

# CBBG

## Center for Bio-mediated & Bio-inspired Geotechnics

Newsletter • Fall 2017 • Volume 8



Edward Kavazanjian, Jr., Ph.D., PE, D.Ge, NAE  
Regents' Professor and Professor of Geotechnical Engineering  
Director, Center for Bio-mediated and Bio-inspired Geotechnics  
School of Sustainable Engineering and the Built Environment  
Ira A. Fulton Schools of Engineering  
Email: edkavy@asu.edu

### As I See It: View from Director's Chair

#### Getting Better All the Time

As we put the recent NSF Site Visit behind us and move forward with Year 3 of CBBG operations, it is a good time to reflect upon what we accomplished in Year 2, and what remains to be done. Year 2 was a year of significant progress and accomplishments. Building upon the lessons we learned in Year 1, in Year 2 we revised our Strategic Plan, improved our processes and programs, enhanced communications among team members, moved forward towards field deployment of CBBG technologies, and increased industrial engagement in and support for CBBG research programs.



Revision of the CBBG Strategic Plan was driven in part by the realization that NSF funding is not sufficient to fund all of the good ideas put forth by CBBG Senior Investigators. In light of this realization, we resolved to sharpen the focus of CBBG projects receiving NSF funding to concentrate on civil infrastructure systems, and to put an increased emphasis on leveraging NSF funding with funding from other sources, including other NSF programs, other agencies, and our industrial partners. In revising the CBBG Strategic Plan, we eliminated the Natural Resource Development Thrust as part of our enhanced focus on civil infrastructure systems. Elimination of the Resource Development Thrust was not as dire as it may sound, as the projects in this thrust were redistributed to other thrusts. However, following a subsequent review of our project portfolio as part of our initiative to sharpen our focus on Geotechnics for civil infrastructure systems, several projects were targeted for sunset of NSF support. Two projects also were re-directed from a focus on microbially derived hydrocarbons for energy generation to soil and groundwater remediation applications.

Projects upon which NSF support will be sunset include projects formerly in the Resource Development Thrust as well as projects from the Environmental Protection and Infrastructure Construction Thrusts. I note that when a project is targeted for sunset of NSF support, the CBBG continues to support graduate students working on that project for another year (to provide a "soft landing" for students working on that project), and CBBG will work with the Senior Investigator(s) for the project to secure support from other funding sources.

An important part of the improvement in our processes and programs was increased transparency for decisions on funding of projects. Of course, increased transparency goes hand in hand with enhanced communication. Along these lines, we formalized rubrics for our annual project review and for evaluation of proposals for new projects, and provided the evaluation scores and any relevant comments to our Senior Investigators on their projects and proposals.



We also enhanced engagement of our Industrial Partners (IAB) and Science Advisory Board (SAB) in these evaluations, though we still have room for improvement in this area as we try to strike the balance between engagement and over-whelming our partners with evaluation requests.

On the project front, our carbonate precipitation technologies are moving from the Enabling Technology stage to the Systems Integration test bed stage. Systems Integration testing of our MICP (microbially induced carbonate precipitation) and MIDP (microbially induced desaturation and precipitation) technologies for mitigation of earthquake-induced soil liquefaction has begun at the UC Davis NHERI (Natural Hazards Engineering Research Infrastructure) centrifuge facility. Planning is underway for field scale testing for two different applications of our EICP (enzyme induced carbonate precipitation) technology initiated in Year 2.

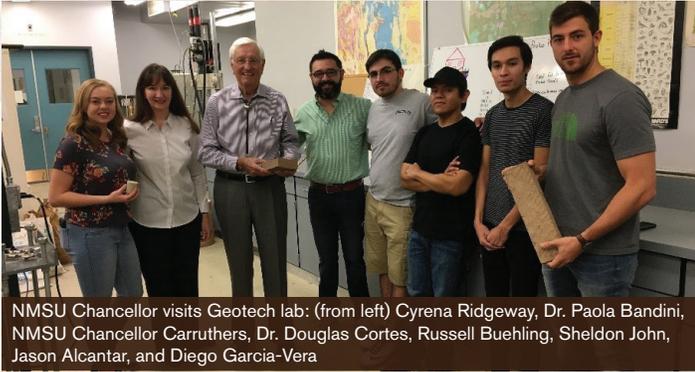
(Director's column continued on page 7)

## Important Dates

**April 11-13, 2018**  
CBBG Mid-Year Meeting  
Georgia Institute of Technology  
Atlanta, Georgia

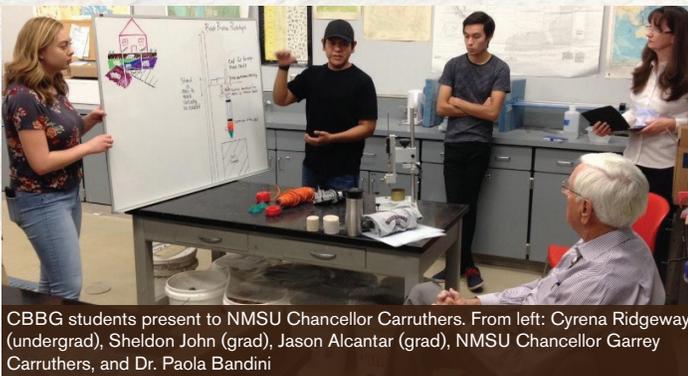
# Research Highlights

## NMSU Chancellor and President Visits Geotech Lab and CBBG Researchers



NMSU Chancellor visits Geotech lab: (from left) Cyrena Ridgeway, Dr. Paola Bandini, NMSU Chancellor Carruthers, Dr. Douglas Cortes, Russell Buehling, Sheldon John, Jason Alcantar, and Diego Garcia-Vera

On September 11, 2017, New Mexico State University Chancellor Garrey Carruthers toured the NMSU geotechnical laboratory to learn more about CBBG research. Drs. Paola Bandini and Douglas Cortes and their CBBG student researchers described their projects and outreach activities. NMSU Chancellor Carruthers was particularly interested in the experiential learning and research experiences that CBBG offers to NMSU undergraduate and graduate students. After the lab visit, the Chancellor posted on Facebook, "Very impressive work being done! by the CBBG team in the NMSU Civil Engineering Department", and reiterated the institutional support.



CBBG students present to NMSU Chancellor Carruthers. From left: Cyrena Ridgeway (undergrad), Sheldon John (grad), Jason Alcantar (grad), NMSU Chancellor Garrey Carruthers, and Dr. Paola Bandini

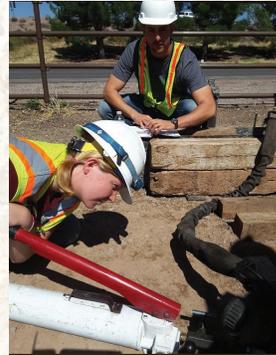
## NMSU Microbiologist Joined Research Team that Develops Permeable Reactive Barrier



Dr. Yanyan Zhang, NMSU Assistant Professor

In Fall 2017, Dr. Yanyan Zhang joined the CBBG team that works to develop a microbially enhanced iron-modified permeable reactive barrier (PRB). Dr. Lambis Papelis is the project's senior investigator. Dr. Zhang is an assistant professor in the Department of Civil Engineering at NMSU. Her expertise and research is in environmental microbiology. Dr. Zhang received her Ph.D. degree in environmental engineering from the University of Missouri, and was a postdoctoral fellow in the University of Alberta, Canada before joining the NMSU faculty in Fall 2016.

## NMSU Students Participated in Micro Pile Load Test Demonstration



CBBG graduate research assistant Diego Garcia-Vera (rear) participated in micro pile load test demonstration on NMSU campus

Pullout and lateral load tests of four micro piles were performed at the NMSU Main campus to demonstrate the test procedures to students and engineers. In this hands-on field experience, CBBG NMSU students had the opportunity to closely participate in the micro pile load tests by collecting displacement data and applying the loading. The demonstration included the cone penetration test (CPT), which was used for the design of these micro piles. The load test demonstration and a delicious BBQ lunch were provided by RAMJACK of New Mexico in early October.



(left) Demonstration of CPT for students. (right) CBBG graduate students participated in micro pile load test demonstration on NMSU campus

## Cortes Invited by Italian Institute of Technology for Research Collaboration



Dr. Douglas Cortes of NMSU with Dr. Barbara Mazzolai, IIT CMBR Center Director

Dr. Douglas Cortes of NMSU was invited by the Center for Micro-BioRobotics (CMBR) of the Italian Institute of Technology (IIT) to visit in October. Cortes' visit to the CMBR in Pontedera (Province of Pisa, Italy) was focused on formalizing his collaboration with the IIT's CMBR research team, and included research presentations by Cortes and his Italian counterparts. Dr. Cortes leads the CBBG-funded research at NMSU to create a self-excavating geo-probe inspired on the evolutionary adaptations developed by earthworms and roots. The Istituto Italiano di Tecnologia (IIT) promotes

Italy's technological development and higher education in science and technology. Particularly, IIT's CMBR group aims at designing and developing new robotic solutions and advanced components taking inspiration from nature, primarily from plants and soft animals.

## CBBG Researchers at ASU to Participate in International Consortium



CBBG researchers at ASU to participate in an International Consortium to perform a field demonstration of using biological processes to improve the geotechnical stability of 'running' sands at the Port Lands area in Toronto, Ontario, Canada in Spring 2018.

The consortium led by Dutch firm, Groundwater Technology BV, successfully carried-out the first phase, a bench-top feasibility study, evaluating the potential of using Microbially Induced Carbonate Precipitation to stabilize Port Land soils at the laboratory of Deltares in Delft, The Netherlands. Waterfront Toronto now awarded a \$313,022 CAD for the on-site demonstration of this process at the Port Lands. The demonstration will be one of the projects enabling the challenging development of Port Lands into a thriving combination of nature, river Don wetlands. It will show how attractive properties can be achieved in an environmentally friendly manner using these natural processes. The demonstration will implement these processes at full operational scale on a limited portion of the site. The results will be analyzed and the process considered for implementation by the Waterfront Toronto project team.

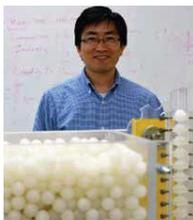
<http://waterfronttoronto.ca/nbe/portal/waterfront/Home/waterfronthome/procurement/awardedcontracts>

## Krajmalnik-Brown Featured in Nature Magazine



ASU's Biodesign Institute was included in the September 25, 2017 issue of Nature. The article described how the Institute was designed to foster collaboration. Dr. Rosa Krajmalnik-Brown, CBBG Thrust Leader, indicated that through her collaborations within the Institute, she has found differences in microbial flora among individuals that could relate to autism.

## Dai Featured in U.S. DOE Newsletter, Fire in the Ice



Dr. Sheng Dai, a Senior Investigator at Georgia Tech, was recently featured by Fire in the Ice, the newsletter of the U.S. Department of Energy highlighting the latest developments in international gas hydrates research and development.

Click here for the entire article. [https://www.netl.doe.gov/File%20Library/Research/Oil-Gas/methane%20hydrates/MHNews\\_2017\\_Summer.pdf#page=19](https://www.netl.doe.gov/File%20Library/Research/Oil-Gas/methane%20hydrates/MHNews_2017_Summer.pdf#page=19)

## 2016 CBBG Summer REU Continues Lab Research



Alana Erickson, 2016 CBBG Summer REU at UC Davis, was offered a paid position in a bioinformatics lab at the University of Florida after volunteering over the summer. The lab has been working on creating a genetic algorithm to determine genetic networks that drive different types of cancer. They are doing this by analyzing protein interactions, life expectancy, and having a binary matrix that indicates whether a mutation occurs on the specific gene or not. There was a previous paper and algorithm developed that accomplished this, but that algorithm runs in exponential time, which is a problem. This can become extremely time consuming to run, because depending on complexity, it can take days or weeks to determine the network. The newly developed algorithm is looking to run and find these genetic networks in linear or squared time. Alana attributes her success in obtaining the position to her time at UC Davis with mentor Charlie Graddy, who provided her with "research skills that have thoroughly impressed my new PI."

## CBBG Researchers Microbes Can Clean Up Pollutants and Benefit Industry

In new research, CBBG graduate student, Sofia Esquivel-Elizondo, Dr. Rosa Krajmalnik-Brown, CBBG Thrust Leader, and Dr. Anca Delgado, CBBG Senior Investigator, demonstrate that microbes can also be harnessed to clean up recalcitrant pollutants and generate chemicals of widespread benefit to industry.

To learn more, read the article here: <https://biodesign.asu.edu/news/microbial-communities-clean-toxic-waste-and-generate-useful-chemicals>

## Iskander Delivers Lecture on Soil Structure Interaction at Georgia Tech



Dr. Maged Iskander visited Georgia Tech, and delivered a lecture as part of the CBBG SLC webinar series. The lecture titled "Visualizing Soil Structure Interaction and Flow, Non-Intrusively" was broadcast to all CBBG partner institutions (ASU, NMSU and UCD). Iskander, who has been conducting research using transparent soils for more than 20 years, recently introduced the geotechnical community to a Wiki on transparent soils at [wp.nyu.edu/ts/](http://wp.nyu.edu/ts/). Dr. Iskander posed for a photo along with GT CBBG students (left to right) Ariel Siegel, Seth Mallett, Mahdi Roozbahani, Dr. Maged Iskander, Dr. Prashanth Vangla, Boyoung Jeong, Rodrigo Borela, Fernando Patino and Nimisha Roy after his webinar.

# Out & About

Student Research Conference, hosted by NMSU this fall. Community college student, Oscar Gallegos, was sponsored

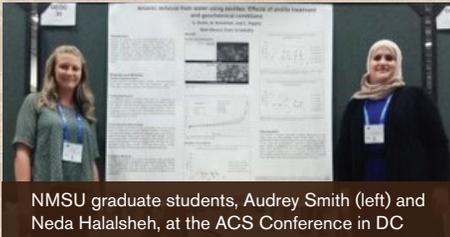
## Brad Weldon and Paola Bandini presented at EARTH USA 2017



Dr. Brad Weldon at EARTH USA 2017 Conference

Drs. Brad Weldon and Paola Bandini of NMSU presented their CBBG research on fiber-reinforced earthen construction at EARTH USA 2017 Conference, the 9th International Conference on Architecture and Construction with Earthen Materials. The 3-day conference was held in Santa Fe, New Mexico with participants from 14 countries. The conference included a tour of historic landmarks built with earth blocks, including the Oldest House in the U.S. (1646).

## NMSU Students and Faculty Presented at ACS Conference



NMSU graduate students, Audrey Smith (left) and Neda Halalsheh, at the ACS Conference in DC

Dr. Lambis Papelis and his graduate research assistants Neda Halalsheh (Ph.D.) and Audrey Smith (M.S.) presented their CBBG research at the American Chemical Society (ACS) National Meeting in Washington, DC August 20-24, 2017. The presentations were on the effects of geochemical conditions and treatment of zeolites on their ability to bind selenium and arsenic oxyanions.

## Community College REU and Undergraduate Researcher Presented at Conference



Community college REU student, Oscar Gallegos, presented at the New Mexico AMP Student Research Conference

NMSU undergraduate researchers Oscar and Russell presented posters of their CBBG projects at the New Mexico AMP

Student Research Conference, hosted by NMSU this fall. Community college student, Oscar Gallegos, was sponsored by CBBG to participate in the SCCORE research experience at NMSU in summer 2017. Oscar was mentored by graduate student Diego Garcia-Vera as part of a team of six other students working on natural fiber-reinforced earth bricks. The Summer Community College Opportunity for Research Experience (SCCORE) program supports pre-transfer community college students to serve as research assistants. After a successful summer research experience, Oscar transferred to NMSU civil engineering program and continues as a CBBG undergraduate research student. Russell Buehling is an undergraduate research student (electrical and computer engineering major) working with the NMSU team led by Dr. Douglas Cortes to develop a bio-inspired self-excavating geo-probe. Russell's graduate mentor is Sheldon John.



Undergraduate research student, Russell Buehling, presented at the New Mexico AMP Student Research Conference

## van Paassen to Present at Pan-American Conference



CBBG Senior Investigator, Dr. Leon van Paassen will be providing a State-of-the-Art lecture on "Biogenic Gas Formation for Ground Improvement

Applications" at the Pan-American Conference on Unsaturated Soil Mechanics in Dallas, Texas with Dr. Ed Kavazanjian and several CBBG researchers as co-authors from November 12-15, 2017.

## van Paassen Presented at University of Montana Seminar Series

Dr. Leon van Paassen, CBBG Senior Investigator, was invited by the Center for BioFilm Engineering at the University of Montana to present a seminar on September 21, 2017, entitled, "Advances in bio-based geotechnical engineering." van Paassen's research aims to develop sustainable solutions for improved resource efficiency in the civil and mining engineering industry. He strives to reduce environmental impact

from these industries through integration of environmental biotechnology and geotechnical engineering.

## Delgado Presents at ASU Seminars



In September and October, Dr. Anca Delgado, CBBG Senior Researcher, gave two seminars:

- The "long" road to continuous cultivation of chlorinated ethene-bioaugmentation cultures. Environmental Engineering Seminar, School of Sustainable Engineering and the Built Environment, Arizona State University, Tempe, AZ, October 2017.
- Continuous cultivation of chlorinated ethene bioaugmentation cultures – making a come back? Biological Design Seminar, School of Biological and Health Systems Engineering, Arizona State University, Tempe, AZ, September 2017.

## Almajed Presented at 2017 Grouting Conference in Honolulu, Hawaii



Dr. Abdullah Almajed, CBBG Post-Doctoral Scholar, recently presented his paper entitled, "Bio-inspired Soil Improvement using EICP Soil Columns and Soil Nails," at the 5th International Grouting Conference in July 2017. The conference focused on new technologies and current practice related to Grouting, Deep Mixing, and Diaphragm Wells.

## Frost Presents at 19th ICSMGE in Seoul



CBBG Co-PI David Frost presented a paper at the 19th ICSMGE in Seoul in September titled "Biologically-inspired insights into soil arching and tunnel stability from the topology of ant nests". The paper was co-authored by CBBG graduate students Mahdi Roozbahani and Karie Yamamoto, along with 2016 REU students Kendra Jackson and Lindsay Leonard as well as SURE undergraduate student Mykala Jones.

# Honors & Awards

## El Kortbawi Receives Edward S. Nolan Scholarship from International Association



Maya El Kortbawi, UCD graduate student, was awarded the 2017-2018 Edward S. Nolan Scholarship from the International Association of Foundation Drilling and the Industry Advancement Fund (ASDC).

Maya earned her Bachelor of Engineering (BE) in Civil and Environmental Engineering from the Lebanese American University in 2013. After graduation, she dedicated one full year for research on earthquake-induced landslides in Lebanon. She also worked for one-year at Dar Al Handasah-Shair and Partners, an international consultant based in the Middle East. Maya earned her MS in Civil Engineering from Virginia Tech with an emphasis on geotechnical engineering. Her thesis topic was on liquefaction in New Zealand during a historic earthquake. In September of 2017 she joined the Geotechnical Group at UC Davis and CBBG, to work towards a PhD under Professors Katerina Ziotopoulou and Jason DeJong and perform research on the upscaled modeling of MICP.

## Bandini and Samani are new members of CE Department's Advisory Group at NMSU



(left) Bandini received certificate as new ACAGE Member from ACAGE President Edward Martinez. (right) Samani received certificate as new ACAGE Member from ACAGE President Edward Martinez

Drs. Paola Bandini and Zohrab Samani were initiated as Members of the Academy of Civil, Agricultural and Geological Engineering (ACAGE) at NMSU. The ACAGE serves as liaison between the Civil Engineering (CE) Department and the engineering profession, and provides guidance, ideas, program and curriculum evaluation, and general support to the Department. Former CBBG graduate student Daniel Franco was also initiated as Associated Member. The ACAGE initiation ceremony and banquet were held at Las Cruces Convention Center as part of the NMSU Homecoming events on October 26.

## NSF I-CORPS Update on NMSU Student Participation



NMSU graduate student, Saman Mostafazadeh-Fard, (left) with potential customers of his product's ecosystem for NSF I-Corps team program

In a previous issue of the CBBG Newsletter, we published as story about NMSU student, Saman Mostafazadeh-Fard, and his technology mentor, Professor Zohrab Samani, who were awarded a \$50,000 NSF I-Corps Team grant. Through this grant, they participate in the 7-week I-Corps curriculum on entrepreneurship in Fall 2017. Saman and Samani recently returned from the NSF Innovation Corps

(I-Corps) kickoff session in Los Angeles, CA. During the next couple of weeks, this I-Corps team will interview 17 customers in their product's

ecosystem each week to eventually reach a conclusion on whether their business thesis will be a success if brought to the real market. Their product is a liquid organic fertilizer produced from green plant waste.

## Delgado Joins ASU CBBG as Assistant Professor



Dr. Anca Delgado joined the School of Sustainable Engineering and the Built Environment (SSEBE) at Arizona State University (ASU) as an Assistant Professor in August 2017. She is also a faculty member of the Biodesign Swette Center for Environmental Biotechnology, ASU. Dr. Delgado received a Ph.D. from Arizona State University under

the supervision of Dr. Rosa Krajmalnik-Brown. Her Ph.D. work focused on biogeochemical factors that affect the rates and extent of bioremediation of chlorinated ethenes and on the development of high-rate bioreactors for growth of bioaugmentation cultures. During her postdoctoral appointment at ASU, Dr. Delgado studied strategies for enhanced bioremediation by combining biodegradation and chemical oxidants for remediating soils contaminated by heavy petroleum hydrocarbons.

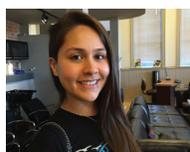
As an Assistant Professor, Dr. Delgado will research soil and water microbial processes that sequester, recycle, and transform carbon and chlorine compounds for (i) contaminant removal, (ii) minimization of harmful chemicals in food production, (iii) improvement of soil quality, and (iv) biofuel precursor production.

## Reynolds Awarded \$5,000 Fellowship from SWANA



Mark Reynolds, CBBG graduate student, has been awarded a \$5000 fellowship from the Solid Waste Association of North America (SWANA) to continue his work on methane generation and methane monitoring at municipal solid waste landfills.

## Esquivel Elizondo Successfully Defends Dissertation



Sofia Esquivel Elizondo, CBBG Ph.D. candidate, defended her dissertation, Microbial Communities Involved in Carbon Monoxide and Syngas Conversion to Biofuels and Chemicals, on Monday, November 6, 2017. Congratulations, Dr. Elizondo!

## Vangla Joins Georgia Tech as Post-Doctoral Research Fellow



Dr. Prashanth Vangla has joined the Geosystems Engineering Group at Georgia Tech as a post-doctoral research fellow. He will be devoting a portion of his efforts to CBBG activities, including participation in the IDEA working group activities and helping coordinate selected outreach activities at Georgia Tech in the coming year, including the RET, REV, REU and YS programs.

In addition, he will be collaborating with a number of GT CBBG researchers in experimental studies related to ants and roots. Prashanth joins Georgia Tech from the Indian Institute of Science Bangalore where he completed his PhD in January, 2017 on shear behavior of interfaces. Prashanth joined Georgia Tech on October 6. and got a rapid introduction to CBBG by attending the Year 2 Annual Meeting at ASU.

## CBBG 2nd Annual Meeting Award Winners

The most rewarding part of the Annual Meeting is the distribution of awards to Center participants for their accomplishments. At this meeting, awards were made for Outstanding Volunteer, Poster Winners, Perfect Pitch Competitors, and SWOT Input.



The Outstanding Volunteer – one student from each partner university was recognized for her/his commitment to outreach activities. Each winner received a certificate and a \$100 cash award.

ASU: Kimberly Martin  
 NMSU: Diego Garcia-Vera  
 GT: Mahdi Roozbahani  
 UCD: Sophia Palumbo

The Perfect Pitch Competitors – were recognized at the meeting for their participation as a competitor in CBBG's first Perfect Pitch Competition. Certificates and cash prizes were awarded as follows.

1st Place: Kimberly Martin of ASU (\$300, plus an opportunity to represent CBBG at the ERC Biennial Meeting in Alexandria, Virginia, on November 1, 2017).

2nd Place: Peter Zerkowski of NMSU (\$200)

3rd Place: Jordan Greer of UCD (\$100)

Honorable Mention: Devajani Borah of ASU (\$50), Wilson Espinoza of GT (\$50), and Seth Mallett of GT (\$50).



The Annual Meeting Poster Winners – 1st, 2nd, and 3rd place winners were awarded cash prizes and certificates. There were two sets of poster winners – for Research posters and for Education Posters.



Education Posters:

1st place, poster #47: Jenna Kelmser, REU from Humboldt State University; Annie Kirkwood of UCD; and Vivien Le of UCD (\$100 each)

2nd place, poster #52: Steven Clemens, RET from Dysart Unified School District and Miriam Woolley of ASU (\$75 each)

3rd place, poster #45: Ziqi Chen, REU from Lafayette College; Zhihui Chen, REU from Lafayette College; Jordan Greer of UCD; and Charles M.R. Graddy of UCD (\$50 each)

Research Posters:

1st place, poster #1: Charles M.R. Grady of UCD (\$100)

2nd place, poster #24: Diego I. Garcia-Vera, Eduardo Davila, and Peter Zerkowski of NMSU (\$75 each)

3rd place, poster #25: Jose Pasillas, Jason Alcantar and Seyed Aleali of NMSU (\$50)

The Student Leadership Council (SLC) SWOT Awards were given for the top three most informative and insightful responses to the SWOT Survey that was disseminated by the SLC to all active CBBG students. The SLC selected the winners by reviewing all survey responses and selecting the best entries.

The SWOT Award winners will receive \$100 cash award:

Jordan Greer of UCD

Miriam Woolley of ASU

Sophia Palumbo of UCD



# Diversity & Inclusion

a scholar, teacher, and administrator, she has been interested in how the language, conventions, and structures of academic disciplines shape the development and dissemination of knowledge in those fields. She is a frequent contributor to workshops on diversity and inclusion at the Teaching Academy at NMSU.

## Saenz Presents at National Academy of Sciences

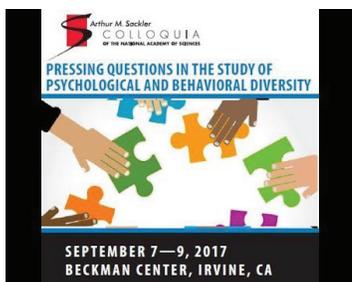


Professor Delia Saenz, CBBG Director of Diversity & Inclusion, presented her work at the National Academy of Sciences, Arthur M. Sackler Colloquium on September 7-9, 2017.

The meeting of scholars from different disciplines focused on 'Pressing Questions in the Study of Psychological and Behavioral Diversity'. Research presentations and discussions revolved around what it means to have an inclusive science. Does it make a difference, for example, if scholars are not themselves diverse or have little experience with diverse contexts/populations? Does the lack of diversity among members of research teams affect the questions that are posed, the populations that are included in research, and the interpretation of results? Do we want to have a body of knowledge that truly captures the full range of human behavior? How can we improve our responsibility as scientists who are charged with uncovering truth?

In her presentation, Professor Saenz encouraged scientists to engage in inclusive knowledge-building. The NAS Sackler Colloquium was held at the Beckman Center in Irvine, CA.

You may watch her presentation at: [https://www.youtube.com/watch?v=AA Ru0Z\\_3ZWM&feature=youtu.be](https://www.youtube.com/watch?v=AA Ru0Z_3ZWM&feature=youtu.be)



DELIA SAENZ  
[www.youtube.com](http://www.youtube.com)

This video is from the National Academy of Sciences Arthur M. Sackler Colloquium Pressing Questions in the Study of Psychological and Behavioral Diversity held Sept 7-9, 2017 at the Beckman Center in Irvine, CA.

## Torres Presented Workshop on Diversity and Inclusion to CBBG Participants



On October 13, 2017, Dr. Mónica Torres presented a workshop in webinar format to CBBG participants entitled "Equity, Inclusion and Higher Education: Implications for Science and Engineering." The workshop was organized around two themes. The first theme was the demonstrated benefit to science of diversity and inclusion of scientists from a

broad range of backgrounds, experiences, and perspectives. The second theme was how to create climates and cultures that support diversity and inclusion. She provided sources in the form a reading list of short articles from Scientific American, a story from National Public Radio referencing a study in Nature, and information about the Howard Hughes Medical Institute Inclusive Excellence Initiative. There was a good discussion with the students of factors that helped them feel included.

Dr. Mónica Torres is the Vice President for Academic Affairs at Doña Ana Community College (DACC), a two-year institution that one of the campuses of New Mexico State University. Prior to her appointment, she was Associate Professor and Department Head in English at NMSU. As

(Director's column continued)



CBBG is exploring three potential field sites (with three different industry partners) as test beds for fugitive dust mitigation via EICP. With receipt of the certificate of occupancy for the CBBG Field Station on the ASU Polytechnic campus, planning is underway for field scale testing of our EICP columns for ground improvement in the Biogeotechnical Test Pit and EICP erosion control technologies using the Rainfall Simulator. Planning for the centrifuge and test pit test beds was done in collaboration with one of our industrial partners who contributed services in-kind for the planning exercise. I note that we also have obtained direct financial support for one of our new Year 3 projects on removing phosphorus and nitrogen from ground and surface waters. These efforts mark not only the initial forays by CBBG into Systems Integration test beds, but also important milestones in engagement with our industrial partners and leveraging of NSF funding.

As part of our efforts to increase industrial engagement, we recruited five new members for our Industrial Partnership program, with two more memberships pending. We are particularly pleased that these new members include a small entrepreneurial biogeotechnology start-up firm, an industrial services firm, a large public utility, and a government agency. These additions increase the span of our Industry Partnerships across the value chain of stakeholders in CBBG. Year 2 also saw impressive advances in our innovation, diversity, education activities (IDEA) program. I do not want to sell these advances short, but I am out of space so I will save them for my next column.

On a final note, I want to thank everyone who contributed to CBBG's growth and successes in the past year. I look forward to making additional strides forward towards our goals in Year 3 in collaboration with you. In accordance with the engineer's mantra of continuous improvement (and with apologies to John Lennon and Paul McCartney), we truly are getting better all the time.



# Education & Outreach

## Fulton Family Carnival

On October 13, 2017, CBBG faculty, staff, evaluators, and students participated in the Fulton Family Carnival to welcome new engineering students to ASU. Drs. Larson and Savenye spoke with families about the Center and opportunities to work in CBBG labs. Dr. van Paassen and graduate student, Devajani Borah gave demonstrations about calcium carbonate precipitation. Visitors were intrigued with a liquefaction demonstration given by graduate student, Wu Gao, and a dust mitigation experiment with graduate student, Miriam Woolley. Limon Bogere, Vertically Integrated Project (VIP) undergraduate, discussed his research on the use of silica solution extracted from rice husk ash to mitigate volume change of expansive soils. Graduate students Yanxin Yang, Neda Javadi, Daehyun Kim, and Veteran Research Supplement (VRS) undergraduatr Devon von Lichtenstein mingled with students and their families to discuss their research and talk about the CBBG. Our external evaluator from CREST, Dr. Wendy Barnard, captured a count of total participants at the event and those actively involved with the CBBG hands-on activities. She also brought two tablets for gathering contacts interested in the Center, which will be added to the new CBBG Salesforce database. Freshman Oniya Silas, one of the new VIP researchers (previously a Young Scholar) brought her mother to the booth to learn more about our research.



Fulton Family Carnival



Fulton Family Carnival

## NMSU Family Festival

The NMSU Family Festival had parents and students (their children) working together on a STEM problem. Throughout these family festivals, NMSU faculty and students discuss the CBBG research and have activities to reflect on this research. Activities range from having the students building a home for their worm, while others are studying circuitry. There are discussions about the CBBG research before and then the families chose their activity.



Young Scholars at NMSU Family Festival

In October, Jennifer Chandler led a panel of four researchers at the International Leadership Association's (ILA) 19<sup>th</sup> Annual Conference in Brussels, Belgium in addressing *Leadership in STEM: Challenges and Trajectories*.



Dr. Chandler also served as a judge for the student leadership case study teams and presented a poster on her leadership research with the CBBG IDEA Working Group.

The panelists presented their research revealing similar leadership challenges in each STEM area. While those in STEM tackling multidisciplinary complex global problems must also possess leadership knowledge and practice leadership skills, leadership knowledge and skills are frequently absent from STEM education programs.



## Summer RET Implementation

This fall, the CBBG Education team had the opportunity to observe the 2017 summer RET participants implement their CBBG research inspired lessons in their classrooms. The team witnessed 4th grade through community college age students critically thinking about and engaging with real world biogeotechnical problems.



September 5, 2017 CBBG RET participant **Susan Rumann**, Student Achievement Coach for Estrella Vista STEM Academy in Avondale, AZ, implemented the lesson "What is Engineering" during

four sections of a science course for a total of 116 eighth grade students. Susan had students research types of engineering and introduced Kimberly Martin, CBBG graduate student, who discussed what it is to be a geotechnical engineer. Susan broke students into small groups to view school models and hypothesize whether or not the building models would be able to withstand liquefaction. Then Kimberly helped them test a few of the models with a shake table. Students' faces registered surprise that every model toppled as a result of liquefaction.

September 5, 2017 CBBG RET participant **Michelle Gerrick**, Sixth Grade Teacher for Estrella Vista STEM Academy in Avondale, AZ, implemented a unit entitled "What Type of Soil is Needed" during two



sections of a science course for a total of 51 sixth grade students. When her students were asked to transition from math to science, they cheered. Michelle modeled for students the different sieve sizes and the process for sieving soil. She broke students into smaller groups, and then asked them to predict which sieve size would have the most soil in it. Students were heard proclaiming that finding just the right spot on the triple beam balance was "like magic," and jumping up and down to shout "Ms. G we got it!" When groups finished weighing their soil, they were able to conduct their sieve analysis. Later, Michelle had students use a design thinking process to determine what soil types should be used based on unique problem situations.



September 12, 2017 CBBG RET participant **Stephen Batchelder**, Eighth Grade Science Teacher for Estrella Vista STEM Academy in Avondale, AZ, implemented

his "Shake It Up" instructional lesson with approximately 109 eighth grade students over four sections of science. Stephen's students conducted online research to determine what strategies engineers have employed to deal with liquefaction. They developed the scientific question: How does the material applied to a soil affect the amount of time it withstands liquefaction? Students developed a hypothesis based on a chosen material (powdered milk, salt, gelatin, or diaper polymer), and whether or not it would strengthen or weaken the soil. Then small groups of students tested the various materials. Students found that all of the treatment materials were effective in withstanding liquefaction except for salt.

September 12, 2017 CBBG RET participant **Anthony Haduch**, Fourth Grade Teacher for Estrella Vista STEM Academy in Avondale, AZ, began the



implementation for his instructional unit on the "Implications of Concrete Dams." In order to provide context for the larger unit on concrete dams, Anthony began with developing his students' understanding of engineering. He had students conduct research on the well-known innovators Margaret Mead, Nikola Tesla, and Benjamin Franklin. As part of this unit, students explored the impact of water on materials, the properties of concrete, and eventually used a design thinking process to understand and evaluate dam construction and failure. In small groups, students determined the best location for building their dam, sketched prototype dams, and used concrete to build their own model.



September 19, 2017 CBBG RET participant **Natalie Aragon**, Seventh Grade Teacher for Canyon Ridge School in Surprise, AZ, implemented her "Soil and Water that is Bio-Mediated Due

to Oil Contamination" lesson with approximately 112 seventh grade students. Natalie broke students into groups to develop a research plan based on their knowledge of plant growth, soil and water contaminants, and microbes.

Students used an engineering design process to collaboratively develop a research plan for their experiment. Students utilized recycled water bottles and different types of plants as part of their testing procedure. They put the plant with soil in the top half of the water bottle. They then added oil-contaminated water and microbes to the plant. The bottom half of the water bottle captured the contaminated water to allow the plant to continue to draw from it. Over the next few days they observed and recorded their data to better understand the effects of microbes on the contaminated water.



September 21, 2017 CBBG RET participant, **Quinn Thacker**, Phoenix College instructor of chemistry in Phoenix, AZ, implemented his "How Can Nature Clean Up Contamination" instructional lesson during two chemistry sections, for a total of approximately 30 undergraduate students. Quinn discussed with his students the concept of bio-mediation and bio-inspiration. He then had students work in small groups to play a matching game that included photos connecting to the concepts they discussed. He then discussed with students the CBBG research project that he participated in over the summer in which his group tested to what extent they could elongate the chemical chain, and determine if it would produce hydrogen gas. He then had students practice with a calculation using data from the summer research study, and they developed a graph also based on that data. He concluded by challenging students to pick one thing in which to participate to help the environment. Later he will have them write up a short report on what they accomplished.



September 25, 2017 CBBG RET participant, **Micah Sandys**, science teacher at Chaparral High School in Scottsdale, AZ, implemented an instructional

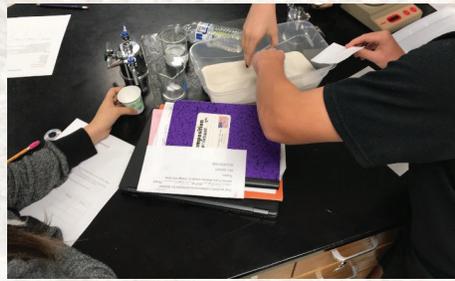
unit called "Nature Solves the World's Toughest Problems" with 116 juniors and seniors during four sections of an environmental biology course. In groups, he asked students to play a game in which students matched natural elements to innovative products. Afterwards they discussed some of the innovations at more length, such as the curved hooks on a plant burr inspiring Velcro. Afterwards, he shared with students that they are going to be working for a hypothetical company

to use nature to inspire the development of innovative products. He has students first practice the process by asking small groups to brainstorm what type of product they could develop from the Howler Monkey. Later, students selected their own aspect of nature as an inspiration for a product, which they developed in teams and pitched as part of an entrepreneurial Shark Tank experience.



September 27, 2017 CBBG RET participant, **Renée Elder**, instructor at Phoenix College, implemented her "Let's Get Dirty with Soils" instructional lesson on soil classification with

18 undergraduate geology students. Renée defined geotechnics and discussed the need to understand the type of soil when building structures. She reviewed terms such as soil type, permeability, plasticity, and porosity. She broke the class into small groups to participate in a soil classification activity. Each group was provided with a type of soil and asked to use their senses to hypothesize its classification. Students then conducted a sieve analysis. Several groups were quite surprised by the grain size distribution and actively questioned their results. Students were then assigned an extension assignment to use their data to determine how to classify their sample soil.



October 11, 2017 CBBG RET participant, **Steven Clemens**, science teacher at Dysart Elementary School in El Mirage, AZ, implemented an instructional unit on "Stabilizing Soil and Preventing Fugitive Dust" with approximately 100 eighth grade students. He connected a short news clip of a 16-car pile-up that resulted from desert and construction dust to his CBBG summer lab experience. They discussed how water is currently the best-known solution for dealing with fugitive dust. He provided students with a document describing the EICP soil improvement technique. Then Steven modeled for the class how to pack the soil in the cup so it was evenly distributed. They tapped the side of the cup, while turning it, doing this 15-20 times, and then finally scraping off the excess sand with an index card. Once this was accomplished and approved, students spritzed the soil with 15 ml of distilled water and covered it with tin foil. Students then created their own soil mitigation solutions using alternatives to EICP and tested them.

## Publications

Saman Mostafazadeh-Fard, Zohrab Samani, and Paola Bandini (2017). Production of Liquid Organic Fertilizer Through Anaerobic Digestion of Grass Clippings, Waste and Biomass Valorization, 1-11, doi: 10.1007/s12649-017-0095-7.

Delgado AG, Fajardo-Williams D, Bondank E, Esquivel-Elizondo S, Krajmalnik-Brown R. 2017. Coupling bioflocculation of Dehalococcoides mccartyi to high-rate reductive dehalogenation of chlorinated ethenes. Environmental Science & Technology 51 (19): 11297–11307. Bio-Inspired Soil Improvement using EICP Soil Columns and Soil Nails. Edward Kavazanjian, Jr., Abdullah Almajed, and Nasser Hamdan. Grouting Conference 2017 EICP. Hawaii.

CBBG graduate students Mahdi Rozbahani and Rodrigo Borela, along with Co-PI David Frost just had a paper titled "Pore Size Distribution in Granular Material Microstructure" published in the journal Materials. The paper is based in part on DEM simulations performed by the authors as part of their studies into self-excavating systems and the role of soil microstructure.



## ASU Homecoming 2017



# Industry & Innovation

## New Projects for Year 3 Selected

Based upon a detailed review of proposals by the CBBG leadership team, with input from Industry Advisory Board, and available funds, the CBBG Leadership team is pleased to announce that the following new projects were selected for funding in Year 3. Many are being funded or co-funded by industry.

- MICP Large Tank Test to Demonstrate Effectiveness of Industry-Grade Treatment Reagents, Improvement Uniformity, and Nitrogen By-Product Removal and Remediation; Senior Investigator Jason DeJong, UC Davis (Hazard Mitigation)
- Colloidal Facilitation of Microbial Induced Calcite Precipitation, Senior Investigator Susan Burns, Georgia Tech (Hazard Mitigation)
- Biogenic Gas Generation to Improve Compaction in Saturated Soil; Senior Investigator Leon van Paassen, ASU (Hazard Mitigation)
- Plant-Extracted Silicate: Applications in Sand and Expansive Soil; Senior Investigator Claudia Zapata, ASU (Hazard Mitigation)
- Development of a Reactive Geocomposite Mat Containing Steel Slag Fines and Organic Media to Remove Nitrogen and Phosphorus from Impacted Groundwater and Surface Water; Senior Investigator Treavor Boyer, ASU (Environmental Protection)
- EICP for Subgrade Improvement and Erosion Control in Sloping Ground; Senior Investigator Paola Bandini, NMSU (Infrastructure Materials and Methods)
- Snakeskin-inspired Anisotropic Surfaces: Prescription of Frictional Interactions at Soil-structure Interfaces; Senior Investigator Alejandro Martinez, UC Davis (Infrastructure Materials and Methods)
- Bio-inspired Geothermal Heat Exchange Systems; Collaborative research - Senior Investigators Douglas Cortes, NMSU and Sheng Dai, Georgia Tech (Infrastructure Materials and Methods)

Noteworthy aspects of these projects include:

- the addition of five new Senior Investigators to the CBBG (Martinez, Burns, van Paassen, Zapata, and Boyer);
- one project (Boyer) with co-funding from an Industrial Partner (Phoenix Services);
- a collaborative effort between Georgia Tech (Dai) and NMSU (Cortes);
- a collaborative effort between NMSU (Bandini) and ASU (Kavazanjian); and
- four projects funded with Industry Partner membership funds (DeJong, Zapata, van Paassen, and Boyer).

We look forward to the contributions from these new projects to the CBBG body of knowledge.

## CBBG Industry Partners



WSP | Parsons Brinckerhoff is now WSP USA

## School of Sustainable Engineering and the Built Environment

### Professor (all ranks) in Biogeotechnical Engineering

Location: Arizona State University – Tempe Campus

The Ira A. Fulton Schools of Engineering at Arizona State University (ASU) and the School of Sustainable Engineering and the Built Environment (SSEBE) seeks applicants for a tenured or tenure-track faculty position in the Civil, Environmental and Sustainable Engineering program in the emerging field of Biogeotechnical Engineering.

Candidates for the position in Biogeotechnical Engineering will have a Ph.D in geotechnical or geoenvironmental engineering, engineering geology, environmental microbiology, biogeochemistry or a related discipline. The successful candidate for this position will work within and is expected to contribute to the growth and success of the [Center for Bio-mediated and Bio-inspired Geotechnics \(CBBG\)](#), a National Science Foundation-sponsored Gen-3 Engineering Research Center ([www.biogeotechnics.org](http://www.biogeotechnics.org)). Duties of the successful candidate will include delivering in-class and on-line instruction at the undergraduate and graduate level, conducting research in biogeotechnical engineering through the CBBG, participation in CBBG professional development, outreach, K-14 education, and assessment activities, and working with the CBBG Student Leadership Council and other associated student organizations.

CBBG is an interdisciplinary center with research and teaching interests spanning a wide range of topics related to the Grand Challenge of infrastructure systems sustainability. CBBG thrust areas include geologic hazard mitigation, environmental protection and ecological restoration, and infrastructure construction materials and methods.

Faculty members at ASU are expected to develop an internationally recognized and externally funded research program, teach undergraduate and graduate courses related to biogeotechnical engineering, adopt innovative educational practices in both graduate and undergraduate instruction, advise students and undertake service activities as appropriate to their rank.

Successful candidates will also support the mission of the Civil, Environmental, and Sustainable Engineering program and the Ira A. Fulton Schools of Engineering and are expected to participate in interdisciplinary research and teaching endeavors both within the Fulton Schools and across campus. SSEBE has 51 faculty members, approximately 1160 undergraduate and 420 graduate students, and generates annual research expenditures in excess of \$12.6 million per year.

Appointment will be at the **Assistant, Associate or Full Professor** rank commensurate with the candidate's experience and accomplishments. The projected start date is August 2018, but accommodations can be made for the best candidates.

**Although tenure home may be in any of the Ira A. Fulton Schools of Engineering, the School of Sustainable Engineering and the Built Environment is currently the most involved in the interest areas of the search.**

#### Required qualifications:

- Ph.D in geotechnical or geoenvironmental engineering, or a discipline related to biogeotechnics.
- Demonstrated evidence of research capability and commitment to teaching excellence as appropriate to the candidate's rank.
- Demonstrated ability to procure sponsored research appropriate to the candidate's rank.

#### Desired qualifications:

- As part of its New American University initiatives, ASU seeks candidates with research interests addressing critical infrastructure grand challenges across multiple spatial and temporal scales.
- It is anticipated that the successful candidate will broaden the scope of ASU's research in bio-mediated and bio-inspired design for geotechnical aspects of civil infrastructure under the auspices of the CBBG.

#### APPLICATION INSTRUCTIONS

Review of applications will begin December 15, 2017; if not filled, additional applications will be reviewed on the 1st and 15th of the month thereafter until the search is closed. Apply at <https://hiring.engineering.asu.edu>. Candidates will be asked to submit the following through their Interfolio Dossier.

- Cover letter
- Curriculum Vitae
- Statement describing research interests
- Statement describing teaching interests
- Statement describing professional goals
- Contact information for 3-5 references

For more information or questions about this position, please contact the search committee chair Edward Kavazanjian via email at [Edward.kavazanjian@asu.edu](mailto:Edward.kavazanjian@asu.edu).

Arizona State University is a VEVRAA Federal Contractor and an Equal Opportunity/Affirmative Action Employer. All qualified applicants will be considered without regard to race, color, sex, religion, national origin, disability, protected veteran status, or any other basis protected by law. See ASU's full non-discrimination statement (ACD 401) at <https://www.asu.edu/aad/manuals/acd/acd401.html> and the Title IX statement at <https://www.asu.edu/titleIX>.

# Partner Universities

**UC DAVIS**  
UNIVERSITY OF CALIFORNIA

**ASU** ARIZONA STATE  
UNIVERSITY

**NM**  
STATE  
UNIVERSITY

 **Georgia Institute  
of Technology**



# How does nature do it?

Nature has developed elegant, efficient and sustainable biologically-based solutions to many challenges that vex geotechnical infrastructure systems. Examples include ant excavation processes that are 1000 times more energy efficient than man-made tunneling machines, carbonate cemented sand that is exceptionally resistant to erosion and earthquakes, and self-sensing and self-healing tree root structures that are 10 times more efficient than any mechanical soil reinforcing/foundation system yet devised.

The NSF Engineering Center for Bio-mediated and Bio-inspired Geotechnics (CBBG) will focus on ecologically friendly, cost-effective solutions, inspired by nature, for development and rehabilitation of resilient and sustainable civil infrastructure systems. It will serve as a nexus for two transformative trends in engineering: biologically-based design and sustainability.



CBBG is a National Science Foundation (NSF) Engineering Research Center funded in 2015 under cooperative agreement EEC-1449501, and headquartered at Arizona State University.



[biogeotechnics.org](http://biogeotechnics.org)

**ASU** Ira A. Fulton Schools of  
**Engineering**  
Arizona State University