

## **2009 Award Winners**

### **Research and Creative Activities Symposium**

#### Outstanding Research and Creative Activity:

- David Sprunt, Christine Shine, Carrie Kronberg  
DC - College of Architecture and Planning, Landscape Architecture & Urban Design  
*Hybridscape: A Proposal for Wynkoop Street & Denver Union Station*
- Jamie Carpio  
DC - College of Liberal Arts and Sciences, Anthropology  
*Determining bone utility and effectiveness as tools: termite extraction at lake Manyara, Tanzania during the Dry Season in Tanzania*
- Dustin Neel  
DC - College of Liberal Arts and Sciences, Geography-Earth Science  
*Isolation and characterization of cadmium-resistant bacteria*
- Francie Hyndman  
AMC - School of Dental Medicine, Craniofacial Biology  
*Misregulation of Dlx5/6 in Hand2 mutants leads to loss of tongue*

#### **Chancellor's Awards for Excellence:**

##### **Undergraduate Research:**

- Matthew Taussig  
DC - College of Liberal Arts and Sciences, Biology  
*Mutating TCRzeta to study SLAP-dependent ubiquitination*
- Megan Blatner  
DC - College of Liberal Arts and Sciences, Biology  
*Characterizing and Ameliorating Cognitive Deficits of TS65Dn mice -a model of down syndrome- using a computerized olfactometer*

##### **Graduate Creative:**

- Aris Garrison, Kristin McCartney, Britta Moline-Ayars  
DC - College of Architecture and Planning, Architecture  
*Affordable Green Housing*

##### **Graduate Research:**

- James Kovacs  
AMC - Graduate School, Biomolecular Structure  
*Use of NMR to Define CR2:C3d Interactions in Solution Reveals Dual SCR1-2 Interface with C3d: Confirmation Using a Novel Ligand-Selective Inhibitory Peptide*

## **Hybridscape: A Proposal for Wynkoop Street & Denver Union Station**

**David Sprunt**, Landscape Arch & Urban Design (dual degree), DC - College of Architecture and Planning

**Christine Shine**, Landscape Architecture & Urban Design, DC - College of Architecture and Planning

**Carrie Kronberg**, Architecture & Urban Design, DC - College of Architecture and Planning

**Gary Taipalus**, M-Arch/MUD 2008, College of Architecture & Planning

**Faculty Sponsor:** Mr. Fred Andreas, DC - College of Architecture and Planning

*Activity Type:* Graduate Creative Activity

**2009 Outstanding Research and Creative Activities Award Winner**

Denver Union Station was once the gateway to the city and remains one of the finest examples of a major 19th century transportation hub. Our objective in this studio project is to provide sustainable urban design guidance for the renaissance of Union Station and the Wynkoop Street corridor between Cherry Creek and Coors Field, creating a major public space in the heart of the city. HYBRIDscape is a vision that bridges the gap between the street's historic past and a sustainable future. Our project envisions a sustainable, walkable, and transit-served urban neighborhood that serves as a gateway to Lower Downtown. As the station once again becomes the region's major transportation hub, the project transforms parking lots and the historic street in front of the station into a pedestrian-friendly plaza. The design creates a flexible space that handles thousands of daily commuters, special events and sports crowds, and also provides more intimate spaces, manages storm water, generates power for the neighborhood, and highlights native plants, natural processes and local history. The project integrates urbanism with high-performance buildings and high-performance infrastructure as a means to create potential: for architecture, for humanity, and for a sustainable future.

# **Determining Bone Utility and Effectiveness as Tools: Termite Extraction at Lake Manyara, Tanzania during the Dry Season in Tanzania**

**Jamie Carpio**, Anthropology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Charles Musiba, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

**2008-2009 UROP Award Winner**

**2009 Outstanding Research and Creative Activities Award Winner**

Taphonomic evidence of bone surface modification for tool use by early hominins was recently recognized at Swartkrans in South Africa by Backwell and d'Errico; however, very little taphonomic research of this type has been conducted in East African Pliocene sites. During the 2008 UCD Tanzanian field school in anthropology at Laetoli, we conducted experiments to test whether bones recovered from recent death assemblages could be modified and used for termite fishing at mounds near Lake Manyara. Bone tools were modified and used to puncture termite mounds, thus creating a use wear pattern that would be indicative of tool use and compared with fragmented fossil bones found at Laetoli. A scan electron microscope (SEM) was used to examine bone surface modification associated with tool use (polishing and striations) that match those reported from Swartkrans as possible evidence of Australopithecines early bone modification and tool use for termite fishing. We report that to achieve the greatest number of termites, in terms of calorific intake, with the least amount of energy expended most likely occurred shortly after the rain season or at locations where mounds are in close proximity to water sources.

# Isolation and Characterization of Cadmium-Resistant Bacteria

Dustin Neel, Geography-Earth Science, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Timberley Roane, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

**2008-2009 UROP Award Winner**

**2009 Outstanding Research and Creative Activities Award Winner**

The bacterium *Pseudomonas* sp. S8A, initially isolated from a mine tailing-contaminated soil, demonstrates a high degree of resistance to cadmium toxicity, up to 200 ppm soluble cadmium. In characterizing this bacterium's resistance to cadmium, several mechanisms of metal detoxification were identified. In response to cadmium, *Pseudomonas* sp. S8A produces a cadmium-binding exopolymer and a cadmium-binding biosurfactant, both known among other metal-resistant bacteria. However, unique to *Pseudomonas* sp. S8A is a newly identified genetic mechanism possibly partially accounting for the high degree of cadmium resistance. This mechanism, identified as part of the Cpx cell stress response system, has not before been identified in environmental bacteria, such as *Pseudomonas* sp. S8A. The specific objectives of this UROP project were two-fold: (1) characterize cadmium-resistant bacteria from the Pennsylvania mine site in Colorado; and (2) use the polymerase chain reaction (PCR), a molecular method used to identify specific genes, to screen for the presence of the Cpx stress response system in the cadmium-resistant bacteria. The isolation and characterization of cadmium-resistant bacteria is of great interest due to their potential use in metal detoxification and remediation of contaminated sites.

# Misregulation of Dlx5/6 in Hand2 Mutants Leads to Loss of Tongue

Francie Hyndman, Cell Biology, Stem Cells, and Development, AMC - Graduate School

**Faculty Sponsor:** Dr. David Clouthier, AMC - School of Dental Medicine

*Activity Type:* Graduate Research

**2009 Outstanding Research and Creative Activities Award Winner**

Lower jaw development is orchestrated by signaling cascades that are regulated temporospatially, and are refined through permissive and inhibitory signals. We have previously shown that endothelin-A receptor signaling is crucial for establishing the identity of cranial neural crest (CNC) cells in the mandibular arch through a mechanism that involves Dlx5 and Dlx6 (Dlx5/6). Dlx5/6 induce expression of Hand2, a basic helix-loop-helix transcription factor. Little is known about the function of Hand2 in mammalian facial development because Hand2<sup>-/-</sup> embryos die by embryonic day (E) 10.5 from vascular failure. To circumvent this lethality, we created a conditional targeted Hand2 mouse line using a Cre-loxP approach. Using the Wnt1-Cre mouse line, we deleted Hand2 within all CNC cells. We find that Hand2 conditional knockout mice exhibit facial defects that include mandibular hypoplasia and loss of tongue (aglossia). Aglossia is preceded by aberrant maintenance of Dlx5/6 expression in the disto-oral mandibular arch mesenchyme. In vitro studies show that Hand2 represses the Dlx5/6 pharyngeal arch-specific enhancer. Thus, Hand2 normally ensures normal tongue development by repressing Dlx5/6 expression within the disto-oral mandibular arch. In the absence of Hand2, Dlx5/6 expression is maintained and ectopically activates an osteogenic program at the expense of a tongue development program.

# Mutating TCRzeta to Study SLAP-dependent Ubiquitination

**Matthew Taussig**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Aimee Bernard, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Mutant forms of TCR $\zeta$  were generated in order to determine which residues of the zeta chain of the T-cell receptor (TCR $\zeta$ ) are ubiquitinated by Src-like adapter protein (SLAP) in combination with c-Cbl (an E3 ubiquitin ligase). The mutants will aid in the investigation of how SLAP-dependent ubiquitination of TCR $\zeta$  affects internalization, intracellular trafficking, and degradation of the TCR complex. Using a plasmid containing the TCR $\zeta$  gene and the technique of site directed mutagenesis, the intracellular lysines were mutated to arginines, a chemically similar amino acid to which ubiquitin cannot bind. There are nine total lysines in the intracellular domain of TCR $\zeta$ , and nine mutant forms of TCR $\zeta$  were generated. Cell lines that stably express our mutant forms of TCR $\zeta$  could then be established enabling the study of TCR internalization and trafficking in the presence or absence of SLAP and c-Cbl. This project aims to increase our understanding T-cell signaling pathways and the mechanisms that control T cell development and function.

# Characterizing and Ameliorating Cognitive Deficits of TS65Dn Mice - A Model of Down Syndrome -Using A Computerized Olfactometer

**Megan Blatner**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Diego Restrepo, AMC - School of Medicine

*Activity Type:* Undergraduate Research

We tested the learning performance of trisomic TS65Dn mice and disomic littermates in a computerized go-no go task where mice learned to discriminate between the odors of citral (10% in mineral oil) and mineral oil. We concluded that at least some of the trisomics are able to perform the task, but the disomics require about half the number of trials to reach a learning criterion (disomic= $343 \pm 249$  trials, trisomic= $716 \pm 342$  trials,  $n=6$ ,  $P=0.035$ , paired student t-test). When we presented a new odor pair (1% propionic acid versus a 1:1 mix of 1% propionic acid and benzaldehyde) the disomic mice performed significantly better than trisomics ( $F=8.39$ ,  $P=0.0046$ ,  $n=6$ , Anova Two-Way statistic). We also performed an additional odor search test where the animal has to dig to find a petri dish containing peanut butter, and we observe that the disomics find the peanut butter about two times faster than the trisomics (disomic delay= $2.39 \pm 0.79$  min, trisomic delay= $4.89 \pm 2.08$  min,  $n=6$ ,  $P=0.037$ , paired student t-Test). Our hypothesis is that learning deficits of trisomic TS65Dn mice are due to decreased cholinergic innervation of key brain areas. After finishing characterization of behavioral deficits of the trisomic mice we plan to alleviate the deficits by performing deep brain stimulation in the cholinergic basal forebrain, and i.p. injections of galantamine to improve performance of synaptic transmission by basal forebrain cholinergic neurons.

## **Affordable Green Housing**

**Aris Garrison, Kirstin McCartney, Britta Moline-Ayars**, Architecture, DC - College of Architecture and Planning

**Faculty Sponsor:** Mr. Rick Sommerfield, DC - College of Architecture and Planning

*Activity Type:* Graduate Creative Activity

Can housing be affordable, beautiful and sustainable? Greensburg Kansas, destroyed by a F5 tornado two years ago has asked this question of the University of Colorado Denver and we have an answer. Using intelligent design and research a prototype house has been developed for the town of Greensburg. It has presented an elegant low cost housing solution for the climate and culture of Greensburg. This design embraces passive solar design and day lighting while using sustainable products and smart contemporary design. It is intended to be a starter home for the current and future residence of Greensburg. The first phase of the project is approximately 750 square feet with one bedroom that costs about \$70,000. The house is design for expansion so it can grow with the tenant into a 3 bedroom or 2 bedroom live/work space. This gives residence the opportunity to move in now and not outgrow their investment while adding quality and value to the housing stock in this small community.

# Use of NMR to Define CR2:C3d Interactions in Solution Reveals Dual SCR1-2 Interface with C3d: Confirmation Using a Novel Ligand-Selective Inhibitory Peptide

**James Kovacs**, Biomolecular Structure, AMC - Graduate School

**Faculty Sponsor:** Dr. V. Michael Holers, AMC - School of Medicine

*Activity Type:* Graduate Research

Complement receptor 2 (CR2) is a cell membrane protein, with 15 or 16 extracellular short consensus repeats (SCRs), that promotes B cell responses and bridges innate and acquired immunity. SCRs 1 and 2 mediate the interaction of CR2 with its four known ligands (C3d, EBV gp350, IFN-alpha, CD23). Inhibitory mAbs against SCR1-2 block binding of all ligands. To develop ligand-specific inhibitors that would also assist in identifying residues unique to each receptor-ligand interaction, phage were selected from random libraries by panning with recombinant SCR1-2, followed by specific ligand-driven elution. Derived peptides were tested by competition ELISA. One peptide, C3dp1, exhibited ligand specific inhibition at mid-micromolar IC50. C3d was titrated into 15N labeled SCR1-2, which revealed chemical shift changes indicative of specific inter-molecular interactions. Chemical shift changes were mapped onto the crystal structure of SCR1-2. With regard to C3d, the binding surface includes regions of SCR1, SCR2 and the inter-SCR linker. SCR1 and SCR2 demonstrated distinct binding modes. The CR2 binding surface incorporating SCR1 is inconsistent with a previous X-ray CR2-C3d co-crystal analysis, but consistent with other previous results. Titration with C3dp1 yielded chemical shift overlapping with C3d, indicating that C3dp1 interacts at the same CR2 site as C3d./