



# Center for Bio-mediated & Bio-inspired Geotechnics

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

Happy New Year! Since our last newsletter (July 2016), the CBBG ERC has completed its first year of operations, so this newsletter inaugurates a new year (Year 2) of CBBG operations. Our first Annual Meeting (NSF Site Visit to the CBBG ERC) took place on October 25-27, 2016, at ASU and was, from my perspective, a resounding success. We had a total of 150 attendees at part or all of the meeting, and filled the Carson Ballroom in ASU's Old Main building to capacity.



Courtesy of W. Savenye

Attendees included 49 students from the four CBBG partner Universities, and 26 participants and guests from our summer Research Experience for Undergraduates (REU), Research Experience for Teachers (RET), and Young Scholar (YS) programs. The poster session in which 51 posters, prepared by our CBBG students and summer program participants were

displayed, was clearly a highlight of the meeting. Attendees from both Industry and Academia commented on the quality of the posters and the enthusiasm of the students and pre-college teachers presenting the posters. Once our enhanced website is fully rolled out, these posters will be available for viewing by CBBG members on-line in a virtual poster session. Our Administrative Director, Regina Sanborn, and Project Coordinator, Michelle Walker, deserve special mention for handling the unexpectedly large number of attendees in what appeared to be a seamless manner to those in attendance (except, probably, to Regina and Michelle).

The most substantial part of the meeting was a series of presentations on our first year accomplishments and plans for Year 2 to the Site Visit Team assembled by our sponsor, the National Science Foundation, on the second day (October 26). At the end of the day, the Site Visit Team posed a series of questions to the CBBG Leadership Team to which the Leadership Team responded the next morning. The Site Visit Team then went into Executive Session to write their report, while CBBG faculty and staff continued on with the Annual Meeting program.

Activities associated with the Annual Meeting on Day 1 (October 25) included a meeting of our Industrial Advisory Board (IAB), a student-IAB mixer (reception and dinner), and working dinners for the Council of Deans, the Innovation, Diversity, and Education Activities (IDEA) Working Group, and co-Principal Investigators with the Scientific Advisory Board (SAB). On Day 3 (October 27), the CBBG ERC held a workshop in the morning for CBBG faculty and students on Bio-Inspired Design that was chaired by Professor David Frost of Georgia Tech and included presentations by David and by Professor Wendy Newstetter of Georgia Tech, and a lunchtime presentation by Professor Ted Pavlic of the ASU Biomimicry Center. After lunch, the various CBBG Working Groups (inter-University groups of faculty and students working on related technologies) met to exchange information and talk about potential collaborations.

We are eagerly anticipating the NSF Site Visit Team report. Based upon the questions they asked of the Leadership Team and our "reading of the tea leaves," we anticipate a positive review that recognizes how much we accomplished in Year 1, but notes that there is still much work to do in Year 2 to fulfill the full potential of the Center. We certainly recognize we still have much to accomplish (as it was impossible to achieve all of our goals in one year) and have already begun working on some of our Year 2 initiatives – more on them (and on the Site Visit team report) in the next newsletter.



Courtesy of W. Savenye

## Important Dates

**February 25, 2017**

ASU Night of the Open Door

**April 5-7, 2017**

CBBG Mid-Year Meeting  
University of California, Davis

**June 2017 - July 2017**

Summer Programs at CBBG Partner Universities  
REU/RET/Young Scholars

**August 7, 2017**

ERC 360 Closes for Grant Year 2

**September 2017**

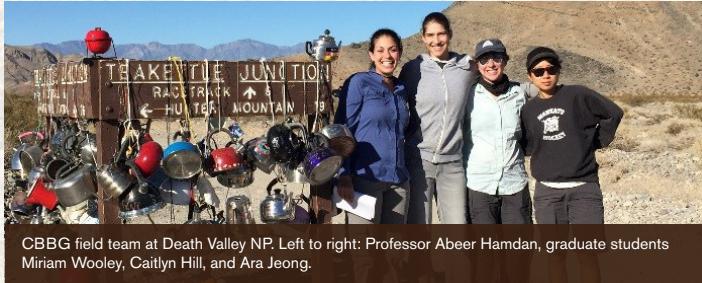
CBBG Year 2 Annual Report Due to NSF

**October 2017**

Year 2 NSF Site Visit to CBBG

# Research Highlights

## CBBG Helping to Restore One of America's Natural Wonders



CBBG field team at Death Valley NP. Left to right: Professor Abeer Hamdan, graduate students Miriam Wooley, Caitlyn Hill, and Ara Jeong.

Recently, a motorist illegally drove onto Racetrack Playa in Death Valley National Park, defacing the famous dry lake bed by leaving 10 miles of tire tracks across its surface. Park officials have said that this is the worst case of vandalism they have ever seen. Upon learning of the damage, CBBG graduate students Miriam Woolley and Caitlyn Hall assisted by ASU graduate student Ara Jeong and Phoenix College Professor Dr. Abeer Hamdan, a CBBG Education Partner, traveled to Death Valley National Park to view the damage.

The CBBG team is currently collecting background information on the geochemistry of the sediments and crust on the Racetrack Playa and assessing whether CBBG technologies can play a role in mitigating the impact of the damage to the crust. For more information on the incident at the Racetrack Playa, see the article at <https://www.apnews.com/fa5d78019042470bb1ca05b2cd1b8909/Motorist-defaces-area-of-Death-Valley-park-with-tire-tracks>.

## New Post-Doctoral Researcher at CBBG ASU



Hamed Khodadadi Tirkolaei, who graduated in February 2016 with his Ph.D. from Eastern Mediterranean University in Cyprus, started working in July 2016 as a Post-Doctoral Researcher at the Center for Bio-mediated and Bio-inspired Geotechnics (CBBG) Engineering Research Center at Arizona State University (ASU). Hamed had worked at CBBG for six months as an exchange scholar

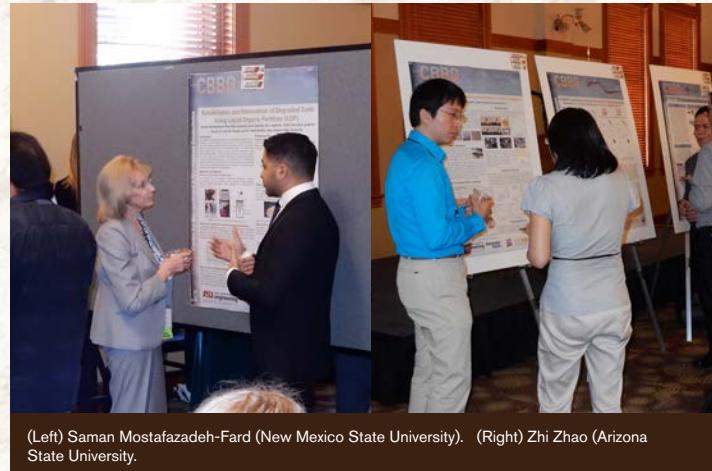
while earning his Ph.D. His research focuses on Enzyme Induced Carbonate Precipitation (EICP).

## Former REU Participant Joins CBBG UCD as Undergraduate

Gabby Hernandez joined the CBBG group at UCD in Fall 2016 after working this past summer as an REU participant. Her research will involve MICP cemented sands and its response to dynamic loading.

## CBBG Research Poster Winners

In the Research poster competition at the recent CBBG Annual Meeting, we are pleased to announce that First Place resulted in a tie, and prizes were awarded to Zhi Zhao of ASU and Saman Mostafazadeh-Fard of NMSU. Second Place was awarded to Caitlyn Hall of ASU, and Third Place was presented to Matthew Burrall of UC, Davis. The recipients received certificates and cash awards. Congratulations on this achievement!



(Left) Saman Mostafazadeh-Fard (New Mexico State University). (Right) Zhi Zhao (Arizona State University).



(Left) Caitlyn Hall (Arizona State University). (Right) Matthew Burrall (University of California, Davis).

## Technology Transfer

Sofia Esquivel Elizondo, CBBG graduate student, wrote a blog entry entitled, "Switching Gears in Research: From Dechlorination to Terrestrial (and Extraterrestrial) Carbon Monoxide Oxidation. <http://www.environmentalbiotechnology.org/blog/switching-gears-in-research-from-dechlorination-to-terrestrial-and-extraterrestrial-carbon-monoxide-oxidation>

Pu Yang, Sean O'Donnell, Nasser Hamdan, Edward Kavazanjian and Narayanan Neithalath (2016). "3D DEM Simulations of Drained Triaxial Compression of Sand Strengthened using Microbially Induced Carbonate Precipitation." International Journal of Geomechanics

Zhi Zhao, Nasser Hamdan, Li Shen, Hanqing Nan, Abdullah Almajed, Edward Kavazanjian and Ximin He (2016). "Biomimetic hydrogel composites for soil stabilization and contaminant mitigation." Environmental Science & Technology

# Out & About

Two CBBG REU students, Gabriella Irra (ASU) and Briana Astorga (GT), entered posters about their Summer Research Projects in the Virtual Poster Showcase of the American Geophysical Union. Their entries included a video presentation about their research.



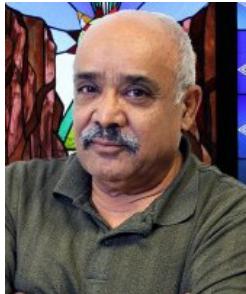
Jean Larson, Willi Savenye & Kristin Elwood presenting about CBBG Education at the AECT conference

Members of the Innovation, Diversity, and Education Activities (IDEA) working group presented several papers at the annual meeting of the Association for Educational Technology & Communications (AECT) held October 17-21, 2016, in Las Vegas, Nevada:

Savenye, W., Larson, J., Zapata, C., Kavazanjian, E., Elwood, K., Reed, A., Mitchell, M., Brown, S., Bronner, C., Saenz, D., Newstetter, W., Benton-Johnson, F., Dalal, M., Gomez, M., & Delgado, N. The Ultimate Higher Education Start-Up: Building Education, Outreach and Diversity for an NSF Engineering Research Center.

Elwood, K., Savenye, W., Jordan, M., Larson, J., & Zapata, C. Design Thinking: A New Construct for Educators. Educational Technology & Communications (AECT), Las Vegas, NV, October 17-21, 2016.

Savenye, W., & Ozogul, G. How Do I Form a Research Question? What is a Research Agenda?



Professor Zohrab Samani of New Mexico State University was invited to present his CBBG research at the HD3 Discovery Day hosted by the High Desert Discovery District (<http://www.hddd.org/>) November 9-10, 2016 in Las Cruces, New Mexico. HD3 is an independent, non-profit organization committed to identifying and commercializing technology projects in New Mexico. Professor Samani was among a selected group of innovators who

presented their project or opportunity to a 30+ globally connected experienced business achievers, investors, entrepreneurs, and product developers at the Discovery Day event. Samani's CBBG project studies the rehabilitation and restoration of degraded soils using a liquid organic fertilizer. The project's co-PI, Dr. Paola Bandini, and graduate student, Saman Mostafazadeh-Fard, also participated in the networking sessions with the potential investors.

## SLC President Gomez Shares Student Experiences

On October 28, 2016, Mike Gomez, SLC President, participated as a panelist in a graduate student panel and shared his experiences as a TA, including how to balance teaching and research responsibilities. He gave advice to ten high-achieving first-year graduate students participating in the NSF-funded Preparing Engineering Graduate Students for the 21st Century (PEGS 21). The program targets first-generation, low-income students.

## CBBG Students Present at 2016 NMSPE Issues Conference



Victor Lara (left) and Saman Mostafazadeh-Fard (right) presented their CBBG research at the 2016 NMSPE Issues Conference

Two NMSU students were invited to present their CBBG research at the 2016 NMSPE Issues Conference held in Albuquerque, New Mexico on November 4, 2016. The presentation was part of the Environment and Sustainability track, and focused on the transformation and valorization process of organic waste into a liquid fertilizer and its various applications, such as restoring the top soil and establishing vegetation cover in degraded soils. The presenters were graduate student, Saman Mostafazadeh-Fard, and undergraduate student, Victor Lara, of NMSU. The NMSPE is the state-level group in New Mexico of the National Society of Professional Engineers (NSPE).



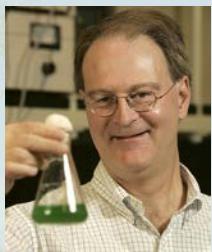
Georgia Tech PhD researcher and SLC Vice President, Seth Mallett, spent 3 months in Japan during Summer 2016 conducting X-ray CT studies of the pull-out of tree root analogues at the Port and Airport Research Institute in Yokosuka, Japan. Seth's study abroad was funded by NSF through the East Asia & Pacific Summer Institute program (EAPSI) which covered travel, accommodations, and a stipend for the study period. Comparable facilities to those

he used during the study are not available in the U.S. and thus apart from the direct research benefits, afforded the opportunity to initiate longer term collaborations between PARI and CBBG researchers.



CBBG Co-PI and Cross-Cutting Thrust leader David Frost has given a number of lectures internationally where he has promoted CBBG and the ongoing research activities of the Center. Specifically, he gave the opening Plenary Lecture at the Inaugural Transportation Research Conference in Beijing on June 6, 2016 entitled "The Evolving Role of Materials in Infrastructure Engineering." The conference was attended by almost 1,500 transportation professionals who heard about material innovations inspired by nature. Frost gave a similarly titled invited keynote lecture to 200 civil engineering researchers at the Civil Engineering Research Association of Ireland annual conference in Galway on August 29, 2016. Frost gave a lecture at the State Key Laboratory for Geo-Hazard Prevention and Geo-environmental Protection at Chengdu University of Technology on August 5, 2016 entitled "Infrastructure Engineering Innovations and Inspirations" as part of a half day workshop on hazard mitigation that was attended by 60+ science and engineering researchers. Frost also gave a similarly titled lecture at the Port and Airport Research Institute in Yokosuka, Japan on August 10, 2016 to earthquake and tsunami researchers where he discussed bio-inspired solutions for coastal resilience.

# Awards & Recognition



Dr. Bruce Rittmann received the Perry L. McCarty/AEESP Founders Award from the Association of Environmental Engineering and Science Professors in September. This award is given annually to an environmental engineering or science professor to recognize that individual's significant contributions to environmental engineering education, research, and practice. The recipient of this award receives a plaque, a cash prize, and a travel allotment to attend the awards ceremony.

Rittmann also gave the 2016 Scientists' Luncheon Lecture at the WEFTEC (annual conference of the Water Environment Federation) in New Orleans on September 26, 2016. The title of his talk was "From Treatment to Resource."

Dr. Rittmann directs the Swette Center for Environmental Biology, whose goal is to achieve technological advances that would add methods of treatment and resource recovery for coping with increasingly daunting challenges of supplying a growing world with clean, safe water, as well as more energy. He has more than 600 peer-reviewed papers, among the most highly cited by engineering and science peers in the world. Rittmann has mentored and advised hundreds of students to guide them in their pursuit of engineering degrees, including more than 40 who have received their doctoral degrees and have gone on to become leaders in research, education, and industry.



Dr. Edward Kavazanjian, Jr., CBBG Center Director, was featured in an **Engineering News-Record** article, "Tomorrow's Building Materials," demonstrating how he and his team are accelerating natural processes to solidify soils and find new solutions for geotechnical engineering. Kavazanjian reported that CBBG is casting a wide net, looking at everything from how geotechnical systems could mimic tree roots to considering how foundation pile-driving might learn from burrowing holes. The Center's work demonstrates how construction evolves as researchers advance the underlying science.



Jose N. Pasillas, NMSU graduate student, received the 2016-2017 ADSC's Industry Advancement Fund fellowship (\$3,000) and the Dwight David Eisenhower Transportation Fellowship (\$7,500). As part of these fellowship awards, Jose will be attending the ADSC 2017 Annual Meeting in Palm Springs, CA and the 2017 TRB Annual Meeting in Washington, DC. Pasillas also was awarded a graduate scholarship from the Academy of Civil Engineering (ACAGE) at New Mexico State University (NMSU) for his leadership in professional student organizations. Jose is a Masters' student and Chi Epsilon President at NMSU, as well as the Outreach representative of the CBBG Student Leadership Council (SLC).



Congratulations to Ali Nasirian, NMSU doctoral student, for successfully defending his doctoral dissertation focused on the fundamentals and applications of thermal conduction in dry soils and porous rocks. Dr. Nasirian is a research assistant on the CBBG team that works to develop a bio-inspired motile probe for ground investigation, which is led by his advisor, Dr. Douglas Cortes at NMSU. He is a graduate mentor to two undergraduate students and a graduate peer in CBBG. Nasirian also has served as an elected Senator for the College of Engineering and Chair of the Finance Committee of the Associated Students of New Mexico State University (ASNMSU). Ali's professional goal is to become a faculty member, and is making plans for a post-doctoral researcher's position in 2017.



Karie Yamamoto, Georgia Tech undergraduate researcher and SLC undergraduate representative, has been selected as a recipient of a President's Undergraduate Research Award (PURA) to partially support her activities in CBBG. Karie is conducting studies in the Sustainable Geosystems Engineering Laboratory as part of the Frost Group on ant-tunneling using the automated time-lapse system she implemented earlier this year.

## 2016 Academic Ranking of World Universities:

Georgia Institute of Technology, the University of California, Davis, and Arizona State University have been recognized as premier engineering schools in the 2016 Academic Ranking of World Universities from the Shanghai Ranking Consultancy. In the Civil Engineering discipline, GT placed #7, UCD #39, and ASU #77. In the Environmental Engineering discipline, UCD placed #26, ASU #31, and GT #53.



# Education & Outreach

## Learning from the Smartest Engineer – Nature!

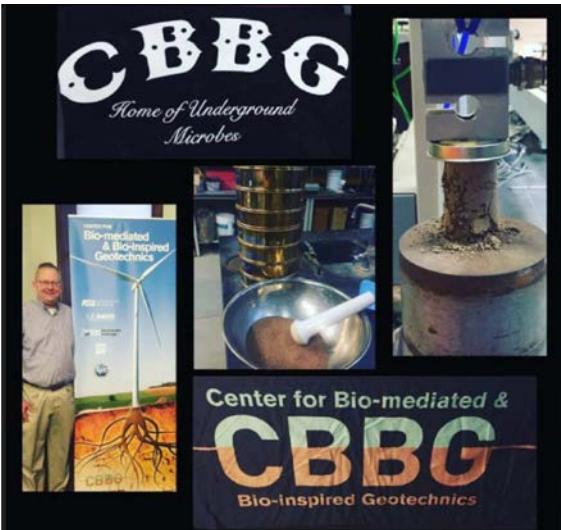


Kimberly Martin and Hani Alharbi help Kira and Rebekah Farnsworth test out their MSE Wall

On Saturday, October 22, 2016, CBBG faculty, students, and staff hosted a biogeotechnics booth at the campus-wide Homecoming Block Party for all ASU Sun Devils and the general public, which was attended by thousands of devoted fans. Participants enjoyed fun, hands-on

experiments, demonstrations, and discovery of how researchers in the CBBG Engineering Research Center are learning from nature to solve engineering problems.

## High School Newsletter Features CBBG RET



This past summer, Scott Currier was selected to be one of eight teachers in a Research Experience for Teachers (RET) program with the Center of Bio-mediated and Bioinspired Geotechnics (CBBG) at Arizona State University.

The Highland Lakes School in Deer Valley, Arizona recently featured Currier in its August, 2016 school newsletter to showcase his selection as a CBBG RET.

The RET program was five weeks long. The five weeks consisted of daily participation in a research lab, seminars from industry scientists and engineers, and collaboration amongst peers developing CBBG research-based curriculum to bring back to the classroom. Mr. Currier worked on the project of soil reinforcement with plant fibers.

Mr. Currier plans to implement lessons he develops into the 4th grade Science curriculum, share lessons and concepts with his peers, and create an after school STEM program with an emphasis in Geotechnics.

## Field Trip Day

On November 21, 2016, students from local middle schools will visit the CBBG labs at ASU as part of a new engineering outreach event, "A Day in the Life of...Field Trip Days." Fifty 4th-6th graders will have a chance to participate in hands-on activities, lab tours, and demonstrations with CBBG researchers.

## Upcoming Webinars



On Monday, November 21, 2016, CBBG welcomes **Phil Dowd**, Director of Intellectual Assets at AzTE, ASU's Technology Transfer Office. Mr. Dowd will present a Center-wide webinar on Protection of Intellectual Property.

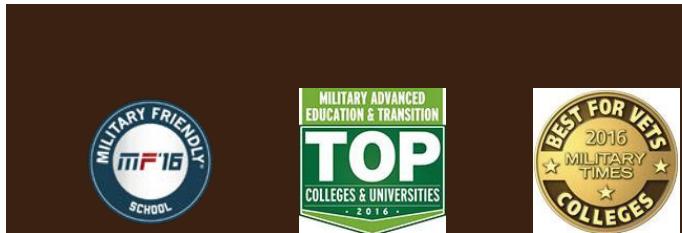
Times for seminar: University of California, Davis partners – 12 p.m.; New Mexico State University and ASU partners – 1 p.m.; Georgia Institute of Technology partners – 3 p.m.



On Wednesday, November 30, 2016, CBBG welcomes Diversity and Inclusion speaker, **Dr. Erika Camacho**, Associate Professor of Mathematics at Arizona State University. Dr. Camacho will present a Center-wide webinar on MENTORING. To find out more about Dr. Camacho's work, please go to <http://www.public.asu.edu/~etcamach/>.

Times for seminar: University of California, Davis partners – 11 a.m.; New Mexico State University and ASU partners – 12 p.m.; Georgia Institute of Technology partners – 2 p.m.

To participate in the webinars in person, please go to GWC 137 on the ASU Tempe Campus. To participate via Vidyo, go to web: <https://asu.idsflame.com/flex.html?roomdirect.html&key=DCRfJm0m20ewFS6U6U2BoJYEb2I> or dial in by phone at 480-884-1557 x10574622 ). These webinars will be recorded and posted on the CBBG website at a later date.



CBBG's Education Partner, the Pat Tillman Veteran's Center (PTVC), is dedicated to providing assistance to veterans, which makes it no surprise that Arizona State University has been named one of the nation's top universities for veterans. PTVC representatives will be delivering a CBBG-wide webinar on Getting to Know Veteran Students in Spring 2016 to share strategies for supporting veteran students for academic success.

## CBBG's Summer 2016 Research Program Participants, REUs, RETs and Young Scholars, Present at NSF Site Visit

Everyone at CBBG was very happy to welcome back our Summer 2016 Research program participants for the NSF Site Visit on October 26, 2016.



Ten of our thirteen summer Research Experience for Undergraduate (REU) participants from all over the U.S. returned to present research posters about their projects to the more than 150 meeting participants, including members of the NSF site visit team, and CBBG faculty, graduate students, staff, and industry and education partners. Their posters are displayed at <https://sites.google.com/a/asu.edu/cbbg-reu-2016/>.

Five of the eight summer Young Scholars, who were high-school students, displayed their posters to showcase their research experiences. Their posters can be seen at <https://sites.google.com/a/asu.edu/cbbg-ysp-2016/>.

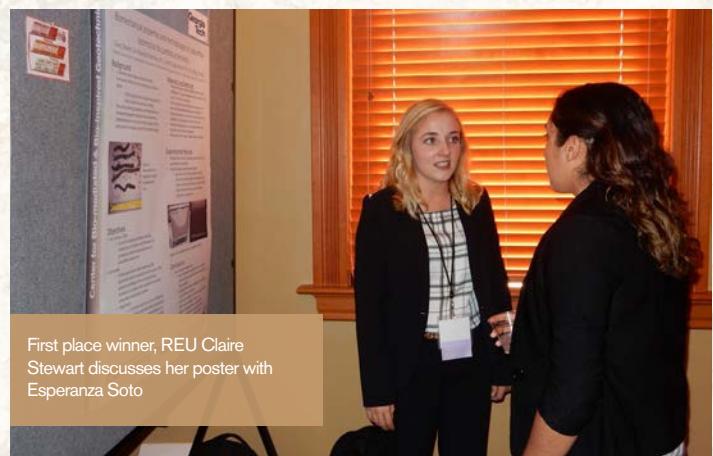


Eight of the eleven Research Experience for Teachers (RET) instructors also created posters about their research and how they have been implementing their CBBG-based lessons into their classrooms. Once the teachers have implemented, tested and updated their lessons, their lessons will be made available, too, via the CBBG web site.



## CBBG Education Research Poster Winners

In the Education poster competition at the CBBG Annual Meeting we are pleased to announce that First Place was awarded to Claire Stewart, REU, Second Place to Steven Clemens, RET, and Third Place to Farouq Hannoob, REU. Certificates and cash prizes were awarded. Congratulations on this achievement!



## Workshop on Problem Based Learning

Following the First Annual meeting, a half day workshop was organized by Wendy Newstetter and David Frost from Georgia Tech. The workshop was held at CBBG headquarters in the Goldwater Center for Science and Engineering at ASU, and was attended by 50+ individuals from across the partner Universities.



Dr. Wendy Newstetter, Georgia Tech Education Lead, along with Dr. David Frost, Georgia Tech Thrust Leader, presented a workshop on Problem-Based Learning on October 27.

The title of the workshop was "Re-Thinking Our Thinking: Problem Based Learning for CBBG." The agenda for the workshop included brainstorming sessions with participants working in groups, a lecture by Dr. Wendy Newstetter (Georgia Tech) titled, "Problem-Based Learning: An instructional approach for fostering integrative reasoning and problem solving in CBBG," a lecture by Dr. Ted Pavlic (ASU) entitled, "An Ecological Approach to Bio-Inspired Design and Engineering," and a lecture by Dr. Jason DeJong (UC Davis) on, "A CBBG Perspective on How We Are Evolving Our Thinking." The event generated great discussion amongst participants, and set the stage for a follow-on event at the Year 2 mid-year meeting to be held in Spring 2017.

## Hands-On Laboratory Experience for Middle School Students

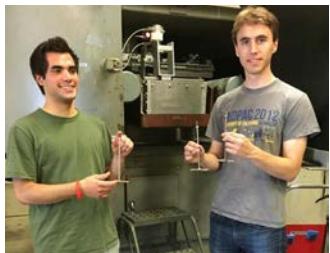


Middle Schoolers enjoy lab time

Summer 2016 RET participant Becky Reher, who is a 5th and 6th grade science teacher at Drew Elementary in Atlanta, brought 150 students to Georgia Tech for hands-on experiences in various research labs. As part of the activity, the students visited the Sustainable Geosystems Engineering Laboratory where Becky had worked during the Summer.

Apart from seeing the laboratory she worked in, the students got to interact with CBBG graduate and undergraduate researchers, and participate in activities related to ant-hill structures as well as "square wheels" rolling over "rough roads."

## Santiago Participates in UCD REU Program



From late May 2016 to June 2016, Mark Santiago, an undergraduate student from Syracuse University, participated in the CBBG REU Program at UCD. He worked closely with Matthew Burrall, UCD graduate student, on the design of 3D printed root-inspired foundation models, as well as the design of the apparatus

for subsequent pullout testing of those models on the Schaevitz centrifuge. The first two tests of the suite were completed before the end of the REU program.

## UCD Outreach Activities

From July 18-22, 2016, nine teachers participated in a professional development workshop at UCD on sustainable engineering. Initial activities introduced participants to the topics of engineering, civil engineering, geotechnical engineering, sustainability, and underrepresented groups in engineering (especially women). The majority of the technical content was provided by six graduate students (three from CBBG) through interactive presentations and seven educational modules. Teachers provided graduate students with feedback on the modules based on their classroom experience. The workshop provided an opportunity to discuss potential partnerships between local educations and CBBG faculty and students at UCD.

An all-day camp was held from July 25-29, 2016, for 24 female students from a local elementary school female students, who were entering grades 3 to 5. The camp's goal was to provide a safe space in which girls could explore geotechnical and environmental engineering topics. In addition to technical topics, the camp program included discussion of female role models in engineering (e.g., Emily Roebling), strategies for overcoming imposter syndrome, and the need to support each other (i.e., prevent bullying). The majority of technical content was provided by six graduate students (three from CBBG).

On October 21, 2016, the Yolo County Office of Education hosted a STEM Conference for Middle School Girls. Ten selected teachers were invited to bring eight students to participate in STEM activities throughout the day. UCD students ran two of the six activities offered.

## CBBG Year 1 Outreach Volunteer Winners

At the recent NSF Site Visit to the CBBG ERC, four students were awarded certificates and prize money for being the top outreach volunteer winners for Year 1. They are:



**Miriam Woolley**  
of Arizona State  
University (ASU)



**Alejandro Martinez**  
of Georgia Institute of  
Technology (GT)



**Jose Pasillas**  
of New Mexico State  
University (NMSU)



**Michael Gomez**  
of the University of  
California, Davis  
(UCD)

## NMSU Civil Engineering Department and CBBG ERC featured in Salon Discovery



Dr. Paola Bandini

The NMSU Department of Civil Engineering and the CBBG ERC were featured in the Salon Discovery gala held September 9, 2016. The evening theme was "NMSU Civil Engineering: EnRoute to Better Infrastructure." The event highlight was an engaging on-stage conversation with CBBG Thrust Leader, Dr. Paola Bandini, and her colleague, Dr. Phil

King, with KRWG-TV/FM's Fred Martino about how civil engineers continue to improve lives. The event also unveiled the new video featuring the NMSU Civil Engineering Department and its partnership with two NSF Engineering Research Centers, CBBG and ReNUWIt (Video available at: <https://ce.nmsu.edu/>). Following the interviews, guests and public were delighted with a concert by the NMSU's own Latin Grammy Award-winning La Catrina Quartet at a fine reception.

## High Schoolers Design Bio-Inspired Resilient Earthen Construction



New Mexico State University PREP students and mentors testing a small-scale adobe wall on the shake table (Photo by Brad Weldon)

This summer 44 high school students interested in engineering careers learned that approximately one-third of the world's population lives in some form of earthen dwelling. Traditional adobe, made of sun-dry mud bricks, is found throughout the Southwestern U.S. in many historic buildings and new construction.



New Mexico State University PREP high school students constructing the small-scale adobe wall model (Photo by Paola Bandini)

The high school students, mostly from southern New Mexico schools, participated in the CBBG 2-day activity on Bio-inspired Resilient Earthen Construction and learned the fundamental concepts of bio-inspired design, sustainability, and infrastructure resiliency. Dr. Brad Weldon, as CBBG researcher, developed and delivered this

outreach module as part of the 2016 NM PREP High School Academy, a 2-week Pre-Freshman Engineering (PREP) summer residential camp for diverse, high-achieving students organized and hosted yearly by NMSU.

The high schoolers used their creativity and STEM knowledge to design and construct small-scale adobe walls incorporating bio-inspired reinforcing elements using only natural materials and fibers. Their adobe walls were then tested simulating earthquake loading on a shake table to explore the mitigating effects of their designs against natural hazards. Each team presented and explained the inspiration behind their design as well as their results and recommendations to their peers, faculty and student mentors.

The participants included 49% ethnic minority and 25% female students from 14 school districts. Drs. Brad Weldon and Paola Bandini are working on adapting the module content and activities as a stand-alone outreach event to take to middle schools in the area and share it with CBBG partner universities for possible implementation in other school districts.

Recognition was given to the CBBG personnel who were selected to grace the covers of the CBBG First Annual Report to the NSF. They received a framed copy of their cover. They included:



Megan Altizer and Anca Delgado



Angel Gutierrez



Abdullah Almajed



Matthew Burrall



Edward Kavazanjian, Jr., CBBG Director, was invited to Texas A & M University to deliver the 24th Buchanan Lecture on October 14, 2016. His presentation was entitled, "Bio-Geo-Alchemy: Biogeotechnical Carbonate Precipitation for Hazard Mitigation and Ground Improvement."

# Diversity & Inclusion

A key component of CBBG is its commitment to diversity and the creation of a culture of inclusion. That commitment is reflected in our Diversity and Inclusion Strategic Plan. In that plan, we outline a vision for the Center: CBBG will create a culture of inclusion that permeates all Center activities, including all of our research, education, and industry partnership programs. Our education and outreach efforts will be targeted to increase participation of groups who are currently underrepresented in the disciplines represented by the Center.

## Women in CBBG

	Leadership team	Faculty	Graduate	Undergraduate
National Engineering	N/A	15.2%	24.3%	20.3%
All ERCs 2015 (Domestic)	31.1%	24.6%	30.8%	38.3%
CBBG (Domestic)	<b>66.7%</b>	<b>29.7%</b>	<b>51.6%</b>	<b>60%</b>
All ERCs 2015 (Foreign)	9.1%	18%	26.2%	37.9%
CBBG (Foreign)	0%	0%	20%	0%

## Underrepresented Minorities in CBBG

	Leadership Team	Faculty	Graduate	Undergraduate
National Engineering	N/A	2.5%	5.6%	5.9%
All ERCs 2015 (Domestic)	9.1%	8.1%	9.1%	16.5%
CBBG (Domestic)	0%	<b>13.5%</b>	<b>9.7%</b>	<b>13.3%*</b>
All ERCs 2015 (Foreign)	0%	1.8%	2.3%	12.1%
CBBG (Foreign)	0%	<b>33.3%</b>	<b>6.7%</b>	0%

## Hispanics/Latinos in CBBG

	Leadership Team	Faculty	Graduate	Undergraduate
National Engineering	N/A	3.7%	8.5%	13%
All ERCs 2015 (Domestic)	5.1%	5.5%	9.5%	19.1%
CBBG (Domestic)	<b>22.2%</b>	<b>10.9%</b>	<b>19.4%</b>	<b>43.3%</b>
All ERCs 2015 (Foreign)	9.1%	2.7%	4.1%	12.1%
CBBG (Foreign)	0%	<b>33.3%</b>	6.7%*	0%

CBBG has outlined four goals for diversity and inclusion:

**Goal 1:** Increase the participation of underrepresented groups within the emerging field of biogeotechnics and its related disciplines.

**Goal 2:** Create an environment in which the participants represent different backgrounds, disciplines, and perspectives across all levels of the Center.

**Goal 3:** Provide academic and professional development opportunities for all Center members to increase awareness and understanding about inclusion, with a goal towards building a culture of inclusion in the Center.

**Goal 4:** Bring awareness and excitement about biogeotechnics to targeted pre-college and college level participants from a diversity of backgrounds represented by the communities in which the partner institutions reside.

Each partner university in the Center has a diversity lead: Dr. Martha Mitchell from New Mexico State University, Dr. Delia Saenz from Arizona State University, Dr. Alejandro Martinez from the University of California, Davis, and Dr. Felicia Benton-Johnson and Tia Jackson from the Georgia Institute of Technology. This team meets regularly with the Innovation, Diversity, and Education & Outreach Activities (IDEA) Working Group to ensure that Education, Outreach and Diversity are well-integrated in the Center.

Each semester, we have at least one activity specifically focused on creating a culture of inclusion. In Spring 2016, Clifton McNish from NMSU gave a webinar, delivered synchronously to all partner universities, on the "Culture of Inclusion and Relationship to Effective Practice." In Summer 2016, we facilitated workshops at each campus with a discussion of the meaning of "tokenism," the social science research on the effects of tokenism, and a discussion of what actions we can take to mitigate the effects of tokenism. The materials for the workshop were developed by Dr. Delia Saenz.

As part of the CBBG diversity and inclusion activities, the IDEA Working Group selects four best practices in diversity and inclusion each year. These best practices are then given to the CBBG Deans' Council. The four identified best practices for Year 1 are:

- Partner closely with schools/organizations to identify a highly diverse and talented pool for summer programs (Research Experiences for Teachers, Research Experiences for Undergraduates, Young Scholars Program);
- Review all websites (centers, departments, colleges) to ensure universal design principles are applied for accessibility;
- Create workshops that are attended by all Center participants and engineering faculty, that give exposure to social science research on inclusion; and
- Use written reflections completed by CBBG participants immediately following diversity and inclusion workshops to reinforce awareness and potential action.

## Diversity and Inclusion Education Conference

On Tuesday, November 1, 2016, representatives from the Inclusion, Diversity and Education & Outreach Activities (IDEA) Working Group attended the Diversity and Inclusion Education Conference 2016, which was hosted by the ASU Committee for Campus Inclusion and held in the Memorial Union on the Tempe campus.

A variety of workshop sessions were offered, including "Understanding and Supporting Veteran Students" by CBBG Educational Partner, the Pat Tillman Veteran Center, the "Accessibility@ASU" session on increasing inclusion through accessibility, and a session about "Teaching about Race, Inequality, and Whiteness in the ASU Classroom," where presenters shared experiences and strategies for engaging students in examining and discussing these issues.

## Diversifying STEM+H Pathways

CBBG Educational Partners, the Center for Gender Equity in Science and Technology (CGEST) and the Center for Biodiversity Outcomes, gathered a diverse group to discuss ways to collectively create a community of scholars committed to diversifying STEM+H pathways. Dr. Claudia Zapata CBBG Deputy Director, Dr. Wilhelmina Savenye, CBBG Education Director, Dr. Delia Saenz, CBBG ASU Diversity Lead, and Dr. Jean Larson, CBBG Education Coordinator, participated in a November 4, 2016, meeting to focus on solutions and opportunities for involvement.

# Industry & Innovation

## **Industry Advisory Board Meeting:**

The Year 1 National Science Foundation (NSF) Site Visit to the CBBG ERC on October 26-27, 2016, had a large industry showing. Eleven of thirteen industry partners and their guests brought a total of 18 industry participants to the meeting. The closed-door Industry Advisory Board (IAB) meeting held a day prior to the NSF Site Visit was co-lead by the Leadership Partners, Chris Hunt from Geosyntec Consultants and Doug Sawyer from Republic Services, and Dr. Nasser Hamdan, the CBBG Industry Liaison Officer. The IAB had a very productive meeting that included discussions on the formation of subcommittees focused on project types and/or specialty areas, completion of a SWOT analysis, project reviews, a student database for internship and employment opportunities and sponsored projects. CBBG Director, Ed Kavazanjian, paid a brief visit to the IAB meeting and heard first-hand from our industrial partners. CBBG Industrial Partners devoted a great deal of time and effort to participate in this annual NSF site visit, and the Center greatly appreciates their commitment to the success of CBBG.

## **The IAB-Student Mixer & Dinner:**



An industry-student mixer & dinner was held on the eve of the NSF Site Visit to CBBG at ASU's Old Main building. The mixer started with brief 1-2 minute introductions by the industrial partners and was followed by conversations on topics ranging from student research, to career opportunities, to industry projects. The mixer was an informal, networking style event to encourage students to seek out and engage many of the 18 industry representatives in attendance. The mixer also included student posters showcasing their work at the CBBG ERC that helped spark interests and facilitate discussions. Conversations remained strong throughout the evening as many of the discussions carried over into dinner and after. Dr. Nasser Hamdan, the CBBG Industry Liaison Officer, heard many positive comments from both industry representatives and students about the event including:

*"[the mixer] encouraged students and industry to break the ice and start a dialogue. I found speaking with the industry members incredibly eye-opening as they have a lot of experience with technology application and collaboration ideas for CBBG and its researchers". C.H.*

*"[the mixer was] a great environment to speak with the industry partners because the fact that they were at the mixer was already a sign that they were interested in speaking with students and hearing about the research going on [at CBBG]". J.A.*

*"I really enjoyed the time set aside for the students and industry to mix . . . [and] talking with people who are interested in applying my research in the real world . . . ". M.W.*

In summary, the IAB-student mixer and dinner was a well-received and productive event that will surely be a "must do" for CBBG students next year with the participation of our industrial partners.

## **CBBG INDUSTRY MEMBERS:**

The CBBG ERC has a total of thirteen industry members as follows:

### **Leadership Level:**



### **General Level:**



### **Associate Level:**



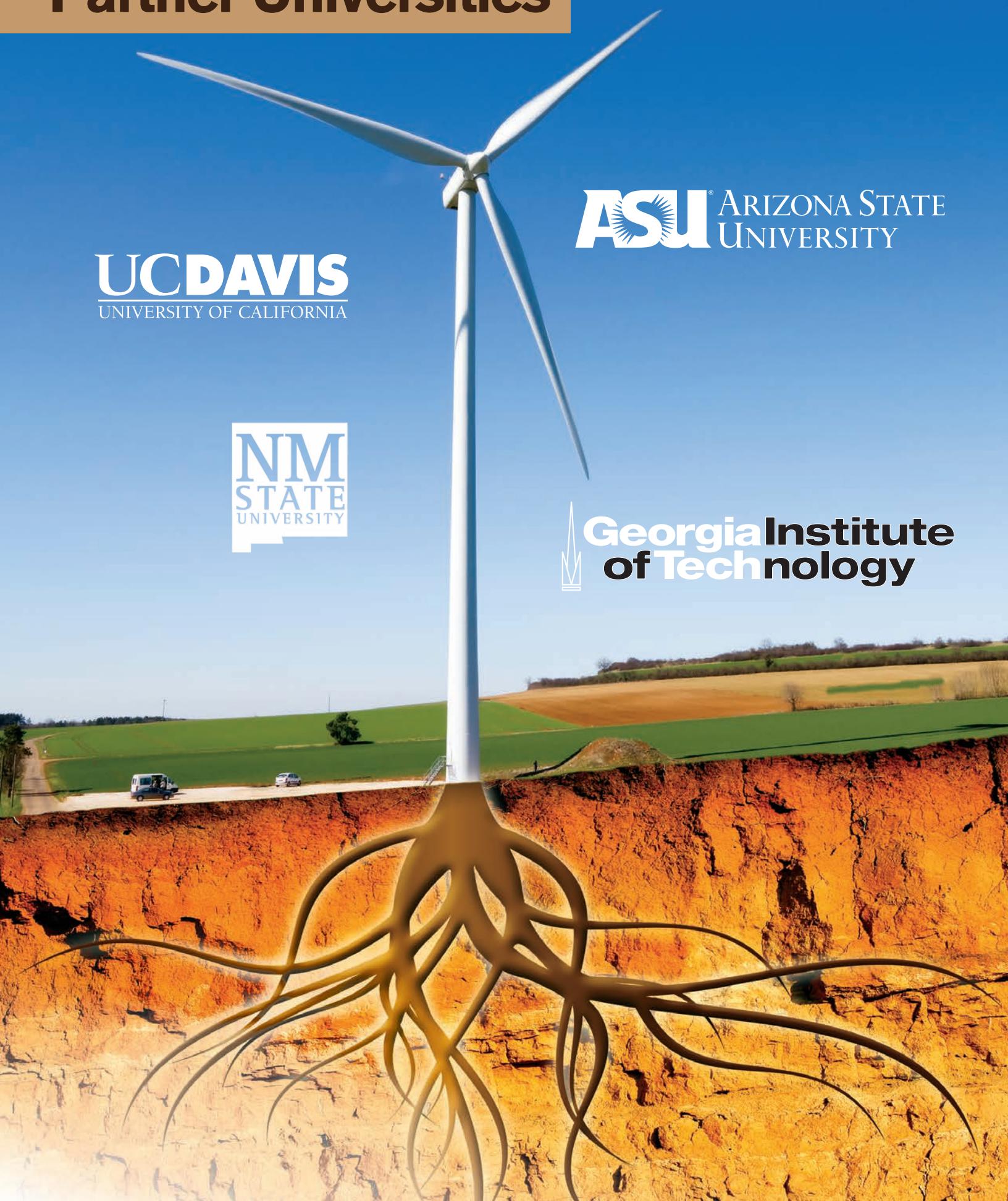
# Partner Universities

**UCDAVIS**  
UNIVERSITY OF CALIFORNIA



**ASU** ARIZONA 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)

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