

# FOUNDATIONS

NEWSLETTER OF THE GEO2YC DIVISION OF THE NATIONAL ASSOCIATION OF GEOSCIENCE TEACHERS

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## Course-Based Undergraduate Research Experiences (CUREs): A Community College Perspective

By Chris Johnson

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**Background:** The President's Council of Advisors on Science and Technology (PCAST) published a report in 2012, "[Engage to Excel](#)", that called for more laboratory classes during the regular academic year to become more "discovery-based research courses". However, the report does not provide specifics on how that might be achieved. To help bridge the gap between the directive and its implementation, the National Academy of Science held a convocation in 2015 on the current knowledge base and challenges of implementing "course-based undergraduate research experiences" (CUREs). This article summarizes the [report](#) from this convocation - "Integrating Discovery-Based Research into the Undergraduate Curriculum".

**Problem:** Undergraduate research is a well-established high-impact practice known to increase scientific literacy and involvement (e.g. recruitment and persistence) of underrepresented groups. However, most undergraduate research is done by a few top students working closely with faculty. Thus, this high-impact practice of undergraduate research isn't very accessible to those students who would benefit most – students from

underrepresented groups and underperforming students.

**Solution:** To affect a larger audience and bring research to more underrepresented and underperforming students, some faculty are bringing research to the regularly scheduled academic year courses. The basic structure of a CURE might include first creating a situation in which students learn how to use data collection equipment (such as water quality meters or an x-ray fluorescence (XRF) analyzer) and mapping software (GIS and smart phone apps). Then each student identifies their own problem and develops their own hypothesis and testing strategy. Ideally this would be part of the faculty members' existing research focus so that the research remains "authentic". Students then develop a plan and implement their test or data collection activity before finally interpreting and presenting their results in class. Peer and faculty mentoring at every stage is necessary and mutually beneficial.

**Major Findings:** The following is a list of the key take-home points from the report:

- Course-based research should be authentic such that students know they are involved in a real scientific problem and that the work matters to the scientific community and contributes to the field.
- Students learn more about the nature of science the more they are responsible for posing and addressing their own research questions.
- If CUREs are "scaled up" – expanded to the entire department or school with wide support by faculty and administration – then there is potential to increase recruitment of majors, especially from underrepresented groups, as well as increase retention and completion rates.
- Evaluation of program efficacy should extend beyond student self-reporting to evaluation

based on objective and longitudinal metrics such as recruitment, persistence, completion and diversity.

- Institutional commitment (e.g. funds, resources, professional development, faculty reward systems, etc.) is helpful when bringing research to a large number of undergraduates.
- Partnerships with other higher education institutions, especially for community colleges, can help institutionalize course-based research.
- Faculty reward structures may need to be changed to include course-based research experiences in the tenure and promotion guidelines.
- Efforts should be made to include and support adjunct faculty.
- Since infrastructure (e.g. scientific equipment) may not be available, alternatives may be used such as 1) on-site research where the campus facilities become the lab (i.e. building performance metrics and greenhouse gas emissions etc. such as the Campus as a Living Laboratory program at the Cal State Universities), 2) remote access to shared instrumentation such as the remotely operable scanning electron microscope at the University of South Florida, and 3) mining of existing online databases.

**Community College Example:** At Salt Lake Community College (SLCC), many geology majors are engaged in CUREs focused on soil sampling and analysis using an XRF analyzer and water quality meters. SLCC is located in a mountainous region with a legacy of metal ore mining which has left soil and stream sediment with high concentrations of lead and arsenic. The XRF measures the concentration of heavy metals in parts per million (ppm) and therefore is an excellent tool for students to use for their own research projects and compare results to established limits.

To incentivize students to conduct this research, students in their first majors class (Physical Geology) can replace their normal final project with the final project from an optional Field Studies class. This field studies class involves local weekend field trips, sampling and analysis equipment training, GIS mapping skills, and then a

group field sampling and analysis trip in Big Cottonwood Canyon near an abandoned mine. Students learn how to analyze the soil for metals and make a GIS map using ESRI's Collector app on their smartphones. Later, for their final project, students identify their own research question for their own site and develop their own hypothesis that can be tested by collecting soil and analyzing for metals.

The project is successful in the sense that over the last two years, 9 of the 20 students involved presented at the SLCC Science Symposium and four of these won awards. This project hasn't been expanded fully to a CURE required for all geology majors, but the initial success shows that there is opportunity for CUREs at the community college level.



## Augment Your Lecture with Virtual Field Trip Apps

**By Natalie Bursztyn**

*California State University Fullerton  
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It's one-quarter of the way through the semester, and the students still have their game faces on, but the non-majors are clearly just trying to get through their science requirement by memorizing what they can of the key terms at the end of each chapter.

The first lecture on Geologic Time was on Monday; now it's Wednesday, and 95 students are lined up and sitting outside the class door with their smartphones, Snapchatting, texting and Facebooking their friends about how boring yet another lecture is going to be, especially on such a perfect, warm fall day.

Today, however, will be different.

After the instructor opens the door, the students shuffle in, head to their usual seats, and make no move toward opening their notebooks or putting their phones away. The instructor interrupts their

reverie to inquire how many students have smartphones or tablets. More than three-quarters of the class does.

“Okay”, she says, “Get with a partner so there’s at least one smartphone or tablet between the two of you.” The students shuffle and rustle and murmur among themselves, eventually forming partnerships. “While you were choosing partners, I emailed the class an app. Please go ahead and install it now, then we’ll head outside.” The students fiddle with their phones, suddenly intrigued.

Soon, there are 95 college students roaming around the campus quad, animatedly discussing which direction is east and what “superposition” means again, so they can beat their friends to the next location in Grand Canyon on their virtual field trip.

The instructor overhears her students asking each other questions like, “What was the difference between ‘dis-’ and ‘non-conformity’ again?” “Where did you find the youngest unit at that Hance Rapid stop?” and, “What was your score at the end, did you get a helicopter ride?”

Now, instead of trying to memorize a dozen new vocabulary terms, the students are reviewing the unit on stratigraphic principles they were just introduced to in a physical and applied practical manner. Now, the students are informally

competing against each other to earn the highest score so they can get a virtual helicopter ride out of Grand Canyon and win the game.

Are you an instructor who’s trying to figure out how to engage lower-division students in high-enrollment geoscience classes? Why not use the technology most of them already carry in their pockets?

The trio of free Grand Canyon Expedition apps are available for Android and iOS. Take a few minutes now to download them yourself. Search “GCX” and you will see an orange trilobite logo for Geologic Time, a purple fault logo for Geologic Structures, and a blue canyon logo for Hydrologic Processes.

The concept for the Grand Canyon virtual field trip (VFT) apps was modified after the series of location-based GeePerS math games made by the Interactive Design for Instructional Applications and Simulations (<http://idias.usu.edu/>) lab at Utah State University.

The VFTs use the built-in GPS of portable smart devices and relative locations, meaning that all of the locations and distances that the player interacts with are relative to their initial starting point. Each virtual field trip location is geo-referenced, but the entirety of the Grand Canyon has been scaled down to 100 meters, making a 21-day raft trip from Lees



**More than 100 students at Utah State University explore the faults and folds of Grand Canyon during their Geology 101 lecture class, Spring 2015.**

Ferry to Lake Mead fit within a typical campus quad. The geographic location of the player does not matter; however, the player must be outside as the apps are dependent on their smartphone or tablet GPS getting a clear signal.

All three VFT modules use the same digital elevation model (DEM) base map of Grand Canyon, and begin at the traditional rafting trip launch of Lees Ferry. Between Lees Ferry and Lake Mead, each module has 10 different field trip stops that represent outstanding real world examples of curriculum content for each VFT's distinct geologic theme.

Each field trip stop appears in sequence after a question, or question and interactive touchscreen task, is answered correctly. Points are allocated to each question based on the number of attempts, and incorrect answers trigger explanations of the answer selected so the student can immediately know why the answer they chose is not right.

Each location has a multiple-choice question associated with the image of that field trip stop, and the associated information is provided in text and video format. Approximately half of the locations also have an interactive touchscreen activity that either requires the student to identify and tap on a geologic feature presented on the screen, or swipe the screen to draw a line (along a fold axis or direction of maximum stress), or indicate the direction of movement of a fault's hanging wall.

The design takes advantage of the benefits of games that provide immersion-in-context, rewards for correctness (increasing motivation), and immediate feedback in response to student interaction. Each VFT takes approximately 20-30 minutes to play, a length aimed to capture the typical student's attention span as well as easily fit into a lecture class time slot, become part of a lab activity, or be assigned as homework.

I have created a video to illustrate how the play-through of these apps works. Check it out here:

<https://goo.gl/gHEqDg> 

*Editor's note: Further apps and accompanying publications are in progress. Follow updates here:*  
[https://works.bepress.com/natalie\\_bursztyn/](https://works.bepress.com/natalie_bursztyn/)

# President's Column

**by Kaatje Kraft**

*Whatcom Community College,  
Bellingham, WA*

It's with a bittersweet note, that I write my last letter as president of the Geo2yc division. I am ready to have more free time, but of course, would like more time to make our division stronger. That said, it is with great confidence that I pass the reins on to Brett Dooley.

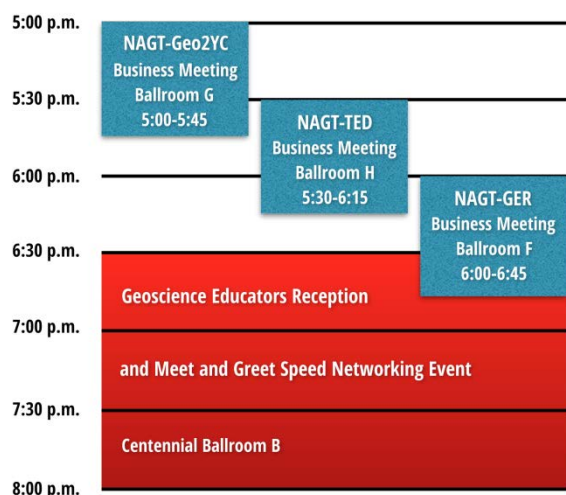
I have been blessed with incredible volunteers to work with and get to know, as I have been involved in the Geo2yc division. I would like to thank Chris Johnson and Wendi Williams for serving as interim webmaster and secretary/treasurer, respectively. It was a tumultuous year, and they helped to stabilize the process. I am even more pleased that they have agreed, and you have voted, to have them continue in the official capacity for three-year terms. In addition, I'd like to acknowledge all the hard work that Karen Layou has done to advocate for and honor our adjunct faculty. Lastly, I'm thrilled to welcome former newsletter editor for the Geo2yc, 2014 Biggs awardee, AND Virginia's Chancellors Commonwealth Professor, Callan Bentley as the incoming vice-president.

Were it not for our volunteers, this division would not exist. With that in mind, it is important to remember that Amber Kumpf (Archivist) and Thomas Whittaker (Newsletter Editor) will be ending their service at the end of next year. If either of these positions, and also the next vice-president position, are of interest to you please be sure to notify any of the past-presidents (including me!).

It sounds as if the Earth Educator Rendezvous (EER) was a tremendous success, and had a great showing of faculty from two-year colleges (more than 25!). I was sorry not to make it, but I was out at sea with students as part of the STEMSEAS program (an outstanding experience for a number of 2yc students for which I will share more about in a future issue, but you can read about student experiences aboard these ships here:

<https://stemseas.wordpress.com>). I recognize that for most of us being able to attend one meeting is a gift, much less two, so I know that many of you

who were able to attend EER will not make it to GSA, and some of you may be attending other meetings more local and/or appropriate for your research discipline. But for those of you who will be attending GSA, I hope to see you and please remember that our division meeting is on **Sunday, September 25<sup>th</sup> from 5-5:45 in Ballroom G**. It is staggered with the other divisions in hopes you can attend more than just one business meeting.




In addition, the Geoscience Educators social reception is always a great way to re-connect with colleagues, and this year, will also include a “speed-dating” variety of meet & greet around collaboration potential for education research. Many times, institutions are looking to collaborate with two-year colleges and don’t know where to look. Some of us enjoy having opportunities to pursue our own intellectual pursuits or provide opportunities for our students beyond their initial coursework. And lastly, some of us have been involved in the research game for a while, and may have some valuable insight to share and/or are looking for ways to expand our network (the more I can get to know who is interested, the more names I can pass on when someone approaches me with a request I know I won’t have time for). This meet & greet is a great opportunity for *all* of us and I hope you’ll be interested in attending. The event has been organized between the three divisions in hopes we can foster this time to help build networks and ideas for our members.

Our division has also sponsored a number of sessions and other events throughout the meeting. Check the newsletter or [NAGT website](#) for more details.



Regardless of whether you will be able GSA or not, our annual report is available online: [http://nagt.org/nagt/about/workspaces/council/2016\\_annual.html](http://nagt.org/nagt/about/workspaces/council/2016_annual.html). And as always, I welcome your comments, thoughts and suggestions.

Thank you for allowing me to serve as your president this past year, it is truly a gift to be able to see, support and represent such amazing work you all do for your students. 

***CLICK HERE TO  
Nominate your Outstanding  
Adjunct Faculty  
or visit***


[http://nagt.org/nagt/divisions/2yc/oafa\\_nomination.html](http://nagt.org/nagt/divisions/2yc/oafa_nomination.html)

## Upcoming Changes to the Outstanding Adjunct Faculty Award

**by Karen M. Layou**  
*Reynolds Community College*  
*Richmond, VA*

The Outstanding Adjunct Faculty Award Committee is excited to share some changes with the process by which we recognize our peers who are doing fantastic work to share their passion for geosciences with their students and communities.

These changes are necessary due to modifications of the Geo2YC Division budget, and more importantly, to lack of nominees. Starting in 2017, the award is shifting to recognizing three adjunct faculty during the calendar year (highlighted in the February, May, and September Foundations newsletters, respectively). The Outstanding Adjunct Faculty of the Year will be selected from those three individuals and announced in the December newsletter. All honorees will still receive a one-year complimentary membership to NAGT and the Geo2YC Division, and the Outstanding Adjunct Faculty of the Year will receive a \$750 stipend from Pearson Publishing to support attendance at a professional development opportunity of their choice or purchase of classroom materials.

To adapt to this new schedule, there is no honoree showcased in this edition of the newsletter. Please keep an eye on your email for voting for the 2016 Outstanding Adjunct Faculty of the Year after GSA! In the meantime, take a look around your department, and across your geoscience network. If you have adjunct colleagues (who may not necessarily be at your own institution) who are doing great things the Geo2YC community should know about, or are an adjunct faculty who would like to tell us about your own efforts, please consider completing a nomination form available at: [http://nagt.org/nagt/divisions/2yc/oafa\\_nomination.html](http://nagt.org/nagt/divisions/2yc/oafa_nomination.html). 

## GSA Topical Sessions Sponsored by the Geo2YC Division

The Geo2YC division of NAGT is this year proud to sponsor the following topical sessions at GSA:


**T84. Planning to Make a Difference through the Next Generation Science Standards: Part 1 K–12 Initiatives**

**T85. Planning to Make a Difference through the Next Generation Science Standards: Part 2 Undergraduate and Teacher Training Initiatives**

**T86. Supporting Geoscience Student Transfer Between Institutions and Transitions into the Workforce: Pathways for Success**

**T87. Supporting Students with Disabilities: Innovations and Strategies for Geo-Success**

**T88. Technological Innovation in Geoscience in Two-Year Colleges**

Please consider attending one or more of these sessions, and visit with fellow NAGT members (and pick up a cool NAGT Geo2YC pencil) at booth #457 in the events hall. 

### *Letter from the Editor*

**by Tom Whittaker**

*Unity College, Unity, ME*

*thomasewhittaker@gmail.com*

Dear Colleagues,


Further to the opportunities Kaatje listed in her letter there is also (or soon will be) a call for service on the Outstanding Adjunct Faculty Award Committee. Please contact Karen Layou (see article above), Kaatje, or myself if you are interested in being considered.

For our final newsletter of the year (to be issued in December I would like to share your photos of our Geo2YC pencil with our readers (get one at GSA booth #457!). If you snap any pictures, with your pencil as scale, please consider submitting them to the newsletter along with a brief description of the location and lat-long coordinates.

A reminder that NAGT and the Geo2YC division are only as healthy as our membership. Don't forget to renew for 2017!

Save the Date: [Earth Educator's Rendezvous 2017](#) is in Albuquerque, NM, July 17-21

If you have questions or comments about the content of FOUNDATIONS, or have suggestions for future newsletter items please contact me.

Thank you! 



# NAGT



## Speed Dating Networking and Icebreaker event

**Join us to meet other folks interested in Geoscience Education, form new partnerships and collaborations, and have fun!**

**Location: Centennial Ballroom B - Hyatt Regency**  
**Time: Sunday, September 25 — starting at 7:00 p.m.**

**Brought to you by the Divisions of NAGT:**

- Geoscience Education Research Division (GER)
- Teacher Education Division (TED)
- and Two-Year College Division (Geo2YC)

To learn more about these divisions,  
see the other side of this flyer or visit  
<http://tinyurl.com/NAGTDiv>



# NAGT



## About the NAGT Divisions

In 2011, the National Association of Geoscience Teachers organized the Geo2YC division around topics of common professional interest to two year schools. Following this success, the GER and TED divisions were organized in 2014. Descriptions of each of these divisions can be found below, and leaders of each division will be available at the reception to answer any questions you might have. Learn more by visiting us on the web at <http://tinyurl.com/NAGTDiv>

**Geoscience Education Research (GER):** This division provides networking and professional development for the growing community of geoscience education researchers and to help build relationships between GER, the geosciences, the NAGT Council, and the larger discipline-based science education research community.

**Teacher Education (TED):** This division provides a forum to discuss ideas and resources about geoscience teaching, the improvement of instruction for teachers and teacher educators, and to advocate for teacher education to the NAGT Council and the geosciences community.

**Two-Year Colleges (Geo2YC):** This division supports geoscience educators and education at two year colleges, as well as advocating for two-year college concerns to both the NAGT Council and to the geosciences community.