Engineering Workforce Development – YEAR 6

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ASU Ira A. Fulton Schools of Engineering
Arizona State University
UC DAVIS
UNIVERSITY OF CALIFORNIA
Georgia Institute of Technology
NM STATE
NSF
Center for Bio-mediated & Bio-inspired Geotechnics
CBBG

Educational Impact

Year 6

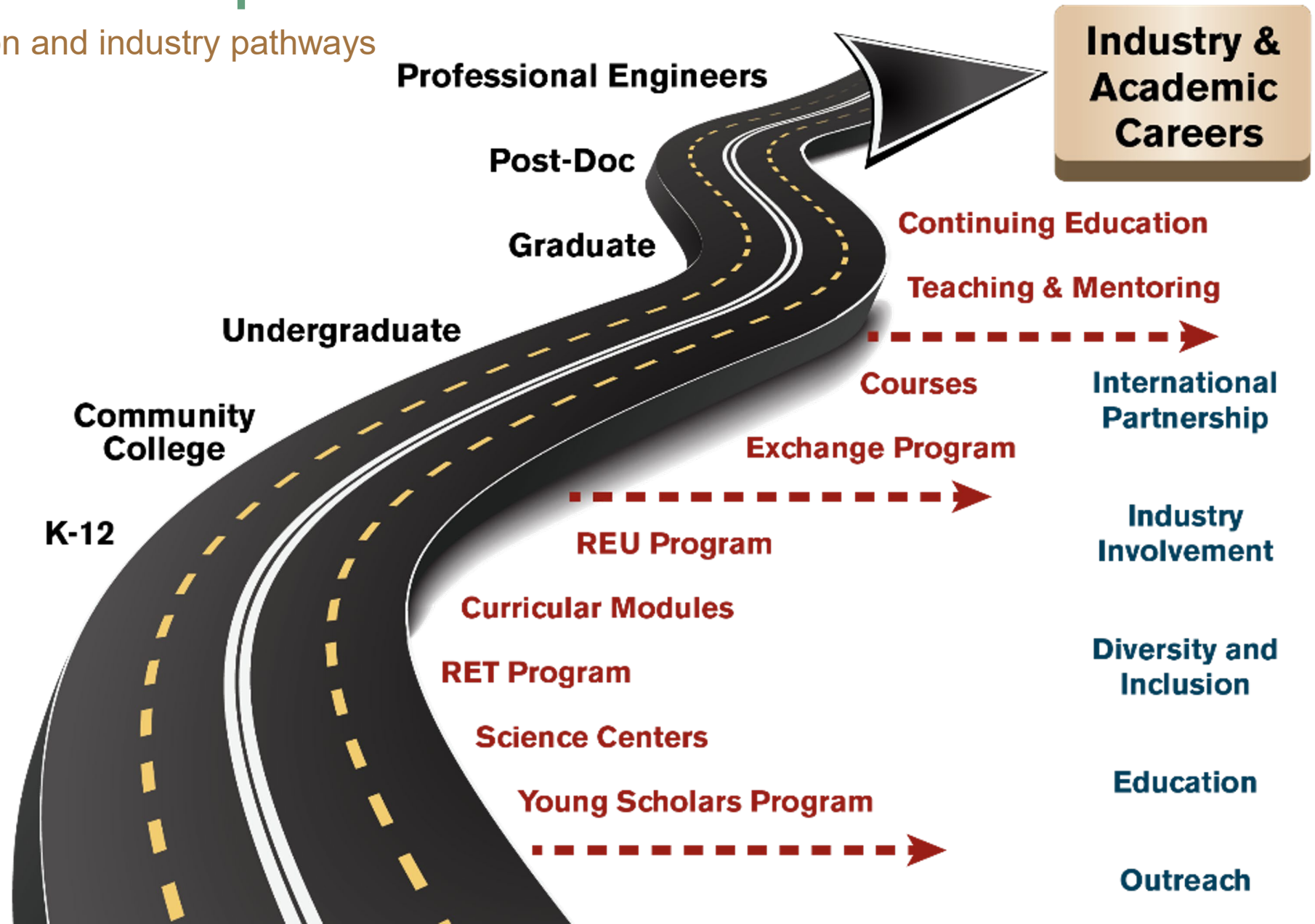
Educational Impact

Incorporate benchmarks for education goals

Education Program Goal	Benchmarks
Desired Skillsets Aid students to become proficient in the skills described in CBBG's Desired Skill Set.	At least 70% of participants report their skills increased Somewhat, Quite a Bit, or A Great Deal by participation in CBBG
Leadership and Innovation Develop a diverse pool of future professionals and scientists in biogeotechnical engineering who are innovative and creative leaders.	At least 70% of participants report their leadership and innovation skills were impacted by participation in CBBG
Diversity and Inclusion Demonstrate diversity, awareness, knowledge and positive attitudes toward increasing opportunities and careers in STEM and biogeotechnics for underrepresented groups.	At least 90% of participants report feeling valued and accepted for their contributions in CBBG
Education Partners Engagement Ensure equal partnerships with teaching and mentoring for learning, engagement and motivation in biogeotechnics.	At least 50% of applications for the summer programs are from our educational partners Engage with educational partners through at least 3 major outreach events
Curriculum Development Development of efficient and effective approaches to deliver biogeotechnical content.	At least 70% of participants report that their understanding of biogeotechnics was impacted by participation in CBBG

Long-term Impact

Support education and industry pathways



University Education

Year 6

Education Goal

Align activities, curricula, and partnerships with goals

	Outputs	Outcomes	Long-term Impacts
Year-long Students	# of undergraduate students # of graduate students # of underrepresented students	Gain in knowledge and skills Development of mentoring skills Demonstration of a diverse & inclusive culture	Persistence year to year Job obtainment in industry Job obtainment in academia
REU Participants	# of REUs by CBBG site # of underrepresented REU # of REU transitioning to Grad	Gain in knowledge and skills Satisfaction with the quality of mentorship received Overall satisfaction with program experiences	Persistence in a STEM major Enrollment in STEM graduate program Progression of role status in CBBG
RET Participants	# of teachers # of underrepresented teachers # of lesson plans developed	Lesson plan preparation Lesson plan implementation Overall satisfaction with program	Dissemination of lessons Implementation of lesson in classroom RETs' perception of their students' motivation in STEM before/after lesson
Young Scholar Participants	# of YSs by CBBG site # of underrepresented YSs # of YSs transitioning to undergraduate students in CBBG	Gain in knowledge and skills Motivation to pursue STEM career Satisfaction with the quality of mentorship received	Enrollment in STEM UG programs Persistence of a STEM major as an undergraduate
Courses and Programs	# and description of new courses developed # of courses listed across CBBG	Students report satisfaction with course material Students report application of course material in lab	Credit bearing course has been created and offered at each institution
Community Outreach	# outreach events per site # of partnerships per site # of people attending the events	Increased participant awareness of biogeotechnics Increased participant engagement Increased motivation to pursue a career in STEM	Enrollment in CBBG university Applying to CBBG programs

Industry Interaction

Build productive collaborations with students and industry

MATRIXNEWORLD
Enabling Progress

Students engaged in industry practices

- Journal articles
- Field-scale phosphorus removal filter
- GOALI Project research
- LCSA project scenario
- Expansive pile prototype test

GOLDER

Geosyntec consultants

Schnabel ENGINEERING

Industry members on dissertation committees

KUNKEL engineering group

HALEY ALDRICH

FREEPORT-McMoRAN

University Curricula

Develop new and improved curricula

Course Name	Status	Level	Course Developer/Instructor
Global Learning: Diversity, Equity, Inclusion, and Justice in Engineering	New Course	Undergraduate	Dr. Colleen Bronner, UCD
UN Sustainable Development Goals: How Can Engineers Affect Social Justice?	New Course	Undergraduate	Dr. Colleen Bronner, UCD
Strategies for Success in Online Learning	New Course	Undergraduate	Dr. Colleen Bronner, UCD
Fundamentals of Geoenvironmental Engineering	Ongoing Course	Undergraduate	Kirk Craig, Geosyntec
Environmental Engineering Fundamentals: Biological Processes	Ongoing Course	Undergraduate	Dr. Anca Delgado, ASU
Bio-inspired Design	Ongoing Course	Undergrad/Grad	Dr. Julian Tao, ASU
Connecting Research to the Broader Community	Ongoing Course	Senior/Grad	Dr. Claudia Zapata, ASU
Contaminant Fate and Transport	Ongoing Course	Graduate	Dr. Treavor Boyer, ASU
Engineering Education I	Ongoing Course	Graduate	Dr. Colleen Bronner, UCD
Engineering Education II	Ongoing Course	Graduate	Dr. Colleen Bronner, UCD

Undergraduate Involvement

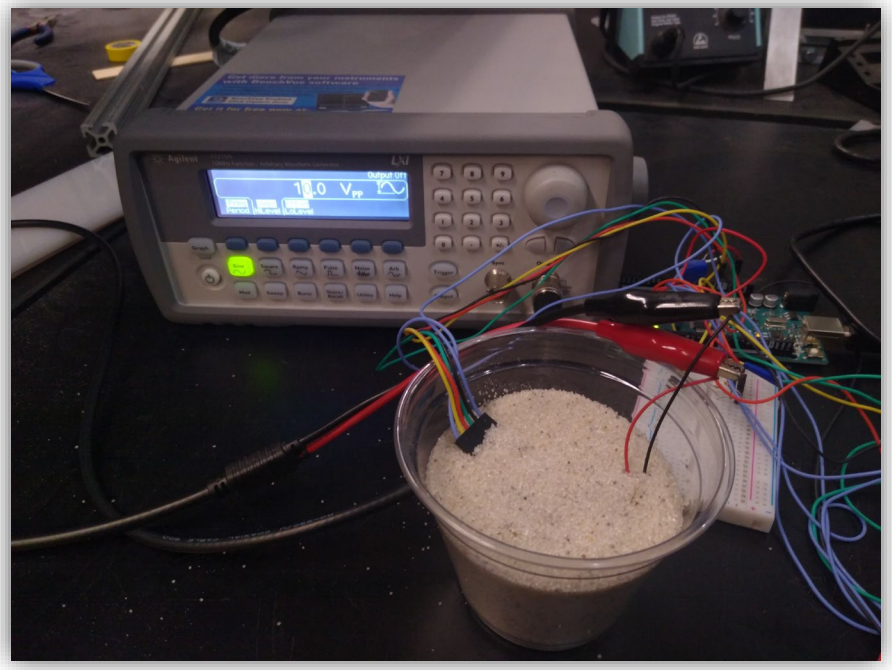
Mentor undergraduates on CBBG research

VIP - Bio-Geotechnics for Civil Infrastructures

- ASU (5)
- Georgia Tech (2)

Research Experiences for Undergraduates (REU)

- 140 applicants
- 15 participants
- Remote and in-person



Cross-partner Educational Opportunities

Build and strengthen collaborative cross-partner opportunities

Community College Partnerships

- Phoenix College Virtual STEAM Days
- Fresno City College

Cross-institutional Collaborations

- EICP research exchange
- Earthen construction
- Field monitoring and sampling

International Collaborations

- Cintana: U. Latina of Costa Rica
- U. of Waterloo, Canada
- Center for Micro-BioRobotics, Italy
- Korea Advanced Institute of Science and Technology, S. Korea

CINTANA EDUCATION

UNIVERSIDAD LATINA DE COSTA RICA
POWERED BY Arizona State University

Foreign Laboratory Student Experiences

Participate in a foreign lab research experience

Students Working in (or with) Foreign Laboratories

- TU Delft – Delft, Netherlands
- U. of Waterloo – Ontario, Canada
- City of Amsterdam, The Netherlands
- King Saud University – Saudi Arabia

Center-to-Center (C2C) Partnership

- PI: Dr. Susan Burns (Georgia Tech)
- Potential student research opportunities

QUEEN'S UNIVERSITY BELFAST

Center for Bio-mediated & CBBG Bio-inspired Geotechnics

iCRAG IRISH CENTRE FOR RESEARCH IN APPLIED GEOSCIENCES

Evaluation/Assessment

Measure impact of educational programming

NSF Engineering Research Centers Unite

ATP·Bio

MERCII

Multi-ERC Instrument Inventory

QESST

Center for Bio-mediated &

CBBG

Bio-inspired Geotechnics

NEWT

CISTAR™

NSF Engineering Research Center

Center for Innovative and Strategic Transformation of Alkane Resources

PATHS-UP

Precise Advanced Technologies and Health Systems for Underserved Populations

Pre-college Education

Year 6

Pre-college Partnerships

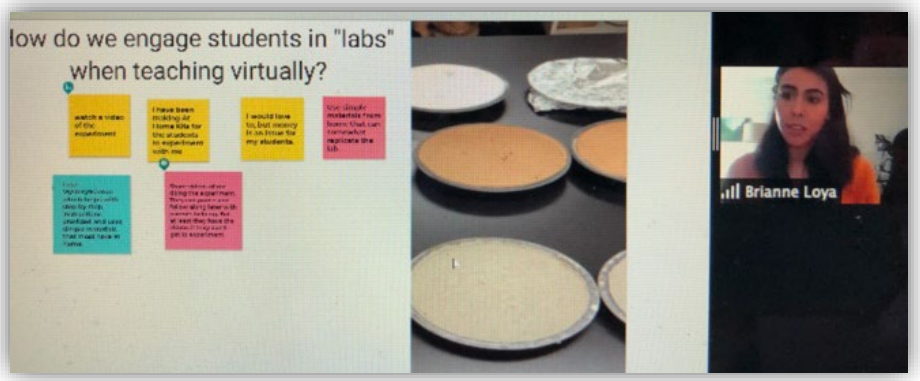
Engage students and teachers through productive partnerships

Engaging with Industry

- Educational and Career Pathways
- Career Profiles

Outreach Extended for Museum Partnerships

- AZ Science Center
- Museum of Nature & Science



MUSEUMS

City of Las Cruces

EDUCATE TO INNOVATE
ARIZONA SCIENCE CENTER

ROCKETS
Raising Our Children's Knowledge by Educating Through Science

Diversity

Engage with schools serving diverse populations

- STEM for Girls
- Culturally responsive mentoring for students from URG
- New partner schools serving diverse student populations
- Inclusive teaching and outreach

Pre-college Curricula

Support and engage parents, teachers, and students with virtual STEM curricula

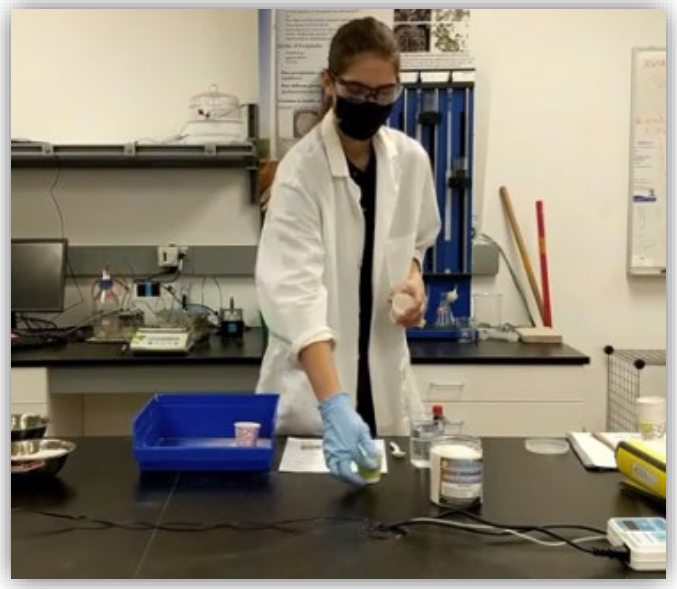
- Virtual Open Door
- YouTube Channel and Materials
- New After-school Lesson Development
- Summer Programs Canvas Course and eLearning

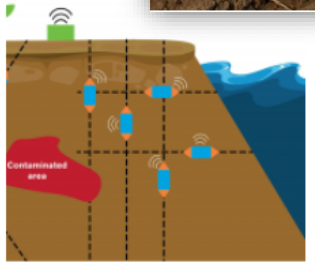
ASU Arizona State University Open Door 2021

STEM Outreach Center
Innovating STEM Education one step at a time

Center for Bio-mediated & CBBG Bio-inspired Geotechnics

YouTube





Learn from Nature! Self-burrowing Robot

Center for Bio-mediated and Bio-inspired Geotechnics (CBBG) scientists and engineers are trying to design a self-burrowing robot inspired by the razor clam in nature, to help monitor soil health conditions. Build a simple burrowing robot at home and discover how CBBG engineers are working to develop efficient, ecologically friendly, and cost-effective solutions that are inspired by nature!

Research Experiences for Teachers (RET)

Expand reach to communities beyond the four partner locations

Participants at all CBBG universities

- ASU (5)
- GT (2)
- NMSU (3)
- UCD (2)

Evaluation Recommendations

- Provide clear expectations
- More mentor/mentee interaction
- Learn about program expectations, CBBG, mentors, and research

Young Scholars Program (YSP)

Participation in CBBG research both face-to-face and virtually

Hybrid/Virtual Format

- 8 YSP (ASU, GT, NMSU)
- Virtual modality increased outreach and impact

Continuing with CBBG

- Four YSP – now UG at CBBG (Honors/VIP)
- Year 1 YSP – finished UG – now Grad student

Participation and Mentoring

Promote collaboration and mentoring

Participation

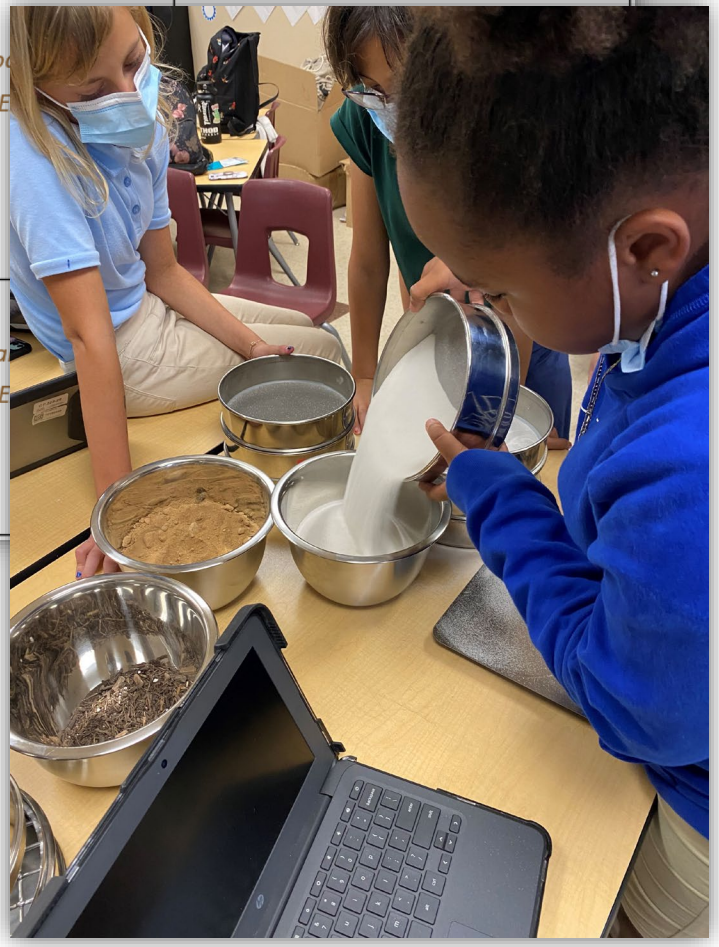
- On campus and virtual
- Videos and lab tours
- STEM teacher PD
- Disseminate best practices

Mentoring Support

- Virtual mentor training
- Mentoring office hours
- 6 mentor training videos
- Resources for providing feedback

Mentor Expectations - Overview

Prior to program	Week 1	Week 2
✓ Send *Welcome Email* ✓ Arrange *Initial Meeting* ✓ Request *Required Materials* ✓ Complete *Lab Planning Document* ✓ Record *Project Overview Video* ✓ Explore *Canvas Course* ✓ Visit *Mentoring Office Hours*	✓ Facilitate *Project Discussion* ✓ Provide *Lab Tour* ✓ Review Mentee's *Intro* ✓ Review Mentee's *Lab E Report*	✓ Provide at least one *Lab Experience*
Week 3	**Week 4**	
✓ Provide at least one *Lab Experience* ✓ Review Mentee's *Lab Experience Report*	✓ Provide at least one *La* ✓ Review Mentee's *Lab E Report*	



Evaluation / Assessment

Measure impact of educational programming

- Alignment with goals
- Impact towards desired outcomes
- Successful recruitment and retention
- Evaluation feedback
  - Optimal virtual delivery
  - Clear expectations and organization
  - Strengthening mentor-mentee interaction

CBBG Center for Bio-mediated & Bio-inspired Geotechnics

Welcome to the CBBG Summer Research Program!

We are excited to have you participate in our program and look forward to getting to know you over the summer.

Orientation	Week 1	Week 2
Complete the required training and record your introduction video.	Learn about all the projects going on at CBBG and tour your lab.	Continue your research, work on your lesson, and discuss engineering education standards.

Week 3	Week 4	Week 5
Learn about Problem-based learning (PBL) in Engineering and use Universal Design for Learning (UDL).	Optimize your engineering lesson for online teaching and remote labs.	Finalize and present your lesson plan and demonstration.

Zoom Calendar Contacts Mentor Resources

Thank You!

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