquito saline and mounted on perfusion pipettes connected to a syringe pump. The transepithelial voltage (V_{te}) was measured. Mounting midguts with the posterior end on the pipette allows continuous perfusion, and a small, lumen negative V_{te} was observed. Addition of theophylline (10 mmol/l, increasing intracellular cAMP concentrations) to the bathing solution resulted in a small, lumen positive V_{te}. Because a valve is located between midgut and hindgut, the posterior midgut is inflated when the anterior part connects to the perfusion pipette. When inflated with mosquito saline the initial, lumen negative V_{te} and the lumen positive V_{te} after addition of theophylline were markedly higher, suggesting that stretch is a stimulator for the ion transport characteristics reflected in V_{te}. V_{te} is inhibited with dinitrophenol, indicating that it reflects active ion transport. Financial support by the NIH (1R01AI063463-01A2) and by a Wagner College Faculty Research Grant is gratefully acknowledged.

Comparison of *E.coli* cell death on Copper Surface vs. Steel Surface. Andrew Fung, Tae Y. Kang, Nidhi Gadura. Biology Department, Queensborough Community College, Bayside, NY.

The broad goal of our study is to understand the mechanism(s) by which copper alloy surfaces kill microorganisms, details of which are still largely unclear. In this project, we compared the killing rate of *Escherichia coli* on Copper Surfaces vs. Steel Surfaces. We also determined the relationship between membrane lipid peroxidation levels in *E. coli* on both surfaces. Quantitative dilutions series were performed to test for bacterial cell death. Our results indicate a biphasic killing curve when *E.coli* is exposed to copper chips however this was not seen on steel chips. TBARS assay was used to measure the lipid peroxidation levels. Increased lipid peroxidation levels in *E. coli* are seen on copper chips and not on steel chip surfaces.

The Effect of VHL on Renal Cell Apoptosis. Michael D. Gallo and Alan Schoenfeld, Adelphi University, Garden City NY.

In Von Hippel-Lindau (VHL) disease, heterozygous germline mutations in the VHL tumor suppressor gene may cause several types of cancers: renal cell carcinoma (kidney cancer), hemangioblastomas (blood vessel tumors), pheochromocytoma (adrenal cancer), and pancreatic tumors. VHL gene products are involved in an ubiquitin E3 ligase complex, where a regulatory transcription factor known as hypoxia-inducible factor alpha (HIFa) becomes down regulated. Essentially, the VHL products play a vital role in suppressing tumor formation. This project focuses on differences in apoptosis among VHL mutations. The 786-O VHL-negative cell line was reintroduced with wild type VHL or various VHL mutations, including type 1 VHL mutations and type 2A, 2B, and 2C VHL mutations. In order to test the effects of apoptosis among the VHL mutations, we used PARP cleavage analysis to detect the bands (cleaved PARP) on a western blot, under conditions of no serum and no glucose media. We found that for both serum and glucose free media treatment, type 1 VHL mutations showed the highest levels of apoptosis and cells with wild-type VHL showed the least. Treatment with rapamycin did not increase apoptosis, but reduced apoptosis in VHL-negative cells in serum free media.

***In vitro* Inhibition of Sindbis Virus Replication by Glycyrrhizin. Luz E. Guevara and Sandra Adams, Montclair State University, Montclair, NJ.**

Alphaviruses, a genus from the *Togaviridae* family, are responsible for a wide spectrum of human and animal diseases, ranging from silent asymptomatic infections to fever to encephalitis. Alphaviruses are transmitted via mosquito bites and have a high incidence of disease in Africa, Asia, Australia and Eastern Europe. Previous research had shown that certain medicinal plant compounds present antiviral activity and can be used to treat infections. The purpose of this study wass to determine if glycyrrhizin, a natural compound found in the roots of the *Glychyrrhiza glabra* plant, found in Europe, was able to inhibit the infection of Sindbis virus in Vero cells. Vero cells, treated with glycyrrhizin, were infected with Sindbis virus. Viral media from these experimental cells and from control cells were then used to determine the viral titer by the $TCID_{50}$ method. Cells were also examined microscopically for morphological differences. The results indicated that there were fewer viral particles released in the experimental plates, with the glycyrrhizin treatment, compared with the control plates. Based on the results, glycyrrhizin is able to inhibit Sindbis virus replication, and can be further investigated for treatment of alphavirus infections. This research is supported by MARC Program – NIH (LG).

Scanning Electron Microscopic Characterization of Structural Reorganization of the Adult Zebrafish Optic Tectum in Organotypic Culture. Michael C. Gutkin, Christopher P. Corbo, Linda A. Raths and Zoltan L. Fulop. Wagner College, Staten Island, NY.

In our previous studies analyzing similar cultures with light and transmission electronic microscopy, we have shown that the brain of the zebrafish *(Danio rerio)* has the ability to survive in organotypic culture for up to 14 days. While a large number of cells died during the first 12 hours in culture, many cells were able to survive, dedifferentiate, proliferate, migrate and begin reorganization of the tissue. Many of these surviving cells reappear close to the surface of the tissue sample and regroup at different regions. In this experiment, samples were collected at: 2, 6, 12, 24, 48, 96 hours and 7 days and were fixed in Karnovsky's fixative, dehydrated through an increasing series of ethanol, and completely dried through propylene oxide evaporation. Intact samples were analyzed using a Topcon ABT-32 SEM and images were digitally captured. In certain cases, samples were broken to reveal the center of the tissue. Through this analysis, we gained a better understanding of the reorganizing capacity of the cells in the optic tectum of adult zebrafish. Our observations suggest that zebrafish brain tissue maintain regenerative capacity even in adulthood. This work was supported by a grant from an anonymous donor to Wagner College.

Anionic Affects on Ionic Liquid Toxicity. Joely Guzman[1], Catherine McEntee[1], Placide Bisangwa[2], Xing Li[3], Sharon Lall-Ramnarine[3], James Wishart[4], [1]Kingsborough Community College, Brooklyn, NY, [2]Brooklyn College, Brooklyn, NY, [3]Queensborough Community College, Queens, NY and [4]Brookhaven National Laboratories, Upton, New York.

Ionic liquids (ILs) are salts that are liquid below 100°C. ILs consist of organic heterocyclic cations, inorganic anions and alkyl groups. Due to their relative non-volatility, non-flammability, wide liquid range and high conductivity, ILs are the solvent of choice in the chemical industry and are considered green alternatives. Data presented here demonstrates that ILs which do not have a toxic affect on microorganisms can significantly inhibit and/or alter root development in alfalfa. The main question addressed here is what effect different anions have on IL toxicity. Anions have an impact on the toxicity of other organic compounds. For example, organic compounds containing phosphate are more toxic than those with bromide. Thus, ILs containing phophate could be potentially more toxic than ILs containing bromide. We used the seed germination and root elongation assay we developed to determine the relative toxicity of iimmidizolium bromides and immidazolium phosphates. Alfalfa seeds were plated onto media containing ten-fold dilutions ranging from 5mM to .0005mM for each IL. Seed germination and root growth were then determined. Our results confirm our hypothesis; immidazolium phosphate ILs have a more negative impact on root growth than their bromide containing counterpart.

Human DNA polymorphism analysis in a family. Rachel Hammer, Avi Appleman and Nidhi Gadura, Queensborough Community College, Bayside, NY.

For humans, one VNTR known as D1S80, is present on Chromosome 1 and contains a 16 nucleotide sequence which is variably repeated 16 to 40 times. Individuals can be homozygous or heterozygous for this genotype. This is the basis of DNA fingerprinting analysis which is widely used for paternity, kinship and forensic analysis. Amplification of DNA from different individuals will result in distinct PCR products. The objective of this study is to isolate DNA and compare DNA polymorphism between individuals by separating the products doing gel electrophoresis. Results from parents and siblings from one family will be analyzed.

Intervening Transcribed Sequences of Silverside Fish and Horseshoe Crabs. Dana Hemlall[1], Chelsea Faison[1], Neeti Bathala[2], Sanel Feratovic[1], Allen Burdowski[1] and Kathleen Nolan[1], [1]St. Francis College, Brooklyn, NY and [2]University of the Arts, Philadelphia, PA.

Total genomic DNA was isolated from silversides from Jamaica Bay, Brooklyn, NY by seining in July 2009 and horseshoe crab eggs from Pickerling Beach, Delaware in June 2009. The eggs were buried in the sand and intermixed with the sand grains, so they could be from more than one individual. Primers from one ribosomal DNA (rDNA) Intervening Transcribed Sequences (ITS 3 and 4) were used to amplify DNA. After amplification, the DNA was run on an agarose gel using electrophoresis. Upon comparison, the horseshoe crabs yielded a larger ITS fragment size. These fragments will be sequenced. This is being done in an attempt to find population-specific DNA markers. This has further implications for fisheries management, so that resources are available for protecting these organisms .The horseshoe crab has become especially endangered from overfishing and commercial exploitation. This is an interesting comparison between a relatively abundant species such as the silverside (*Menidia menidia*), and one that is becoming depleted, the horseshoe crab (*Limulus polyphemus*).

The Ribbed Mussel (*Geukensia demissa)* Does Not Appear to Serve as a Vector for Dermo (*Perkinsus marinus)* in Jamaica Bay, NY. Kenesha Henry, Craig Hinkley and Gary Sarinsky. Kingsborough Community College. Brooklyn, N.Y.

Attempts to re-establish the Eastern Oyster (*Crassostrea virginica*) in Jamaica Bay (JB) are under study. One reason for their decline has been due to the parasitic protozoan *Perkinsus marinus* (dermo). Some oysters grown from spats in JB have become infected with dermo. It is thought that dermo is transmitted amongst oysters and some literature suggests that dermo may be transmitted by mollusks that serve as vectors. This research attempts to determine if the ribbed mussel (*Geukensia demissa*) is a vector for dermo. Gill and mantle tissues were extracted from ribbed mussels collected from JB. DNA isolated from the tissues was subjected to the PCR with a dermo specific primer set. No dermo DNA was amplified from the mussels tested. To verify that DNA had been extracted from all of the mussels tested, the mussel CO1 mitochondrial gene was amplified by PCR utilizing Folmer primers and verified by gel electrophoresis. The CO1 gene was found to be present in all six samples. Amplified DNA was sequenced and was subjected to a NCBI Blast Search which further verified that the CO1 DNA was from *Geukensia demissa.* The results of these experiments showed that the mussels tested were not vectors for *Perkinis marinus.*

Efficient Indexing Using Next-Generation Sequencing Technology. Andrew Hoffman and Charles Du, Montclair State University, Montclair, NJ.

The specific goal of this project is to develop a working method for generating, sequencing, and indexing Ac/Ds transposable element insertions in maize that is rapid, accurate, and cost-effective. The New SOLiD sequencing method aids in this tremendously. Once complete, a resource for gene knockouts in maize using the Ac/Ds transposon system will be available online for use in scientific research, because Ac preferentially transposes into or near genes. First, using available resources such as known Ac and Ds sequences, these sequences will be checked against the current *zea mays* database in NCBI BLAST to confirm their existence. Then, newly predicted Ac and Ds sequences will be searched against the existing database to determine whether they exist in the current library or not Several checks and alignments are performed to make sure these predicted sequences are correct. Next, using brand new maize sequence data generated from SOLiD sequencing, and the B73 data as a reference, the locations of Ac sequences in the newly sequenced W22 genome(and possibly others n the future) will be able to be determined. This data will be compiled into an online database for future researchers to use in gene knockout and other studies. Additional mutations of maize other than W22 could be added to the database in the same way in the future. This study will aid geneticists all around the world who wish to study knockouts of the maize genome.

Copper Surface-Mediated Toxicity Correlates With Memebrane Lipid Peroxidation In *E.coli*. Donna Hughes, Tae Y. Kang, Nidhi Gadura, Queensborough Community College, Bayside, NY.

The mechanism(s) by which copper alloy surfaces kill microorganisms is still largely unclear. The aim of our project is to determine the relationship between exposure to copper alloy surfaces or copper ions, lipid peroxidation, and killing of *Escherichia coli*. We also determined the relationship between membrane lipid peroxidation and plasma membrane structural integrity in *E. coli*. Quantitative dilutions series were performed to test for bacterial cell death. Our results indicate a biphasic killing curve when *E.coli* is exposed to copper chips. TBARS assay was used to measure the lipid peroxidation levels. The bacterial killing rate upon exposure to copper surface also correlates with increased lipid peroxidation levels.

Freshwater Cyanophage AS-1 Genome Project: From Sequencing to Mapping. Jonathan Jimenez, Lauren Pohren, Michelle Reed, Lauren Strawn, and Tin-Chun Chu. Seton Hall University, South Orange, NJ.

Freshwater cyanophage AS-1 is the virus that infects *Synechococcus sp.* IU 625 (SIU 625), formerly known as *Anacystis nidulans* and *Synechococcus cedrorum*. Cyanophage has been suggested as a good environmental indicator due to its natural ability to control the growth of cyanobacteria, a common contributor for harmful algal bloom. AS-1 DNA has been isolated by AquaRNA™, PEG precipitation and ultra-centrifugation to compare the purity and efficiency among 3 methods. AS-1 DNA has been sequenced and sixty-six contigs were obtained and deposited into NCBI GenBank previously. Blastx searches have been performed on all contigs and many viral related proteins are identified. We have designed 34 primers with NCBI Primer-BLAST and PrimerQuest℠ from 10 contigs for PCR-based assays. The qualities of the primers are validated by OligoAnalyzer 3.1. PCR products were then be analyzed by gel electrophoresis and sequencing. We would like to further map the contigs into a complete linear viral genome. Protein annotation and functional genomics will follow upon genome completion.

Use of zebrafish embryos in undergraduate education: teaching science and scientific research in an easy way. Luèsoni Johnson[2], Anna Lysenko[1], Kristin Polizzotto[2], Christopher Corbo[1], Linda Raths[1] and Zoltan Fulop[1], [1]Wagner College, Staten Island, NY and [2]Kingsborough Community College, Brooklyn, NY.

In recent years, zebrafish have become a widely exploited laboratory animal in both scientific research and education. This is because zebrafish offer several advantages as biological subjects. These advantages are usually listed as "the zebrafish litany," which goes as follows: it is a vertebrate (and therefore a good model for comparison to humans); it is cheap to obtain and easy to maintain; and it has external fertilization, translucent embryos, rapid development, and short generation time. The low cost and relative ease of maintenance of zebrafish eggs/embryos entice undergraduate educators to use zebrafish in training their students in developmental biology and/or introduce them to the rigors of scientific research. In this work we share information on how to maintain a small zebrafish colony and how to obtain eggs for instructional purposes. We also present an example of how simple yet exciting observations of developing zebrafish embryos under a basic light microscope equipped with a cheap video camera and a simple computer application could pull a student into a significant biological experience. Grants: NIGMS- Bridges to the Baccalaureate 1R25GN62003, NYSDOE-CSTEP 0516051091 to Kingsborough Community College and anonymous donor to Wagner College.

The Effects of Polyphenolic Induced Differentiation on HO-1, Human Melanoma Cells. Carleta A. Joseph[1], Virinder Parmar[2] and Anthony L. DePass[1], [1]Long Island University, Brooklyn, NY and [2]University of Delhi, Delhi India.

Plant polyphenolic compounds have been found to exhibit anti-cancer effects such as changes of expressions in genes that control proliferation, differentiation and apoptosis. Consistent with our interest to investigate cellular differentiation as a therapeutic target for cancer, we investigated the effects of several synthetic polyphenolic compounds on HO-1 human melanoma cells. We now present data that shows VSP-15 (plant derived polyphenolic compound) exhibiting a dose- and time-dependent terminal differentiated effect on HO-1 cells. Proliferation assays and gene expression analysis using PCR arrays indicate the mechanism of action employed by the compound and indicate changes in gene expression indicative of the anti-proliferative and pro-apoptotic effects hypothesized. Morphological changes and melanin synthesis as well as changes in the expression of the tumor suppressor genes MDA-7/IL-24 (melanoma differentiation gene-7/Interluekin-24) exhibited were clear indications of VSP-15 induced differentiation.

Measures in Cognitive Functions in a Rat Model of Alzheimer's Disease. Renee Joseph[1], Nataly Murillo[1], Linda Ejem[1], Kelly Payne[2], Winsome Smickle[2] and Francisco Villegas[2], [1]Queensborough Community College, Bayside, NY and [2]York College, Jamaica, NY.

Alzheimer's disease (AD) is a progressive neurodegenerative disorder that damages neurons in areas of the brain responsible for cognitive functioning. The purpose of this study is to generate a rat model of Alzheimer's disease (AD), characterized by deficits in cognitive functioning, that includes learning, memory and attention. This pilot study examined the effects of chronic cerebroventricular infusions in rats using mini-osmotic pumps of the neurotoxins, okadaic acid and thiorphan and subsequent cognitive functions. Okadaic acid a selective protein phosphatases inhibitor, and thiorphan is the rate-limiting peptidase neprilysin inhibitor. Fifteen male Long-Evans rats were used in the study and randomly assigned to four groups. Rats in the experimental groups were either infused with okadaic acid (n=6) or thiorphan (n=5). Rats in the control group were infused with cerebrospinal fluid (n=2) and saline (n=2). Following the removal of the pumps and recovery, rats were tested for memory using the Morris water maze, attention using the five-conditional serial reaction time tasks system, and locomotors activity using the Open field tests. Preliminary results found significant differences between groups in: latency time, number of quadrants visited, and distance traveled in the Water Maze. For measures of attention correct responses, omissions, premature and average correct latency were also found to be significant.

Indications of Potential Toxic/Mutagenic Effects of World Trade Center Dust on Human Lung Cell Cultures. Constantino G. Lambroussis, Barbara D. Soares, Sergio Perez, David Gaipa, Anise L. Elie, Fahad T. Rouf, Lotfi M. Bassa and Ann Marie DiLorenzo, Montclair State University, Montclair, NJ.

Preliminary research conducted with human lung fibroblast cells exposed to World Trade Center (WTC) dust at various ppm concentrations and simulated physiological stress environments (via decreased serum levels) indicated that cell proliferation levels decreased as WTC dust concentrations in test media were increased. This pattern persisted regardless of serum level present in the media. The WTC dust particle concentrations assessed for each serum concentration were 1.25, 2.5, 12.5, 25, 125, and 250 ppm. The serum concentrations used were 10% Fetal Bovine Serum (FBS), which represented a non-stressed system, with 2.5% and 1% FBS concentrations used to simulate stressed environments. The purpose of this set of experiments is to investigate the extent of cellular damage resulting from World Trade Center dust exposure to human lung tissues. Assessment for apoptosis (programmed cell death) showed that higher than baseline levels of apoptosis were present in cells exposed to WTC dust in both MRC-5 (male) and WI-38 (female) human lung fibroblast cells. Exposure levels as low as 25 ppm WTC dust have been shown to lead to increased levels of apoptosis. With exposure to WTC dust, decreased cell proliferation and apoptosis result, providing preliminary evidence to support potential mutagenic properties of World Trade Center dust.

Grape and Cranberry Juices Inhibit Tight Junction Disorganization and Reduce Infectivity Titers in Monolayer Cultures of Rotavirus-Infected Monkey Kidney Epithelial cells. Maria Leon[1], Pavel Kibrik[1], Laina Karthikeyan[2], Manpreet Singh[2], Robert Gordon[3] and Steven M. Lipson[1], [1]St. Francis College, Brooklyn, NY, [2]New York City Technical College, Brooklyn, NY and [3]Mount Sinai Medical Center, NY.

Enteric viruses exert their pathologic effects upon the gastrointestinal tract by compromising in part, epithelial tissue tight junction (TJ) function and structural integrity. Prior studies in our laboratory showed an ameliorative effect by grape (GJ) and cranberry juices (CJ) on host cells following virus infection. The purpose of this study was to determine the *in vitro* effect of GJ and CJ on TJ physiology and structural integrity among rotavirus-infected monkey kidney epithelial (MA-104) cells in monolayer culture. MA-104 cells were grown in collagen-coated cell culture inserts in order to simulate the apical and basolateral surfaces present in the intestinal tract. Monolayers were pretreated with manufacturer-supplied GJ and CJ followed by virusal infection. TJ function was determined by changes in transepithelial electrical resistance (TEER). TJ structural integrity was evaluated by immunostaining of the alpha-claudin 1 molecule. Reverse transcription PCR (rtPCR) and transmission electron microscopy (TEM) were performed to determine minimal levels of cellular infectivity and viral replicative morphology, respectively. After 4 days, virus infected monolayers pretreated with purple and Niagara GJs exhibited TEER readings similar to uninfected controls. CJ cocktail drink and manufacturer-supplied CJ drink imparted a significant TJ protective effect ($p < .05$), but to a lesser extent than that of purple and Niagara GJs. Dissipation of TJ structural integrity occurred from 24 to 36-h post-virus inoculation. Genomic target (viz., amplicon) at low level viral input, was markedly reduced following CJ and purple GJ monolayer pretreatment; This effect was less apparent at increasing viral input levels. Electron micrographs revealed a sequestering of virus particles in cellular cisternae among CJ and GJ pretreated MA-104 monolayer cultures. CJ and GJ treatment of MA-104 cells reduce/inhibit rotavirus infectivity titers and in turn, reduce viral detrimental effects upon tight junction structure and function.

Pharmacological Identification of Dopamine D2 Receptors in the Lateral Ciliated Cells of the Gill of the Bivalve Mollusc *Crassostra virginica.* Roshney Licorish[1], Cherryle Brown, Margaret A. Carroll and Edward J. Catapane, [1]Kingsborough Community College and Medgar Evers College, Brooklyn, NY.

Lateral cilia of the gill of *Crassostra virginica* are controlled by dopaminergic-serotonergic innervation. Dopamine slows down beating and serotonin accelerates it. We undertook a pharmacological study of dopamine receptor types. Dopamine receptors are classified as D1-like and D2-like, each with respective subtypes. D1-like receptors are coupled to G protein Gαs and activates adenylate cyclase. D2-like receptors are coupled to the G protein Gαi, and inhibit formation of cAMP by inhibiting adenylate cyclase. Beating rates were measured by stroboscopic microscopy. D1 and D2 agonists and antagonists were tested to determine their efficacy in altering beating of lateral cilia. All D2 agonist we tested were effective in mimicking dopamine, and all the D2 antagonists were effective in blocking the actions of dopamine. None of the D1 agonist and antagonist which we tested altered the beating rates of the cilia or blocked the effects of dopamine. The study shows the postsynaptic dopamine receptors involved in the cilio-inhibitory response of the lateral cells of the gill are of the D2 type. The study also shows that this preparation is a good model for pharmacological studies of dopamine function as well as the pharmacology of drugs affecting biogenic amines in nervous systems.

Using biotechnology tools for DNA fingerprinting analysis. Catherine Lizarraga and Nidhi Gadura, Queensborough Community College, Bayside, NY.

Polymorphic DNA refers to chromosomal regions that vary widely from one individual to next. Individuals can be homozygous or heterozygous for this genotype. In this study we will use PCR as a tool to study the Variable Number of Tandem Repeats (VNTR) pattern in our class. PCR products will be run on agarose gels to determine the size of the amplified locus to reveal the differences among individuals.

The HIV-1 Capsid Protein as a Viral Inhibitor Target. Keron Matthew[1], Michael F. Summers and Peter Mercredi. [1]Medgar Evers College, Brooklyn NY and University of Maryland Baltimore County, Baltimore, MD.

The HIV-1 CA (capsid protein) is a constituent in viral infectivity and replication. Possessing these characteristics makes it a good prospective antiviral target, additionally NMR and crystallography have revealed its structure. CA comprises two domains, the N-terminal domain (CAN) and C-terminal domain (CAC). *N*-(3-chloro-4-methylphenyl)-*N'*-[2-[({5-[(dimethylamino)-methyl]-2-furyl}-methyl)-sulfanyl]ethyl}-urea) (CAP-1) exhibits antiviral activity by forming a complex with the CAN and inhibiting proper assembly of CA during the maturation stage of the viral life cycle. The binding of CAP-1 is facilitated by displacement of the conserved Phe32 residue in CAN, which is proceeded by insertion of the CAP-1 aromatic ring into the hydrophobic cavity. We synthesized CAN in *E. coli* by allowing cells to undergo plasmid transformation. The protein was harvested, purified and placed in NMR buffer for structural analysis in the presence of CAP-1. We found the low affinity of CAP-1 for CAN rules it out for therapeutic use, but it provides insights into the mechanism of viral assembly inhibitors. Hope lies in conducting further structural and analytical studies of the CA domain to find compounds with can disrupt proper CA formation. This project was supported by the Howard Hughes Medical Institute at UMBC grant NIH RO1GM042561-19, the Leadership Alliance and FASEB.

Characterization of Spermatogenesis in *Drosophila simulans.* Vittorio Mena, Peta-Gay Ricketts and Angela V. Klaus, Seton Hall University, South Orange, NJ.

Fruit flies (Genus *Drosophila*) are widely distributed geographically and commonly used in genetics, cell biology, biochemistry, and developmental biology studies. *Drosophila melanogaster* is the most familiar experimental fruit fly species. Our lab is focused on characterizing spermatogenesis in twelve *Drosophila* species whose genomes have been sequenced. *D. simulans* is *D. melanogaster*'s closest evolutionary relative. Therefore we are specifically interested in characterizing spermatogenesis and the testicular architecture in this species. Spermatogenesis occurs within cysts that are contained within the blind-ended, tubular testes. Spermatogenic stem cells are enclosed within cysts at the apical end of the testes, and sperm development proceeds as the cysts are pushed down the testis towards the basal end. The work we report here involves the use of phase contrast, fluorescence microscopy, and confocal imaging to determine where within the testes the specific stages of spermatogenesis and sperm elongation occur in *D. simulans*.

Plant Methionine Synthase is acetylated after Treatment of Roots with Deacetylase Inhibitors. James P. Murphy[1], Cassandra Gabriele[1], Paul A. Paez[1], Kristen Calabro[2], Adriana Martin[1], Omer Aci[1], Anselmo Villagran-Chua[1], Paul Frimpong[1], Felix Ollennu[1], Darnell Blackman[1] and William Tramontano[3], [1]Bloomfield College, Bloomfield, NJ, [2]Manhattan College, Riverdale, NY and [3]Lehman College, Bronx, NY.

Protein was extracted from sodium butyrate treated roots and subjected to western and proteomic analysis resulting in identification of an acetylated protein as a pea ortholog of the vitamin B12 independent methionine synthase. A partial cDNA for the predicted ortholog of this enzyme was produced from pea mRNA. This sequence (GenBank, EF166062) was shown to contain 970 bases. BLASTn analysis demonstrated that this sequence is 86% identical to the *Glycine max* methionine synthase gene. A chimeric methionine synthase protein transiently expressed was used to produce antisera in guinea pigs.In order to confirm our findings, western analysis using the guinea pig antisera on protein purified from pea roots treated with trichostatin A was performed. The level of detected 85 kd protein appeared identical in control and treated roots. The blots were then reprobed with rabbit polyclonal antisera against acetylated lysine. Only the trichostatin A treated roots were shown to display an acetylated protein of approximately 85 kd. This report sugeests that a major non-histone target of the acetyl transferases is a vitamin B12-independent methionine synthase and points to the possibility that modification of this enzyme in part mediates cross-talk between regulatory pathways controlled by methylation and those controlled by acetylation.

Comparison of Neurotoxic Actions of 6-Hydroxydopamine, 5,7-Dihydroxytryptamine and Manganese on Serotonergic and Dopaminergic Innervation of Lateral Ciliated Cells of Gill of *Crassostrea virginica.* Soren Murray, Amanda Hernandez, Edward J. Catapane and Margaret A. Carroll, Medgar Evers College, Brooklyn, NY.

Lateral cilia of *Crassostrea virginica* gill are controlled by serotonergic-dopaminergic innervations from their ganglia. 6-Hydroxydopamine (6-OHDA) destroys dopamine (DA) neurons; 5,7-Dihydroxytryptamine (5,7DHT) destroys serotonin (HT) neurons. Manganese (Mn) toxicity causes Manganism, a Parkinsons-like disorder whose mechanism of action is still being clarified. This study contrasts neurotoxic actions of 6-OHDA, 5,7DHT and Mn, along with physical denervation of the branchial nerve (BN) on ciliary activity of lateral cells. Oyster shells were notched to inject 500 µg of 6-OHDA or 5,7DHT into the posterior adductor muscle, or right shells were removed and animals incubated with 500 µM of Mn. Physical denervations were done by cutting BN that innervate gills. 6-OHDA treatment caused DA supersensitivity when superfused to gill, inability of inhibitory BN electrical stimulation (ES) to slow ciliary beating, and no impairment to serotonergic innervation. 5,7DHT treatment caused HT supersensitivity, inability of excitatory BN ES to speed ciliary beating, and no impairment to dopaminergic innervation. Mn treatments caused inability of DA and inhibitory BN ES to slow ciliary beating, and no impairment of serotonergic innervation. Physical denervations caused supersensitivity to DA. The study shows the 3 neurotoxins have distinct mechanisms of action and provides insight into the neurotoxic actions of Mn.

Presence of Octopamine in Hemolymph and Tissues of *Crassostrea viginica* and Its Possible Role as a Cardioregulatory Hormone. Mathilde Myrthil[1], Kerri Pryce[2], Dahniel Samuel[2], Margaret A. Carroll[2] and Edward J. Catapane[2], [1]Kingsborough Community College and [2]Medgar Evers College, Brooklyn, NY.

Octopamine is a biogenic amine, first identified in octopus. Octopamine is well studied in arthropods and a few gastropods, but rarely in bivalves and not in *Crassostrea virginica*. We utilized two methods to identify and measure octopamine in *C. virginica*. HPLC was performed with an isocratic, ion-pairing Phenomenex Gemini 5 µC18 column with a Beckman HPLC and Jasco FP 2020 Spectrofluorometer. A competitive ELISA was designed using conjugated OA (BSA-G-OA) followed by standards and samples treated with primary anti-OA antibody. After washing, a HRP-labeled secondary antibody was applied and a colormetric reaction generated and measured spectrophometrically. HPLC showed octopamine in ng amounts in gill, palps, cerebral ganglia, visceral ganglia and hemolymph. Octopamine was higher in animals pre-treated with tyramine, an OA precursor. The ELISA confirmed octopamine in oyster tissues. In other experiments, *C. virginica* heart preparations were prepared *in situ* by removing right shells and connecting the ventricles to isotonic transducers. Basal heart rates averaged 5.6 beats/min but were increased in a dose dependent manner by superfusion of octopamine (10µM - 1mM). The study identifies octopamine in nervous system, innervated organs and hemolymph of *C. virginica* by two methods and indicates a possible role of octopamine as a cardio-regulatory hormone.

Effects of methylmercury on the RNA:DNA ratios of larval *Fundulus heteroclitus.* Samantha Nealer and Michelle Cox, Monmouth University, West Long Branch, NJ.

Contaminants introduced into estuarine ecosystems, such as methylmercury, arsenic, and PCBs, have damaging, sub-lethal effects by inducing physiological, morphological, and behavioral damage (Smith *et al*. 1995, Boening 2000, Beauvais et al. 2001, Carletta *et al*. 2002). Specifically, methylmercury has been shown to potentially have significant destructive effects on a hypothetical population of commercially and recreationally important fishes under certain conditions (Murphy *et al*. 2008). Using mummichog (*Fundulus heteroclitus*), a common Atlantic-coast fish that has previously been utilized in related contaminant studies, the biochemical effects of methylmercury on larval development was examined. By modifying the protocol created by Belchier *et al*. (2004), RNA:DNA ratios were analyzed to determine the amount of growth-stimulating protein synthesis occurring in the fish tissues which can be directly related to the fish's nutritional condition (Belchier *et al.* 2004). By quantifying the biochemical variation of larvae exposed to different concentrations of methylmercury, the effects of methylmercury contamination in estuarine environments on developing fishes could be better understood.

Potential plasmid for vanillate-inducible gene expression in *Synechococcus sp.* IU 625. Robert Newby, Jr.[1], Lee H. Lee[2] and Tin-Chun Chu[1], [1]Seton Hall University, South Orange, NJ and [2]Montclair State University, Montclair, NJ.

Heavy metal resistance in cyanobacteria is generally poorly understood. To characterize and classify the interactions, our lab has undertaken research with the *Synechococcus sp.* IU 625 (SIU 625). SIU 625, a freshwater cyanobacterium, is a species of target for its role in many harmful algal blooms (HAB) in industrialized area water ways. We study the effects of several EPA target heavy metals on SIU 625 to predict HAB. We believe that metallothionein, a cysteine rich protein implicit to be the primary means which most organisms deal with heavy metal stress, may be one of the key proteins for heavy metal interactions in SIU 625. Using the known sequence of metallothionein in SIU 625, we seek to create an inducible null mutation using a vanillate promoter based suicide vector to verify the role of metallothionein in SIU 625 under various heavy metal stress conditions. This study has indicated that SIU 625 can utilize vanillate as a main carbon source. The result suggests that vanillate can be used for heterotrophic growth of SIU 625, and can be used to create and maintain an inducible metallothionein null mutant *in vivo*.

Identification and Characterization of Mercury Resistant Genes in *Cyanobacterium Synechococcus* sp. IU 625. Dozie Okafor[1], Jose L. Perez[1], Tin-Chun Chu[2] and Lee H. Lee[1], [1]Montcalir State University, Montclair, NJ and [2]Seton Hall University, South Orange, NJ.

Synechococcus sp. IU 625 (Anacystis nidulans) is a freshwater unicellular cyanobacterium and an obligate photoautotroph that readily harbors plasmids. This organism has been used in many studies to assess the effects of heavy metal toxicity as an environmental pollutant. Cyanobacteria like Syn. sp. IU 625 have general metal resistance mechanisms. However, tolerance to mercury, the heavy metal with the strongest toxicity, is dependent on mercury resistance determinants (mer) that are commonly found in plasmids in many microorganisms. Research into the genome of related strain PCC 7942 indicates that mer genes may also be located on the genome. The present study addresses the issue of plasmid versus chromosomal mediated mercury tolerance in Syn. sp. IU 625. Specific primers are designed for either chromosomal genes or plasmid genes and are used to study the possible existence and location of mer tolerant genes. The findings suggest that mer determinants are located on both the plasmid and genome. The chromosomal mer resistant genes were identified and the resulting partial sequences were then obtained and aligned. This study provides insight on the mechanisms of mercury tolerance in cyanobacterium Synechococcus sp. IU 625.

Effects of environmental contaminants on feeding behavior on larval *Fundulus heteroclitus*. Sarah Opatovsky and Ursula A. Howson, Monmouth University, West Long Branch, NJ.

The goal of this research was to develop a protocol to evaluate effects of environmental contaminants on the feeding behavior of larval fish. Larval behavior was analyzed in two separate studies. Eggs were spawned from lab-reared *Fundulus heteroclitus* stock, and incubated at 17^0 for approximately 3 weeks. Upon hatching, they were placed in either hypercapnia (excess CO_2) or methlymercury treatments (unrelated studies). In the hypercapnia study, carbon dioxide was introduced into treatment tanks to decrease the pH level. Acidity treatments were pH 6.0, 6.5, 7.0, 7.5 and a control (8.0.) Remaining larvae were put into methylmercury treatments of 0 ppb, 5 ppb, 10 ppb, 20 ppb and 40 ppb. The fish were fed daily with frozen *Artemia* nauplii.To test the differences in feeding behavior, the larvae were video recorded at 10, 20 and 30 days post hatch. In each video, five *A.* nauplii were placed into Petri dishes already containing one fish larvae. After five minutes of video was recorded, the video was analyzed and the data was compiled to compare attack successes, total number of attacks and number of prey eaten after one and five minutes. Funding and stipend for this project was provided by NJBEC.

Mercuric Chloride Resistance in *Synechococcus sp.* IU 625. Bijal Patel[1], Christina Picciano[1], Jennifer Todd[1], Lee H. Lee[2] and Tin-Chun Chu[1], [1]Seton Hall University, South Orange, NJ and [2]Montclair State University, Montclair, NJ.

Freshwater cyanobacterium *Synechococcus sp.* IU 625 (SIU 625) has been suggested as an exemplary model organism for environmental studies due to its ability to rapidly adapt to the heavy metal stress. Mercury is highly toxic to all forms of life. Four concentrations: 0, 0.1, 0.5, and 1.0 mg/L of mercuric chloride ($HgCl_2$) have been used in this study to investigate the physiological and morphological responses of SIU 625 to various $HgCl_2$ concentration conditions. Turbidity studies and direct count were carried out to monitor the cell growth. At 1.0 mg/L of $HgCl_2$, the growth of SIU 625 was suppressed dramatically in the first 14 days but later returned as mercury resistant cells. The morphology of the cells became spherical rather than rod shaped compared with the control. The heavy metal concentration analyses showed the SIU 625 was able to pump out the $HgCl_2$ under low concentration (0.1 and 0.5 mg/L) but not at the 1.0 mg/L $HgCl_2$ condition. We then increased the concentration in each flask to study whether we can induce more metal resistance gene expression in the second passage. The result in the second passage showed similar result as the first passage.

In search for the truth in food labeling - "Organic" or "Genetically Modified"? Athanasia Pavlou and Nidhi Gadura, Queensborough Community College, Bayside, NY.

Tomatoes, soybeans, and corn were among the first genetically modified food products approved by US agencies in the 1990s. Since then food biotechnology continues to grow rapidly. This has also led to a lot of ethical debates on what should be done about genetically modified foods. Proper labeling is very important for consumers. We decided to test food products from the supermarket that marked "organic" and compared them to regular food. Since plants are usually modified using viruses like CaMV, in our study we used primers specific to genetically modified food to reveal the truth in food labeling.

Myelin basic protein stimulates chemokine secretion in human astrocytes: importance in the pathogenesis multiple sclerosis. Courtney Peloso, Joe Matarlo and Teresa G. D'Aversa, Iona College, New Rochelle, NY.

Multiple sclerosis (MS) is thought to be an autoimmune disease of the central nervous system distinguished by demyelination. Destruction of the protective myelin sheath causes exposure of axons and interruption of impulse propagation, leading to MS disease pathology. Myelin basic protein (MBP) is an integral component of the myelin sheath, which is released upon its degradation. Previous studies have shown that MBP increases the permeability of the blood-brain barrier (BBB), and induces endothelial cells to secrete CCL2. Based on these data, we examined the expression of CCL2 and CCL5 chemokine production in cultured astrocytes after treatment with MBP. We found that both CCL2 and CCL5 protein were induced. The production of CCL5 and CCL2 were time and dose dependent, where CCL5 protein peaked at 4 hours and gradually declined to 36 hours after treatment. Alternatively, CCL2 protein expression appeared later with initial expression at 36 hours after treatment. These results demonstrate that degradation of the myelin sheath and the release of MBP may aid in the progression of MS by inducing the secretion of chemokines from astrocytes. These chemokines can then recruit inflammatory cells, thereby enhancing the immune response and inflammation, which may result in the continuation of demyelination.We thank Dr. Joan W. Berman at the Albert Einstein College of Medicine for human astrocytes.

Mud Snails (*Ilyanassa obsolete*) May Not be Vectors for Dermo in Jamaica Bay, NY. Vanessa Petion, Craig Hinkley and Gary Sarinsky. Kingsborough Community College, NY.

Natural populations of the Eastern oyster, *Crassostrea virginica* were grown in Jamaica Bay, NY until the early 1920s. It is believed that disease, overharvesting, and the decline of water quality due to urbanization led to their disappearance. One of the diseases, Dermo, is caused by infection of oysters with the protozoan parasite *Perkinsus marinus*. Oysters can become infected when they are around two years old and exhibit a reduction in growth and reproductive capacity. Dermo infections occur primarily in lymph tissues of oysters and usually intensify above a temperature of 20°C as the parasite rapidly multiplies, spreads, and eventually kills the oysters. Dermo is thought to be transmitted from oyster to oyster; however, because there are no natural populations of oysters in Jamaica Bay, we hypothesized that mud snails, *Ilyanassa obsoleta*, can act as vectors for Dermo. To determine whether mud snails can serve as vectors for Dermo, we isolated total DNA from snails and tested for the presence of the *P. marinus* 5S ribosomal RNA gene by the PCR. The results showed that none of the snails tested positive for DNA from *P. marinus* which suggests that mud snails may not be vectors for Dermo in Jamaica Bay.

Study the Potential Antitoxin effect of Green Tea Polyphenols on Human Lung Cells affected by World Treat Center Dust. Miraxh Polozani, Constantino Lambroussis, Ann Marie Dilorenzo and Lee H. Lee, Montclair State University, Montclair, NJ.

Green tea polyphenols are known antioxidants and are frequently used to promote good health. World Treat Center (WTC) Dust study on human lung cells indicated that it decrease cell proliferation and increase in apoptosis at 250 ppm In this study, different green tea extracts were used to study the cytotoxicity and wound healing effect on human lung cells. Epigallocatechin (EGCG), a water soluble polyphenol in pure form, a group of water soluble polyphenols(GTP), a group of non water soluble polyphenols (LTP), and a mixture of all three(combo333) were used in different concentrations (12.5, 25, 50, 75 and 100 uM). Our results indicated that EGCG promoted male (MRC5) and female (WI38) lung cell proliferation in concentrations between 12.5uM-25uM. GTP demonstrated positive results on MRC5's in concentration span of 12.5uM-50uM. WI38's however were more sensitive and proliferation was best at 12.5uM. The Combo333 was a steady concentration and demonstrated terrific cell proliferation as well. The results suggest that particular green tea polyphenols might possess antitoxin abilities and can have a positive effect on MRC5 and WI38 human cells. Based on these findings, we test the potential antitoxin abilities of green tea against World Trade Center dust.

Characterization of phycocyanin operon in cyanobacterium *Synechococcus sp.* IU 625. Arti Rana[1], Lina Halawani[1], Aline Oliveira[1], Tin-Chun Chu[2] and Lee H. Lee[1]. [1]Montcalir State University, Montclair, NJ and [2]Seton Hall University, South Orange, NJ.

Synechococcus sp. IU 625 is a freshwater unicellular cyanobacterium and is one of the causative agents of harmful algal blooms (HAB) in the environment. Phycocyanin is a unique blue pigment and is part of the light-harvesting complex that gives blue-green color in cyanobacteria. This property makes the gene a good candidate for general probe development to be used for PCR-based assay to detect cyanobacteria in the polluted environment. . In this study, 15 primers have been designed and used to prime *Synechococcus sp.* IU 625 DNA. PCR products have been analyzed, purified and sequenced. Complete sequence of phycocyanin has been obtained. BlastN and BlastX searches of the entire operon sequences have also been carried out. Two α, two β subunits and several proteins between the two dimers were identified. Results showed that both phycocyanin α subunit and β subunits are closely related to the subunits in *Synechoccocus elongatus sp.* PCC 7942 and *S. elongatus sp.* PCC 6301. The result suggests that phycocyanin gene is highly conserved among *Synechococcus* species and can be used to identify this species in the environment.

The Phylogenetic Study of Cancer in Internal Ribosome Entry Site (IRES) in Different Organisms. Clarice L. Richardson[1], Tiffani L. Williams, J. Venkatraj and Suzanne J. Matthews. [1]Medgar Evers College, Brooklyn, NY and Texas A&M University, College Station, TX.

A phylogenetic study of cancer in internal ribosome entry site (IRES) in different organisms and its applications are very vital. Our research project focused on obtaining cellular IRES sequences (*Homo sapiens*), finding similar sequences to the cellular IRES sequences, performing Multiple Sequence Alignments (MLA), and generating a phylogenetic tree. In order to obtain cellular IRES sequences, we needed to search several IRES Databases (I.R.E.S Database and IRESite Database). Next, we needed to find sequences that matched our current IRES sequences. Therefore, we performed BLAST and BLAT sequence searches. Our next step was to perform alignments by aligning all the similar sequences we obtained from different organisms with the cellular IRES sequences that matched. The fourth and final stage of our project was to take each alignment obtained by performing multiple sequence alignments (MLA) and create a Phylogenetic Tree. We have obtained thirty seven Cellular IRESs. Our BLAST and BLAT sequence searches have unearthed fourteen different sequences in different organisms that match our cellular IRES sequence. Future work will focus on generating multiple sequence alignments (MSA) of the data obtained, creating phylogenetic trees, and understanding how to interpret applications where phylogeny is used.

The effects of insulin on *Drosophila* spermatogonial Growth *In Vitro.* Peta-Gay Ricketts and Angela V. Klaus, Seton Hall University, South Orange, NJ.

Insulin-like peptides (ILPs) are known to play a role in the progression of *Drosophila* spermatogenesis *in vivo*. Specifically, ILPs are important for the growth of spermatogonia and maturation of these cells into primary spermatocytes. Additionally, ILPs appear to be involved in the signaling pathway responsible for the maintenance of spermatogenic stem cells in the testis stem cell niche. The purpose of our study is to determine the effects of exogenous insulin on *Drosophila* spermatogonial cell growth *in vitro*. We hypothesize that insulin will support the maintenance and growth of cultured spermatogenic cysts that contain developing spermatogonia. Our initial results indicate that the addition of insulin to our culture medium inhibits the degeneration of spermatogonial cysts *in vitro*.

The Potential for Ammonite Survival of the Cretaceous-Tertiary Mass Extinction. Kevin Roche and Kristin Polizzotto' American Museum of Natural History, NY and Kingsborough Community College, Brooklyn, NY.

Recent work shows that some ammonites survived the Cretaceous-Tertiary extinction in present-day New Jersey for at least 10,000 years. We wanted to know whether they survived in other places as well. This can be difficult to determine since post-extinction deposits are sometimes not present, due to erosion or lowering sea levels. We decided to compare the pre-extinction communities that coexisted in different localities. We examined collections from Maryland and South Dakota, which had similar paleoenvironments. However, Maryland has post-impact deposits, while South Dakota does not. We hypothesized that if the pre-impact communities were similar in species composition and environment, then post-impact communities were more likely to be similar. We found that while gastropods and bivalves had relatively low similarity between the two localities, ammonites were much more similar. Thus, even though the environments were similar, the pre-extinction communities were somewhat different. Therefore, it is unlikely that post-impact communities at the two localities would have been highly similar. While ammonites may have survived in South Dakota, more research in this area and at other localities is needed to confirm this hypothesis.

The Toxic Effects of Manganese on Mitochondrial Respiration and Mitochondrial Membrane Potential in the Gill of the Bivalve *Crassostrea virginica.* Claudette Saddler, Sherine Crawford, Margaret A. Carroll and Edward J. Catapane, Medgar Evers College, Brooklyn, NY.

Manganese toxicity produces a Parkinsons-like condition known as Manganism. The mechanism of action underlying Manganism is not completely understood but may be related to the role of manganese in causing oxidative stress and damage to the brain's dopaminergic system. To study effects of manganese on mitochondria, a target for cellular damage from oxidative stress, we prepared gill mitochondria from *Crassostrea virginica* and measured O_2 utilization. Manganese caused dose dependent decreases in O_2 consumption. This was blocked or partially reversed by calcium disodium EDTA (EDTAca), a metal chelator, or p- Aminosalicylic Acid (PAS), an anti-inflammatory agent with chelating abilities. Both are being tested as therapeutic agents for Manganism. We also studied effects of manganese on mitochondrial membrane potentials using the membrane potential-sensitive fluorescent dye, HLB021-152 in a Molecular Devices SpectraMax M5 Plate Reader. Manganese decreased the mitochondrial membrane potential. This decrease was partially blocked by co-treatment with PAS. The study demonstrates the toxic effects of manganese on mitochondrial O_2 consumption and membrane potential and shows that EDTAca and PAS are effective manganese blockers. It also corroborates other results suggesting that the ability of PAS to ameliorate symptoms of Manganism is likely related to its chelating actions.

Manganese Impairs the Activity of Mitochondrial Cytochrome c Oxidase in the Gill of the Bivalve *Crassostrea virginica.* Rebecca Saint-Dic[1], Keisha Kelly[2], Margaret A. Carroll[2] and Edward J. Catapane[2], [1]Kingsborough Community College and [2]Medgar Evers College, Brooklyn, NY.

Overexposure to manganese (Mn) causes extra-pyramidal symptoms known as Manganism, a Parkinson's-like disorder, but the mechanism of Mn neurotoxicity remains largely unknown. Mn accumulates in mitochondria and toxicity may disrupt mitochondrial function. Mitochondrial dysfunction impairs energy homeostasis, raises oxidative stress and is a factor in aging and many neurodegenerative diseases. Bivalves are bioindicators of environmental metal contamination and serve as excellent models to study metal toxicity on cellular systems. Previously we showed Mn accumulates in gill and other tissues of *Crassostrea virginica* and Mn treatments impair gill mitochondrial respiration. Here we examined the effects of Mn on cytochrome c oxidase (COX), complex IV, and the principle terminal oxidase of high affinity O_2 in aerobic respiration. Gill mitochondria were prepared from *C. virginica* and aliquots were exposed to Mn for 30 minutes, re-pelleted, and resuspended in fresh media to remove excess Mn, Mitochondrial COX activity was measured spectrophotometrically. Our results show that short-term exposure of gill mitochondria to Mn (5-40 mM) cause up to a 40% loss in COX activity and corroborate our previous findings that Mn disrupts mitochondrial function in oyster gill and demonstrate a mechanism by which Mn toxicity can disrupt energy homeostasis and increase oxidative stress.

Using Intersimple Sequence Repeat (ISSR) Polymorphisms to Compare Commercial Plants of *Asclepias tuberosa* with Native Populations. Marissa Sansone and Yourha Kang, Iona College, New Rochelle, NY.

Asclepias tuberosa, a.k.a. butterfly weed, is a plant with showy orange flowers that is readily sold in garden stores and seed catalogs as a "native wildflower". Butterfly weed is member of the milkweed family and is found throughout the majority of the contiguous United States (US). However, native populations of the plant have apparently been disappearing in the northeastern part of the US, including New York State. We are determining whether the commercial plants purchased from various seed catalogs based in different parts of the US are genetically distinct from native populations found in New York, as well as Louisiana and Oklahoma. ISSR polymorphism analysis suggests that commercial plants purchased from the different native plant seed catalogs are more genetically similar to each other than to any of the native populations. The data suggests that when commercial butterfly weed is planted, the plants may influence the genetic make-up of existing native populations.

Analysis Of Antibiotic Induced Evolutionary Changes In *E.coli.* Iana Santos[1], Omid Khalpari[2], Todd Holden[1] and Nidhi Gadura[1], [1]Queensborough Community College, Bayside, NY and [2]Queens College, CUNY, Flushing, NY.

This study is designed to look at microbial evolutionary changes in *E. coli* brought about using a controlled dosage of the antibiotic ciprofloxacin as the selective pressure. The evolutionary changes will be studied using bioinformatics. Wildtype (drug sensitive) *E. coli* with tagged GyrA and GyrB genes will be grown in a medium containing a low concentration of ciprofloxacin in order to keep the population stable over the course of several hundred generations. Various drug resistant strains will be isolated, the GyrA and GyrB DNA sequenced and analyzed to look for mutations.

***IN vitro* Anti-proliferative Effect of an Isoflavonoid on HO-1 Human Melanoma Cells. Julee A. Shah[1], Carleta A. Joseph[1], Virinder S. Parmar[2] and Anthony L. DePass[1], [1]Long Island University, Brooklyn, NY and [2]University of Delhi, Delhi 110007 India.**

Polyphenols abundantly occur in the plant kingdom and observed playing an important role in cancer treatment In this experiment, we investigated the influence of a newly synthesized Isoflavonoid, 7-dimethylallyloxy-2-methyl isoflavone, which will refer to as VSP-29, in HO-1 human melanoma cancer cells by evaluating cell proliferation, viabilility, and melanin production as a marker for differentiation. Additionally a RT-PCR screen of 180 genes associated with Human Signal Transduction and Human Apoptosis. We observed that treatment with a single dose of VSP-29 at sub microgram/ml levels decreased cell proliferation without affecting viability as determined by the Trypan Blue exclusion method and stimulated cell dendricity, a morphological feature of differentiated melanocytes. By studying the PCR arrays gene regulation results we can make a speculation that, TRAF-mediated JNK pathway, one kind of Mitogen-activated Protein Kinase (MAPK) pathway may be involved in the mechanism of action of VSP-29 on HO-1 cells. Cells may respond to environmental stress with activation of c-Jun N-terminal kinase (JNK) and subsequently can activate transcription factor Activator Protein-1(AP-1) which has been shown to play a role in cell proliferation, differentiation, cell migration and apoptosis.

A Two-year Study on the Biodiversity and Ecology of the Water Birds at Oakland Lake, Bayside, Queens, New York. Scott C. Sherman, Yahaira C. Paulino and Giselle Rodriguez, Queensborough Community College, Bayside, NY.

The current study on the biodiversity and ecology of the water birds at Oakland Lake began in September 2007. Oakland Lake is a freshwater glacial lake located near the north shore of the western end of Long Island in Bayside, Queens, New York. The lake is a subunit of Alley Pond Park and is under the administration of the New York City Department of Parks and Recreation. Alley Pond Park has a rich biodiversity of animal and plant species, and is one of the most ecologically diverse natural areas remaining in the highly urbanized New York City region. Oakland Lake and the surrounding parkland are important resting and feeding areas for birds traveling along the Atlantic Coast migratory flyway. Large numbers of migratory birds visit the lake, particularly during the fall, winter, and spring. This affects the ecology and abundance of other organisms including coprophagous and coprophilous arthropods such as Diptera of the families Anthomyiidae, Calliphoridae, Muscidae, Sepsidae, and Sphaeroceridae. During the two years of this study 29 species of water birds, belonging to eight zoological families in seven orders, have been identified at Oakland Lake. The results from the first two years of this research are given along with information about the lake's ecology, geography, and history.

Effects of Ocean Acidification on Survival, Condition, and Behavior of Larval Fish. Emma R. K. Simon and Allison Bennett, Monmouth University, Monmouth, NJ.

Atmospheric carbon dioxide (CO_2) has increased around the world and will continue to do so for the foreseeable future. The oceans have absorbed at least half that amount, thereby lessening the effects of the CO_2 to some extent, but this has led to an increase in ocean acidity. This phenomenon has created a surplus of carbon (hypercapnia), leading to a lack of many available chemicals in the water. This translates to a failure, of sorts, in development for many marine organisms. In the case of this study, mummichog (*Fundulus heteroclitus*) have been lab reared and exposed to various levels of acidity, caused by various levels of hypercapnia, as a way to study these affects. The results are quantified by analyzing the symmetry of sagittal otoliths, the largest pair of "ear bones" in these fish. Otoliths allow the fish to orient itself to its surroundings accurately and move quickly. The more symmetrical the otoliths are, as quantified by a uniformity in shape and size, the more fit the fish will be to live; the more asymmetrical, the less likely the fish will be able to evade predators and/ or find food. It was hypothesized that the longer the larvae are exposed to the higher levels of hypercapnia and acidity, the more asymmetrical the otoliths will develop.

Determination of the Presence of *Perkensis marinus* in the Eastern Oyster (*Crassostrea virginica*) Grown in Jamaica Bay, New York, Utilizing the Polymerase Chain Reaction Assay. Svetlana Solomonova, Craig Hinkley and Gary Sarinsky. Kingsborough Community College, Brooklyn, NY.

The Eastern Oyster (*Crassostrea virginica*) had been an ecologically and economically important species in Jamaica Bay, NY from colonial times until the 1920's. Water pollution, overharvesting and disease are causes cited as the reason for their decline. Today there are no known natural oyster beds in the bay. This study determined whether oysters grown from spats for the past eight years were infected with the parasitic protozoan *Perkinsus marinus* (dermo) which is usually transmitted from oyster to oyster. Since there are no known natural oysters in the bay, it was hypothesized that oysters would not be infected. DNA was isolated from gill and mantle tissues and subjected to PCR with dermo specific primers. The PCR products were verified by gel electrophoresis. One of six oysters tested positive for dermo. To verify that DNA had been extracted from all of the oysters tested, oyster CO1 mitochondrial gene was amplified by PCR and verified by gel electrophoresis. The CO1 gene was found to be present in all samples. Amplified DNA from the positive oyster was sequenced and subjected to a NCBI Blast Search which verified that the DNA was *Perkinsus marinus*. Contrary to our hypothesis, the results showed that some oysters are infected with dermo.

Vascular Plant Species Richness in Four Northeastern Cities. Richard. Stalter, B. Drexler and A. Brunson, Saint Johns University, Queens, NY.

We present and compare vascular plant species in Boston, New York, Philadelphia and Washington, DC. A total of 3,657 species have been reported in these four urban areas. One thousand three hundred seventy two species, 37.52% of the total, are common to all four cities. Factors playing a role in vascular plant diversity may be time of settlement, climatic variables (length of the growing season, minimum January temperature and maximum summer temperatures) and the land suitable for invasion and establishment of both native and non-native taxa.

Phenotypic Analysis of a Calcium Signaling Deficient Mutant in the Yeast *Saccharomyces cerevisiae*. Carlee Street, Mark Monzone, Suzanne Baldissard and Eric Muller, Iona College, New Rochelle, NY.

Typically, cytoplasmic calcium ion concentrations are kept low on the interior of cells at rest. These concentrations can be drastically increased via extracellular influx following appropriate stimuli. These high concentrations of calcium are subsequently used as a signaling molecule capable of altering cell physiology. During the mating response of Saccharomyces cerevisiae cytoplasmic calcium rises and is required for long term survival of cells that fail to find a mating partner. Prior work has identified two separate calcium influx systems required to allow calcium entry from extracellular sources. One of these transports calcium with high affinity (HAC) and the second transports calcium with low affinity (LAC). A highthroughput screen of a collection of yeast deletion mutants was assayed for the ability to stimulate the low affinity influx system. Of the 8 mutations discovered which failed to activate calcium influx, only two were previously uncharacterized. One of these, ydl133w, contains 4 transmembrane domains and multiple sites for potential glycosylation which may indicate a novel plasma membrane protein involved in calcium influx. The current study attempts to more fully characterize the phenotypes of the ydl133w mutant, as well as clone the protein from the yeast genome for epitope tagging and subsequent studies on localization, interactions, and protein levels.

Sequencing the Natterjack Toad (*Epidalea calamita*) Mitochondrial Genome. Archana A. Tare, Maureen Dempsey, John J. Gaynor, Kirsten J. Monsen and John K. Korky, Montclair State University, Montclair, NJ.

The Natterjack toad (*Epidalea calamita*, formerly *Bufo calamita*) is native to northern Europe. This toad, the only toad species native to Ireland, lives in loose, sandy soil and is sometimes found in brackish water. There has been a significant decrease in the Natterjack toad population due to loss of habitat from human overpopulation, reduction in habitable coasts due to construction of dykes and seawalls, and acidification of aquatic habitats from acid rain. DNA samples of this species have been collected from Castlegregory, Ireland and Roscullen Island, Ireland. In this study mitochondrial DNA encoding for 12 tRNAs, large and small rRNAs, D-loop and 12 protein-encoding genes have been sequenced for the first time. Protein-encoding genes sequenced include ND1, ND2, COX1, COX2, ATP8, ATP6, COX3, ND3, ND4L, ND4, ND5 and CYTO B. To date 11,278 bp (*ca.* 64% of mitochondrial genome) have been sequenced and assembled into 7 contigs. This study is ongoing and once completed may permit a better understanding of the phylogenetic and phylogeographic relationship of the Natterjack. In addition, a completed mitochondrial genome will permit an examination of genetic differences among Natterjack toad populations throughout Europe and facilitate current conservation efforts for this species.

The Microbial Composition of Marshes in the New Jersey Meadowlands. Kristen Tomasicchio, Lori Gough, Veronica Cavera, and Tom Owen. Ramapo College of New Jersey, Mahwah, NJ.

The long-term effects of previous industrial activity on local microbial ecosystems have been investigated in many settings. The overall goal of our current studies is to investigate the diversity of microbial communities living in sites at the Meadowlands ranging from a heavily impacted Superfund site to a mitigated site. In this research project, we are initially addressing the differences in populations of microbial species between sites using classical methodologies but are planning to more extensively determine the diversity of these communities using 16S rRNA sequencing of both whole community DNA and of DNA from isolated species. We are also employing Winogradsky columns in an attempt to artificially re-create the ecological system of the Meadowlands in the lab so that the impact of heavy metals such as mercury on the flora of a mitigated site can be assessed. We are doing this research in hopes of finding microbes that have adapted to the severely polluted ecosystems which still exist in portions of the Meadowlands marsh. These microbes might also give us a better understanding of how living organisms are impacted by long term pollution.

Optimization of Fatty Acid and Cholera Toxin Concentrations for Treatments of Epithelial Cells: Can Fatty Acids Provide Mucosal Immunity against Cholera Infections? Joanna Tychowski[1], Paula Cobos[2], Laura Lorentzen[1] and Farshad Tamari[3], [1]New Jersey Center for Science Technology Mathematics Education, [2]Kean University, Union, NJ and [3]Kingsborough Community College, Brooklyn, NY.

Cholera is caused by infection of the small intestine by *Vibrio cholera*. In developing countries it can be severe or fatal. The two submit Cholera Toxin (CT) binds to the cell surface allowing one subunit to enter the cell. In response, cyclic AMP levels are elevated, influencing electrolyte and cytokine balances. Fatty acids (FAs) such as oleic, linoleic, and linolenic acids, found in flax (*Linum*) seeds, have medicinal properties. Our ultimate objective is to explore whether metabolites of the above FAs can provide any degree of mucosal immunity, as determined by cytokine dynamics in response to CT challenge. Our first goal is to determine the maximum and minimum concentrations of FAs and CT, respectively, that murine and human epithelial cell can be exposed to. The following control (C) and experimental (E) treatments will then be performed and cytokine levels will be quantified and compared using ELISA: 1. No FA or CT treatment (C), 2.FA treatment only (C), 3. CT treatment only (C), and 4. Pre- and simultaneous treatments with both FAs followed by CT challenge (E). Thus far, using mouse macrophages and MTT assays, the optimum concentrations for oleic, linoleic, and linolenic have been determined at 5-50ng/µL.

Genome-wide Distribution of G-quadruplexes in the Transcribed Regions of Human Genes. Viktor Vasilev, Lawrence D'Antonio, and Paramjeet S. Bagga, Ramapo College of New Jersey, Mahwah, NJ.

G-rich DNA and RNA G-quadruplexes can play significant biological roles in important cellular processes and human disease. The goal of current studies in our lab has been to investigate the role of G-quadruplexes in post transcriptional regulation of gene expression. We have used a bioinformatics approach to study the composition and distribution patterns of G-quadruplex forming motifs in the transcribed regions of >17,000 protein coding human genes. G-quadruplex motifs were found in almost all of the >500,000 of exons and introns that were analyzed. Our studies revealed the prevalence of G-quadruplexes with high putative stability near 5' splice sites in the introns. Stable RNA G-quadruplexes in the vicinity of 5' splice site may be involved in modulating splicing via interactions with regulatory proteins that bind G-rich sequences and influence alternative and tissue specific splicing events. We also found a very strong correlation between the distribution of the positions of ESEs (Exonic Splicing Enhancers) and G-quadruplexes, especially in the exons. Further investigation revealed overlaps between the predicted ESEs and G-quadruplexes mapped near the splice sites. ESE mediated regulated splicing may in fact involve the G-quadruplex structure. Our findings suggest that G-quadruplexes play a regulatory role in splicing of the human pre-mRNAs.

Study on the Effect of Cupric Chloride and Cadmium Chloride on Cyanobacteria *Synechococcus sp*. IU 625. Vico Viggiano[1], Shyam Patel[1], Jose L. Perez[1], Tin-Chun Chu[2] and Lee H. Lee[1], [1]Montclair State University, Montclair, NJ and [2]Seton Hall University, South Orange, NJ.

Cyanobacteria, *Synechococcus sp.* IU 625, were used because they are good indicators of water contamination by heavy metals. In this experiment, the effect of $CuCl_2$ (0, 5, 10, 15 and 30 mg/L) and $CdCl_2$ (0, 10, 15, 25, and 30 mg/L) on the growth of cyanobacteria *S. IU 625* were studied. Growth was monitored by direct count using hemocytometer and turbidity study using spectrophotometer at wavelength 750 nm. The content of $CuCl_2$ and $CdCl_2$ in the cells and media was analyzed by using ICP (Inductively Coupled Plasma) spectrometer. In the cultures containing $CuCl_2$, the growths were similar except 30 mg/L, where the growth was inhibited. ICP study indicated that 87 to 100% of $CuCl_2$ stays outside of the cells. In the 5 mg/L $CdCl_2$ culture, the growth was the same as the control and in 15mg/L it was slightly inhibited. At 30 mg/L, the growth was almost completely inhibited. ICP study indicated that 70 to 80 % of the metal stays in the media. This study suggested that the cells have low permeability to $CuCl_2$ and $CdCl_2$ and permeability may be one of the reasons that the cells are able to tolerate the metal contamination.

Adrenocorticotropin Hormone Expression in the Developing Chicken Limb. Michele J. Vigliotti and Jodi F. Evans, Molloy College, Rockville Centre, NY.

In previous studies using mammalian models we have found both clinical and laboratory evidence of a role for melanocortins in endochondral ossification. The melanocortin system has remarkable conservation among vertebrates and melanocortin receptors are expressed with significant sequence homology in teleosts to mammals. The overall goal of these studies is to provide a more accessible model of melanocortin involvement in endochondral growth. We hope to determine if melanocortins play a role during endochondral ossification of the developing chicken limb. Like in mammals melanocortins are widely distributed throughout the body of chicken and participate in a wide range of physiological functions with the peripheral tissue distribution of melanocortin receptors in chicken more widespread. Our first step was to examine melanocortin expression in the developing limbs of the chick embryo. Using immunohistochemistry techniques, we detected ACTH (1-24) in the limbs of embryonic day 9 chick embryos. This initial data indicates that the chick embryo is a viable model that can be used to determine a role for melanocortin in endochondral growth. Melanocortin expression shows remarkable sequence homology, therefore results of these studies can be extrapolated to many vertebrate models.

Development of Purification of Valproic Acid and Butyric Acid for Positron Emission Tomography Studies. Khaing Win[1] and Sunny Kim[2], [1]St. Joseph's College, Brooklyn, NY and [2]Brookhaven National Laboratory, Upton, NY.

Valproic acid (VPA) and butyric acid (BA) are two epigenetic drugs used for seizures and neurocognitive disorders. While the two acids have been known to bind histone deacetylases that suppresses gene expression, their pharmacokinetics, biodistribution, and the blood brain barrier penetrability remain an enigma. Positron Emission Tomography (PET) using [^{11}C]VPA and [^{11}C]BA could potentially solve these issues. Before [^{11}C]radiosynthesis, purification methods for unlabeled VPA and BA, generated via Grignard precursors, as impure mixtures were developed. High Performance Liquid Chromatography (HPLC) with C18– Gemini column under the isocratic system (acetonitrile (MeCN) and formic acid (FA)) is used. The following optimum purification conditions were found: a 50% MeCN/50% FA for VPA and a 15% MeCN/85% FA for BA. Respective HPLC (flow rate=1ml/min) retention times for BA and VPA were 8.55 minutes and 11.76 minutes. Our preliminary radiosynthesis and purification of [^{11}C]BA was completed within 40 min after the End of Bombardment. [^{11}C]BA was obtained in moderate radiochemical yield (>40%) and high purity (>99%). Radiosynthesis of [^{11}C]VPA is still to be attempted. We have successfully developed conditions for the synthesis and purification of both unlabelled VPA and BA for preparation of the radiolabeled acids to be used for PET studies.

Students' Perception of the Effectiveness of the Use of PowerPoint in Biology Classrooms.
Carla Beeber, Carol A. Biermann and [1]Kumkum Prabhakar,
Kingsborough Community College, CUNY, Brooklyn, NY and [1]Nassau Community College, Long Island, NY.

This study is a follow-up of a previous study evaluating the use of PowerPoint by faculty. In the second part of this study, we developed a questionnaire to assess students' reactions to the use of PowerPoint and collected data on their perception of the effectiveness of its use in the classroom. We intend to study how PowerPoint can affect students' learning considering different students' learning styles and to see whether or not PowerPoint can be a "One fits all " method of teaching. This study was conducted at both Kingsborough Community College/CUNY and Nassau Community College/SUNY. PowerPoint technology is almost a ubiquitous means of instruction in today's biology classrooms. This study evaluates students' perception of its effectiveness given their different learning styles.

Myelin Basic Protein Treatment of Primary Human Endothelial Cells Mediates Cytokine Production and Blood-Brain-Barrier Disruption Characteristic of Multiple Sclerosis.
Teresa G. D'Aversa[1,2], Eliseo A, Eugenin[2], Lillie Lopez[2] and Joan W, Berman[2],
'Iona College, New Rochelle, NY and [2]Albert Einstein College of Medicine, Bronx, NY.

Multiple sclerosis (MS) is an autoimmune disease of the central nervous system (CNS), characterized by demyelination of white matter, loss of myelin forming oligodendrocytes, changes in the blood-brain-barrier (BBB), and lymphocytic and monocytic infiltration, Myelin basic protein (MBP) is a major component of the myelin sheath. Degradation of myelin is believed to be an initial step that leads to the pathology seen in MS. Degraded extracellular myelin affects cells of the CNS. Transmigration of lymphocytes and monocytes across the vasculature, and a compromised BBB participate in the neuroinflammation of MS. Thus, we examined the expression and regulation of the chemokine CCL2 (monocyte chemoattractant protein [MCP]-1) and the cytokine IL-6 in cultured human endothelial cells (EG), a component of the BBB, after treatment with MBP. CCL2 is the most potent chemoattractant for monocytes, and also attracts lymphocytes, and IL-6 is mitogenic for astrocytes, inducing astrogliosis, which is prevalent in MS pathology. MBP significantly induced CCL2 and IL-6 protein from human EC. This induction was mediated, in part, by the p38 MAPK pathway. Western blot analysis showed phosphorylation of p38 MAPK after MBP treatment. Treatment of a human BBB model with MBP caused an increase in permeability that correlated with a decrease in the tight junction protein occludin, and an induction of matrix metalloprotease (MMP)-2, These data demonstrate that soluble MBP induces chemotactic and inflammatory mediators, MBP also alters BBB permeability and tight junction expression, indicating additional factors that may contribute to the BBB breakdown characteristic of MS.

The Biotechnology Bridge -A Collaboration of a Two-Year and a Four-Year College to Create a Pathway from High School through College to Biotechnology Careers.
Ronald Eckhardt[1], Loretta Brancaccio-Taras[2], Craig Hinkley[2], Sarwar Jahangir[2], Myra Kogen[1], Mary Ortiz[2], Kristin Polizzotto[2] and Arthur Zeitlin[2].
[1]Brooklyn College and [2]Kingsborough Community College, Brooklyn, NY.

The Brooklyn Biotechnology Bridge (BTB**)** is designed to provide students with training for immediate employment in New York City's growing biotechnology industry while also building their academic skills. It links Kingsborough Community College (KCC) and Brooklyn College (BC), two branches of The City University of New York, in a joint articulation agreement that ensures students graduating with an A.S. in biotechnology with the most efficient transfer possible to a senior college. As part of the BTB program, local teachers are invited to attend an eight-day summer training institute. The goal of the workshop is to familiarize teachers with state of the art laboratory techniques commonly used in the biotech industry so that they can present these recent innovations as well as their excitement about the field to their students. This past summer sixteen teachers, most from Brooklyn high schools, attended the institute for eight full days from July 6-16, conducting experiments in a DNA laboratory at KCC every morning and afternoon. Additional program highlights include the development of instructional videos on biotech topics to be made available on the Internet and comprehensive tracking of students and assessment of the program's effectiveness. This work was supported by NSF Grant #0802448**.**

Evaluation of Critical Thinking Skills: Case Study Practice.
Patrick Field,
Kean University, Union, NJ.

Critical thinking skills are essential to succeed in today's complex world. In order to improve and retain these skills in an upper level science course, methods of higher cortical processing are modeled in the classroom when working with case studies. By using a numerical scale to compare the answers of nine anatomically-related questions, on tests administered the first and last day of lecture, critical thinking data was evaluated. Qualitative data revealed that students provided many novel hypotheses that utilized evolutionary reasoning correctly. Descriptive and comparative statistics revealed that students significantly improved critical thinking after the semester of instruction and when the case study diagnoses were provided, when compared to the class that did not have the diagnoses.

Diet and Cardiovascular Disease: Contradictory Findings, Contradictory Conclusion.
Richard Pollak,
Queensborough Community College, Bayside, NY.

As biology educators we have a responsibility to explore scientifically contentious matters. Many of our students hold science to have "proven" nostrums such as fat is bad for you, or salt is dangerous, or early detection of cancers (such as prostate cancer) is always beneficial. While many scientific findings will stand the test of time, many will not. Our students and many others are only cursorily aware of the contradictions. Worse, our textbooks and other scientific writings do not reflect these controversies, but instead accept and re-enforce the settled wisdom. We of the science/health community should examine the relevant data and lead a re-evaluation of accepted perceptions. As educators of the future generation of biologists we must provide "case studies" of biological controversies. Findings refuting the usual cholesterol and salt dogma have not been accepted, or have been explained away, by members of the medical/health/nutritional fields who have persisted in advocating lowered cholesterol and less salt for the general population, as do most textbooks. Instead of presenting the science, they present the current wisdom as fact. The value of using the cholesterol and salt questions as "case studies" is that they can engender a healthy skepticism towards new findings, towards their textbooks, towards our pronouncements in the classroom. An open, questioning classroom will keep them alert to possible new findings that challenge or even change current practices. If this does happen then we will have done our jobs well.

Scaffolding Learning Experiences to Enhance Student Research.
Patricia Schneider, Raji Subramaniam, Regina Sullivan and Dwight Meyer,
Queensborough Community College, Bayside, NY.

Engaging our students in authentic research has become an increasing important component of biology education at the College. Students are inspired and prepared to complete meaningful research projects by a carefully designed scaffold of inquiry and problem-based experiences. General Biology lab facilities were updated with networked digital microscopes and computer-based sensors to support a revised curriculum emphasizing inquiry-based exercises with written reports. During Enrichment Workshops, General Biology students work in groups on challenging problems that build content knowledge and cognitive skills. Workshop students outperform non-Workshop students in combined % A, B, C and mean final grades. Two course-based research options are available to students. Introduction to Biological Research and the Research Laboratory Internship that places students in cutting-edge research labs on a senior college campus. Newly approved courses include the Biology Colloquium and Introduction to Biology for Science Majors, designed to develop the science process skills of entering students. NIH or NSF funded faculty-mentored research is a capstone experience for many students. The campus Research Coordinator serves as the key contact for information on all student research opportunities. Since 2006, the number of students engaged in biological research has increased from 21 to 47 per year.

Shamistic Medicinal Plants of the High Ecuadorian Andes.

Richard Stalter,
St Johns, University, Queens, NY.

The knowledge of medicinal plants in the Andean highlands may be as old as the original inhabitants, the Mayans, who settled the area around 10,000 BC. Information on useful medicinal plants has been passed from father to son from the time immemorial. One knowledgeable source of plant medicines was the shaman, an Indian doctor, who was responsible for curing the ills of his tribe. The shaman's means of curing the sick people of his tribe was multidimensional. To combat the evil spirit that had taken the hold of the sick, the shaman ate or drank a product of local hallucinogenic plants, producing a trance-like state that was the essential part of curing the sick. The shaman may have also proscribed medicinal cures made from local plants to heal the afflicted. This treatment was refined after thousands of years of testing various plant products on the diseases of native people. This presentation includes the pictures and descriptions of 15 of the 150 the Shaman's medicinal vascular plants in a book prepared by Stalter and Cruz that are currently used by indigenous Andeans to cure and treat a multiplicity of illnesses.

Morphological investigations of style and stamen lengths and the molecular comparison of tissue- and morph-specific proteins in long- and short-styled plants of *Linum perenne* and *L. flavum*.

Farshad Tamari,
Kingsborough Community College, Brooklyn, NY.

Distyly refers to the presence of two morphologies in a given species with respect to reciprocal positioning of styles and stamens. Distylous plants are typically self-incompatible and do not set seeds upon self and intra-morph pollinations. The genetics of distyly and self-incompatibility (SI) has been elucidated in 28 angiosperm families beginning with work on *Primula*. However, other than the Turneraceae, the molecular biology of this breeding system remains relatively unknown. *Linum* is a commercially important genus with distylous members. Some *Linum* members are used for linen and flaxseed/oil production. Of late, the medicinal properties of flax have been the focus of research, making the study of distyly and SI in members of this genus valuable. To ascertain distyly, the phenotypic expression of style and stamen lengths in *L. perenne* and *L. flavum* were quantified. Both species were found to be distylous. To identify potential tissue- and morph-specific differences in styles, filaments, anthers and ovaries in short- and long-styled plants SDS-PAGE was carried out. As expected, tissue-specific protein profile differences were observed for both species. There also exists morph-specific protein expression in *L. flavum*. These results need to be confirmed. Immunoblotting was performed to investigate the presence of polygalacturonase, a putative self-incompatibility protein found in styles of short-styled plants of *Turnera*. Polygalacturonase is not short-specific in styles of *L. flavum*, but is found in the ovaries of both short- and long-styled plants, indicating a possible role for polygalacturonase in the reproductive biology of *L. flavum*. DNA was isolated from a number of short- and long-styled plants from both species. The gene *polygalacturonase*, as well as *a-dioxygenase*, which is also thought to be involved in distyly and SI, will be PCR amplified for sequence comparison between the two morphs.


Conference Highlights

Benjamin Cummings/MACUB Student Research Grants

Purpose
To provide investigative research support for undergraduate students working under the supervision of faculty member who is a current member of MACUB.

Awards
Applications will be evaluated and awards granted based on the scientific merit and overall quality of the proposed research experience.

1. 4 grants of $500 each will be awarded annually (provided by BC).
2. Complimentary registration for the annual fall conference of MACUB and membership in MACUB for student research grant awardees (provided by MACUB)

Eligibility

1. Only undergraduate students currently enrolled at the institution of a MACUB faculty mentor may apply.
2. The faculty mentor must be a current member of MACUB.
3. Undergraduates who are graduating seniors must plan to complete their research prior to graduation.
4. A student is only eligible to receive one award.

Requirements

1. Student research grants may be used to support scientific investigation in any field of biology.
2. Funding may be used to purchase equipment or supplies required for the proposed project, and/or travel to and from a research location.
3. Grant winners are required to present the results of research supported by this award at the MACUB annual fall conference following the year of the award.
4. Institutional support is required. This may include research supplies, travel expenses, in-kind matches, and other forms of support.
5. All application materials must be submitted on-line at http//www.macub.org by **February 15, 2010** and all applicants will receive notification of award status by **March 1, 2010.**

Application

1. On-line proposal requires:
    a. Student contact information.
    b. Faculty advisor contact information.
    c. Faculty reference letter from the research advisor. This letter must include a statement of institutional support for the project.
    d. Proposal title.
    e. Proposal (maximum of 500 words). The proposal should provide a brief background on the project with reference, a statement of the proposed question or hypothesis to be tested, and a description of the experimental approach.
    f. References
    g. Basic budget justification.
    h. Include discipline. For example, molecular biology, cell biology, genetics, etc.

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