Workshop Conveners

Robert Filson, Department of Geology, Green River Community College (essay)
Laura Guertin, Department of Earth Science, Penn State Brandywine
Kaatje Kraft, Department of Physical Science, Mesa Community College (essay)
Heather Macdonald, Department of Geology, College of William and Mary

Workshop Participants

Eric Baer, Highline Community College (essay)
John Bartley, Muskegon Community College (essay, activity)
Allison Beauregard, Northwest Florida State College (essay, activity)
Callan Bentley, Northern Virginia Community College (essay)
Karen Berquist, College of William and Mary (essay)
Pete Berquist, Thomas Nelson Community College (essay, activity)
Robert Blodgett, Austin Community College (essay, activity)
Priti Brahma, National Oceanic & Atmospheric Administration
Joy Branlund, Southwestern Illinois College (essay)
Eleanor Camann, Red Rocks Community College (essay, activity)
Paul Cutlip, St Petersburg College (essay, activity)
Christopher DiLeonardo, De Anza College
Joachim Dorsch, St. Louis Community College at Meramec
Leila Gonzales, American Geological Institute
Pamela Gore, Georgia Perimeter College (essay)
Richard Gottfried, Frederick Community College (essay, activity)
Frank Granshaw, Portland Community College (essay, activity)
Ann Hadley, Manchester Community College (essay, course)
Jacquelyn Hams, Los Angeles Valley College (essay)
Jan Hodder, University of Oregon (essay)
Amanda Julson, Blinn College (essay, course)
David Kobilka, Central Lakes College (essay, activity)
Karen Kortz, Community College of Rhode Island (essay)
Lynsey LeMay, Thomas Nelson Community College (essay, course)
Cindy Martinez, American Geological Institute
Lina Patino, National Science Foundation
Jacqueline Rousseau, National Oceanic & Atmospheric Administration
Suzanne (Suki) Smaglik, Central Wyoming College (essay, activity, course)
Jessica Smay, San Jose City College (essay)
John Taber, IRIS Consortium (essay)
JoAnn Thissen, Nassau Community College (essay, activity 1, activity 2, activity 3)
William Van Lopik, College of Menominee Nation (essay)
David Voorhees, Waubonsee Community College (essay, activity)
Becca Walker, Mount San Antonio College (essay)
Katryn Wiese, City College of San Francisco (essay, activity, course 1, course 2)
Wendi Williams, Northwest Arkansas Community College and University of Arkansas at Little Rock (essay, course)
James Wysong, Hillsborough Community College (essay, course)

Guest Essay: Joshua Villalobos, El Paso Community College

Workshop Facilitator

John McDaris, SERC, Carleton College

Related Links

Download all the submitted essays in one PDF (Acrobat (PDF) 912kB Jun21 10).

Bob Filson
Green River Community College

One of the major issues identified in the applications submitted for this meeting is the isolation that many two-year college geoscience faculty feel because they are the only geoscientist on the staff. Discuss actions you have taken or your ideas to reduce these feelings of isolation on your campus or with other geoscientists.

Many two-year college (2yc) geoscientists constitute a single-person department within a larger division of other science, math, or engineering colleagues. For many years I was the only geoscientist at Green River Community College (GRCC). We now have two full-time geoscience instructors and three adjunct instructors, but I have found that teaching with colleagues from other departments has been very rewarding and interesting.

The broad range of topics in geoscience makes it easy to find areas of common interest with faculty from other departments. In some cases these coordinated offerings have spanned the range of teaching existing courses with some minor level of coordination to other courses that we developed as entirely new interdisciplinary courses.

Some of the advantages of these interdisciplinary offerings include:

- **Broadening participation-** some of the students who enroll in the coordinated/interdisciplinary course are students who would not have enrolled in a single geoscience course, but are drawn to the course by the theme of the coordinated course.
- **Student retention-** Increased student retention has been observed in interdisciplinary courses in a study conducted by the Washington Center for the Improvement of Undergraduate Education at The Evergreen State College.
- **Learning community-** Since these interdisciplinary courses meet more hours per day, students form closer ties with other students. These bonds could be an important factor in increasing retention.
- **Faculty Development-** I have had the opportunity of working with a variety of faculty from physics, chemistry, biology, astronomy, history, English, and art in coordinated classes. I have learned new approaches to instruction as well as more about the topics in these disciplines.
- **Intellectual development-** Many students do not make the connections between their various classes and they become very motivated by the synthesis of ideas that happens in a coordinated studies class.
- **Continuation in Geoscience-** Although I do not have data to support this claim, I believe that students who have been in coordinated studies classes are more likely to take another class in geoscience compared to students who took a stand alone geoscience course.

I have heard instructors from other colleges say that this approach is a good idea, but it would not work on their campus. I am sure that there are some situations where this may be true, but there are many different modes of interdisciplinary classes and some of these modes require almost no structural changes to existing courses. Learning communities in coordinated classes are a great opportunity for geoscience faculty to become connected with other faculty in their institution.

Although interdisciplinary courses do not solve the geoscience community collaboration we need, this coordinated studies/interdisciplinary approach is an excellent opportunity for people in one-person departments to work with colleagues and find support within one's own college that ultimately benefits the students.

<u>Creating your own Community</u>

Kaatje Kraft
Mesa Community College
Mesa, AZ

A common issue for geoscience faculty at two-year colleges is that of isolation. I have found several strategies that have been helpful for me in addressing this issue. The added benefit has resulted in opportunities to advocate for geosciences at the community colleges and students enrolled in our classes.

One approach to addressing feelings of isolation are to create a community of colleagues around a scholarly idea. For example, I worked with colleagues in various different science (e.g., physics, chemistry, biology, psychology) and math disciplines in developing a common understanding of the Nature of Science. We were part of a faculty and professional learning community as originally described by Milt Cox at Miami University in Ohio (http://www.units.muohio.edu/flc/). We worked to reform our curriculum in each of our individual classes through informed discussions and readings. This community of colleagues helped me to find a place of comfort and a professional sounding board in order to explore new teaching approaches in my classroom. More information about our learning community and some of the findings from this two year endeavor are at:
http://ctl.mc.maricopa.edu/wiki/index.php/Nature_of_Science_FPLC_2006-7 .

Another approach to addressing feelings of isolation is to attend professional development programs that are appropriate for multiple types of institutions. It is rare to find a workshop that only addresses the needs of community colleges. However, attending professional development with multiple institutions serves two purposes—1) you learn more about something that you can take back to your classroom; 2) you help to remind our colleagues at four-year institutions the importance of students at the community college. While money for professional development programs are not always available, there are occasionally travel grants available (of which I have been a beneficiary). Stepping out and interacting with others outside our own campus can help to foster new ideas and new collaborations.

Many times the conversations that occur outside of the official workshop are some of the most valuable that can be gained for future possible collaborations and conversations (never underestimate the power of the conversation at the bar!). For example, I attended the workshop on the, "Role of the Affective Domain in Teaching Geosciences" (http://serc.carleton.edu/NAGTWorkshops/affective/workshop07/index.html). This not only changed my entire mindset to teaching (and helped to confirm some of what I already knew/practiced), I developed some very powerful connections with other colleagues that continue to this day. For example, I am currently a part of a Phase I CCLI grant (http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0914404) in which we are gathering data on student attitudes and motivations in introductory geology classrooms.

The most important thing about these types of collaborations is helping colleagues at four-year institutions realize that the community colleges are uniquely situated to help support a missing link in the geoscience pipeline. If forty-four percent of all undergraduates are attending a community college (AACC, 2009), and the introductory geology class is a common general studies class, we have a large resource pool that university programs should *want* to target. If we want our students to be successful, if institutions want to broaden participation in the geosciences; we not only deserve to be at the table, we *must* be at the table.

American Association of Community Colleges. (2009). *Community College Facts at a Glance*. Washington, D.C., Available at: http://www.aacc.nche.edu

Eric Baer

Highline Community College

What have you found to be most successful in broadening participation in the geosciences at your institution and what made it successful? Consider what aspects of this success are translatable to other two-year colleges.

The most successful action was offering many introductory classes. This allowed students to take multiple introductory level classes and raised enrollments throughout. Furthermore, by having students take multiple classes we usually have a few students in each class that have had a previous class and so are more advanced. These students raise the educational achievement of all by becoming informal leaders.

What are one or two examples of what you've done that has been successful in terms of promoting earth science literacy, developing the geoscience technical workforce (students entering the workforce following their associates degree), and/or preparing future geoscience majors?

1) I have takes geoscience students on a field trip to visit an undergraduate friendly geoscience program so they can see the department, talk to students, and talk to advisors/faculty.
2) To promote Earth Science literacy, our local geologic hazards class has been very beneficial, often getting news coverage and high enrollments.

What strategies have you or your program used to meet one or two of the challenging aspects of teaching at a two-year college?

The most notable strategy is MathPatch/the Math You Need When You Need It – providing support for students with quantitative skill deficiencies.

Describe one aspect about your experience/expertise related to geoscience education and/or broadening participation in two-year colleges that would be useful for others.

I think the development of a local geohazards class was is the expertise that would be most helpful, although I am not sure how unique it is.

Fostering Communication Among 2-year College Geoscience Faculty: Trials and Tribulations

John W. Bartley
Muskegon Community College, Muskegon, Michigan

What strategies have you or your program used to meet one or two of the challenging aspects of teaching at a two-year college?

Ten years ago, I was a participant in the first planning workshop for broadening participation of 2-year colleges in geoscience education. Since then, some changes have taken place to improve things for 2-year college geosciences, but many of the concerns and problems shared among the participants at that first conference are still with us—limited resources, professional isolation, the absence of a national organization devoted to 2YC geoscience education issues, etc.

One of the issues discussed at that first workshop was the lack of communication and sharing of ideas between 2YC geoscience faculty. Most 2-year colleges employ only one geoscientist (if they have any), in their science departments, which can lead to a sense of isolation. Several of us at that time were also involved in the planning process of the Digital Library of Earth System Education (DLESE), and we were successful in starting a discussion group for 2YC faculty that resided in DLESE. This was essentially an email list, and it attracted some interest and discussion among 2YC geoscience faculty, but it was short-lived. Interest waned, and within two years the list was inactive. Recently, a new email group dedicated to 2YC geoscience education issues has appeared, thanks to Heather Macdonald and the Science Education Resource Center at Carleton College (SERC). Although the list has an extensive subscriber base (more than 600 email addresses), to date there hasn't been much activity from 2YC faculty—mostly announcements (posted by Heather), of professional development activities that might be of interest to 2YC faculty, including the workshop for which this essay is being written ☺.

However, email may not be the ideal medium for engaging others in discussion about topics of interest. My opinion comes from two different professional experiences: teaching online and serving on the executive board of the Michigan Science Olympiad (MSO). While the former has clear ties to the challenges faced by 2YC teaching, the latter may not be so obvious, until we consider the fact that both involve the timely exchange of information related to a single concept or group of related topics. Although discussions can be carried on via email, the experience is often less than satisfactory, because the conversations become fragmented, there is often no easily retrieved archive of previous conversations, and a host of other problems with which I am sure most of you are familiar. This problem is easily solved in online teaching through the use of discussion boards included in the content delivery system (e.g., Blackboard or Moodle), but these technologies are not applicable to an organization like the MSO board.

To solve our problem, we (MSO) recently started a group on LinkedIn, a web-based networking service. This has met our needs well, keeping conversations focused, and providing an archive of past discussions that can be accessed easily for future use. I believe that a similar group should be started for 2YC geoscience educators, hosted on LinkedIn or a similar service, or perhaps hosted by SERC as a follow-up to this workshop. I believe that one of the reasons our earlier attempt at fostering a 2YC discussion group failed was due to the shortcomings of communicating via email, and that we might be more successful by using a different strategy in the future.

Allison Beauregard
Northwest Florida State College

What strategies have you or your program used to meet one or two of the challenging aspects of teaching at a two-year college?

Being at a small community college, with only three geoscience instructors and very limited resources, I find the following to be among my biggest challenges:

> 1) providing challenging activities for the top students, interested in pursuing a career in geosciences, while still engaging the general education students, interested in receiving course credits and in moving on; and
>
> 2) lacking a community of geoscientists, with which to network and collaborate.

In a small department, we do not have the resources to offer separate courses or sections of courses for students intent on entering 4-year geosciences programs from those who are only enrolled in courses to satisfy their general education science requirements. In such a situation, the range of student interest, motivation, and background knowledge is vast and it is difficult to both engage the general education students, while at the same time providing a valuable learning experience for the more advanced students. At the same time, I have found it difficult to maintain my own energy and enthusiasm for my position without a network of colleagues with which to interact, discuss ideas, brainstorm, and collaborate. Through collaborations with 4-year University and research faculty, I have found a way to manage both of these challenges simultaneously.

As an example, I have been working on a collaborative project with, Dr. Julie Huber, a research Oceanographer from the Marine Biological Laboratory in Massachusetts. This project is a unique education and outreach effort that links my community college students to cutting edge oceanographic research and has been funded by the National Science Foundation. There are several components to this collaboration, including:

1) On-going communications during my *Introduction to Oceanography* course with Dr. Huber during the semester. These communications include:
    a. In class chat sessions via Skype from her laboratory/office in Massachusetts, as well as from the port of call as she was heading out for a research cruise, during which students could ask questions about what life on a research ship is like, how long does it take to load the equipment onto the boat, and how do you study deep ocean bacteria?.

b. Web blog where my students could post questions to Dr. Huber while she was actually on board a research cruise and she could post answers to their questions. Students asked questions about the progress of the research, the weather, the food, etc.

c. A shared experience between my students and Dr. Huber, during which students saw photographs of a new underwater research vessel that was being tested during Dr. Huber's research cruise and listened as she explained the instrument and how it was being used. To illustrate the immense pressure that the vehicle would encounter in the deep ocean, students decorated Styrofoam cups and sent them to meet Dr. Huber on her cruise. During the cruise, Huber's team of scientists attached the cups to the vehicle during one of its deployments. Because of the extremely high pressure experienced deep in the ocean, the cups shrunk down to about a third of their original size. After the cruise, Dr. Huber sent the research souvenirs back to the class.

2) A summer research internship for four exceptional community college students to work directly with Dr. Huber in her lab in Massachusetts conducting research on microbial life from the deep sea vents.
3) Development of deep sea vent curriculum geared specifically toward the community college setting that incorporates Dr. Huber's ongoing research and results for future dissemination.

This connection of community college students with world-class scientists in the field promotes better understanding of research and potentially may encourage more students to major in the sciences. It provides some exciting activities for the non-majors to stimulate interest in the topic of oceanography, but also provides valuable information on careers and cutting-edge research for the more advanced students. Additionally, the internship program provides a very unique experience for my students to gain some hands-on exposure to research that I cannot provide at my community college. And finally, this collaboration has allowed me to maintain a connection with current research in my field of oceanography.

Callan Bentley

There are a couple of items I'd like to touch on in this essay. Given the breadth of possible questions, I think it would be fair of me to mix and match a bit. So I intend to cover three things here, from general to specific: (1) quality, (2) field work, and (3) blogging.

Quality

One of the 'prompts' provided by workshop organizers asked: "What have you found to be most successful in broadening participation in the geosciences at your institution and what made it successful?" While I could talk about many things here, I think the #1 item that draws students to our classes is quality. My colleague Ken Rasmussen and I have developed a reputation for high standards, enthusiasm, and dedication which recruits more students to our courses than any other variable. Our enrollments have been consistently strong, and our reviews good. Here are some example comments from the website RateMyProfessors.com:

> His lectures are fun and interesting and his use of hilarious analogies keeps the class intrigued in the material. He also teaches through example which I found extremely helpful, like when he shows the class geologic formations in different countries or compares geologic landmarks to Led Zeppelin music videos.
>
> He is extremely helpful, funny, and really enthusiastic about geology, which totally helps learning about it. He is really easy to talk to if you're having problems, but you have to work to get that "A". Study your notes and read ahead and be prepared to think in his class. Highly recommend!

In spite of the current economic downturn, rising enrollments throughout NOVA and maxed-out geology classes every semester led our dean to propose (and get) a third full-time geology faculty person for our campus. This person will start in the fall semester. I find this quite extraordinary for a community college, but see it as a *Field of Dreams*-style "If you build it, they will come." We've built up a strong program, and the students are pouring in. Many NOVA students transfer to George Mason University, and the GMU geology majors are consistently about half NOVA transfer students, and half "home grown" at GMU (with much larger throughput of introductory level students).

We aim for quality in our pedagogy and our lab space and our diction. We dot our i's and cross our t's. I see our dedication to quality as our greatest strength. While this is extremely general, it's also simple real, and it's what keeps the students coming in. I suggest that it should be transferrable to other institutions.

Field work

With one exception, all our classes involve field trip components. My own classes all have mandatory field work components, while other instructors opt for optional field trips. I feel passionately about the power of the field experience to manifest learning that would take longer to soak in via lab work or description in lecture. A consistent theme in my end-of-semester evaluations is that the field trips were a key part of the students' learning experience. They like the break in routine, they like exploring on their own, and they like having the professor guide them through the experience. Many of my Physical Geology students report that the field experience on the Billy Goat Trail is a fundamental "aha" moment, where various concepts originally learned in class come together and form a cohesive picture, like separate threads merging to form a tapestry. A multiyear self-study that I have conducted on field work backs up these claims with quantitative and qualitative data. Our administration supports these field experience by loaning us college vans, paying for gas, and covering the insurance of the field experience. We are very grateful to them for this support.

Blogging

Finally, a unique aspect to my own situation at NOVA is that over the past 2.5 years, I've been writing a public-interest geology blog (contraction of "web log"). This blog (*Mountain Beltway*) serves many purposes: an archive for my own thinking, an interconnected web of communication with other geology-interested people (industry, faculty, students, general public), an opportunity to try out concepts, and a place to share geology, and thus revel in its mysteries and satisfactions. I've gotten a lot of 'geo-blogging,' and I'm not alone. A growing number of geoscientists around the world are committing their thoughts to the Internet, making available a wealth of experience, perspective, and geography. I know that my blog has been a

For example, a student e-mailed me with a question, seeking to clarify a concept that had come up in class, about using bedding/cleavage relationships to determine whether bedding has been overturned. Rather than just replying to his e-mail, I went a step further in my explanation, and then posted it on my blog for all to see. I sent my student the link to the blog post, and then I sent it to the rest of the class, too. A few weeks later, that blog post was still teaching people, and not only in my classes. It garnered this comment:

> I'm an Auburn student currently studying for a Structural final and you have no idea how much this helped! Great explanation and pictures! Saved me a huge headache, thanks from me and the countless people from my class I'm going to have to explain this to now!

The blog has been a source of much positive feedback for me, and it has led to several other opportunities: a research collaboration, a fellowship with the Fine Outreach for Science, and inclusion of some of my blog-hosted images in papers and books. My connections with other geobloggers has been rich and rewarding, with experiences that range from getting together to drink beer at GSA meetings to free lodging while travelling cross-country. Blogging is free. It's a public service, and it makes you a better teacher because you practice expressing concisely the same concepts you teach in class. In the long term, blogging generates a rich online resource that your students can access and learn from, and so can other students (formal or informal) from around the world. It can take as much time or as little time as you want to devote to it, but I have found it to yield rewards well worth the time I invest in it.

There is one other 2-year-school geoblogger that I know of: the talented and prolific Garry Hayes of Modesto Junior College, who authors *Geotripper*. Will you join us?

Faculty-Librarian Collaborations

Karen Berquist, College of William and Mary

What's a librarian doing at a 2yc Geoscience Workshop? Unlike you, I don't grade hundreds of pages every semester; don't hustle to prep for six or more lectures a week, and don't navigate daily challenges from administration and students. I am a geoscience educator in the broadest sense of the term. You might also call me an 'embedded librarian' in the science departments of a 4yc. There I collaborate with faculty, students, and other librarians to support their teaching and learning. Years ago that job was very collection-oriented. Now we focus on instruction and resources. Collaboration is the keyword. Just this week, the American College and Research Libraries (ACRL) Research Planning and Review Committee listed collaboration as one of the Top Ten trends in academic libraries. (*June 2010 College & Research Libraries News vol. 71 no. 6 286)*

What does that mean for you? You teach heavy course loads to a diverse student population, incorporate distance learning, and design assignments that are relevant and engaging. Collaboration should make your work easier and more efficient; it should provide a sense of support and connection for you, the faculty member and it should enhance the experience of your students at every level. How does faculty-librarian collaboration work at your 2yc?

In our institution librarians work with faculty to provide instruction related to specific assignments, prepare course guides, and ensure that faculty and students have the resources they need. Faculty-Librarian collaborations can also reach beyond the home campus. As the numbers of community college transfers into our university increased, I became more aware of our 2yc colleagues. When Thomas Nelson Community College opened a new branch in our area, I arranged a tour for our library staff. Seeing their limited resources, I worked with the TNCC geology instructor and his librarian to indentify key resources for purchase. I was also able to provide new and gently used books and maps for their young collection. Some of those resources were kept on high-profile display in the new library, a promotion of sorts for the geology department!

Collaborations can bust isolation, enhance limited resources of time and materials, and help us keep up with technology and the changing challenges of connecting with our students, whether they are part of the Greatest Generation, Boomers, Gen X, Millenials, or Net Gen.

During the workshop I look forward to hearing how you work with your campus librarians. I would like to use a web-based program, College Guides, to organize links from each of you. Together we can determine the categories: e.g. Web Resources, Online Instruction, Field Trips. I look forward to learning from you as well as offering the expertise of a subject-specialist from the library world. Collaboration: it makes all of us work just a little bit smarter!

Pete Berquist
Thomas Nelson Community College

Most students enrolled in my geology courses may never take a science class ever again, yet I find it likely that the will discuss a scientific topic at some point in their life. Therefore, I feel very strongly that students gain experience communicating moderately technical information to a variety of audiences. One challenge with my courses is that it is not until the latter third of the semester that we focus on more charismatic aspects of geological carnage and processes more obviously related to everyday life beyond igneous, metamorphic and sedimentary rocks. In response to maintaining students' interest and understanding of fundamental geologic principles and their broader implications to Earth processes, I've created an earthquake monitoring project that lasts for several weeks and culminates with a final paper. By the time the assignment is delivered, students have learned about minerals, rock forming processes (including the three major rock types) and Plate Tectonics, and they are starting to delve into learning about earthquakes. This project requires students' interpretations to be built upon the information covered earlier in the semester, to compile information regularly from the United States Geological Survey, and to practice communicating technical information to a range of audiences.

The project starts by students accessing the USGS Earthquake monitoring website and choosing any area in the world that they wish to monitor for seismic activity for two to three weeks. Their monitoring area must be a 10x10-degree map area. Twice a week, students access their 10x10 map area and record any earthquakes that have occurred since the last time they checked in. Information about each event (including magnitude, depth, and date) is entered into an "Earthquake Log", which should be a Word (or similar format) document. Once a week, students post a summary of their area's seismic activity on a discussion board. For full-credit, they must reply to another student's post with a thoughtful reply.

The monitoring, discussion board posts, and documentation of earthquake activity comprises half of the project. The final portion of the project requires students to write a paper that requires background research on the tectonic history of their area, summarizes the earthquake activity that occurred during their monitoring period, and speculates on what sort of tectonic setting their area will be in the future (at specified time intervals of 1Ma, 10Ma, and 100Ma). Furthermore, students must predict what types of rocks they would expect to find in their area based on their understand of the tectonic environment and association of rock forming processes specific to tectonic settings.

This paper serves as a sort of capstone project by requiring students to incorporate content covered previously in the semester. For example, they use empirical information about earthquakes and identification of physiographic features to resolve the tectonic setting of their monitoring area (covered during our study of Plate Tectonics). Identification of lithospheric composition and plate motion is married with their prior understanding of rock forming processes to predict what rock types they would expect to find within their environment.

Student's gain earth science literacy by reading through a variety pages within the USGS website. The assignment requires gathering general and technical information, which is easily accessible via the USGS. Two goals for this project are for students to realize how easy it is to obtain this range of information and to become more familiar evaluating reputable and authoritative online resources.

In addition, I challenge students to further develop their earth science literacy by fostering an ability to clearly communicate technical scientific information with family, friends, and classmates. The project accomplishes this goal by requiring the final paper to be written in two distinct styles: some portions (for instance, the introduction) should be written at the level that the general public could understand and other portions are communicated at a more technical level. In the words of a committee member on one of my theses, a good thesis should include "a grandma paragraph". That is, the paragraph that your grandma could read and leave with an understanding of what you have worked on for the last 4 years. Although my students may have only spent three to four weeks on this assignment, I feel strongly that they practice summarizing a multi-step project with technical information to a non-scientific audience.

My experience with this assignment has been quite rewarding. I find that students who seemed dormant for most of the semester commonly become quite engaged in monitoring their areas and keen on applying previous course content. I also tend to find students asking me questions more frequently; trying to clarify information they've read during their monitoring or research. By not assigning monitoring area's students are more vested and interested in learning about their region and this is easily documented in their initial discussion board post which includes an explanation about why they choose their area. The final products clearly speak for themselves in terms of providing a meaningful experience accessing and interpreting data, learning technical information about earth processes, and attempting to communicate technical information to non-scientific audiences.

Build It and They will Come

Robert H. Blodgett
Austin Community College

A project to construct a groundwater monitoring well on an Austin Community College (ACC) campus provides a number of lessons on using limited resources to improve geoscience education at a two-year college. The project started with the help of Francye Hutchins, an enthusiastic 40-something geology student who though ACC should celebrate the first Earth Science Week. Still ongoing, the well project has received donations of equipment and services from seven businesses, government agencies and non-profit organizations; dozens of hours of volunteer consultation from local hydrogeologists; media coverage in event attended by a state politician, students, and college officials; and after several years of success, a 200 square-foot wellhouse and teaching facility built by the college.

The first lesson learned is to use the enthusiasm and personal/professional connections of geology students to extend educational resources. In addition to being an ACC student, Ms. Hutchins worked as executive assistant to the director of the Texas Mining and Reclamation Association. She used her connections with geologists at Alcoa's Sandow Mine east of Austin to set up a meeting about drilling a well at ACC during Earth Science Week. Initially proposed as a boring to take a core for ACC geology courses, Alcoa approved expanding the project to an automated monitoring well in the Edwards aquifer. Francye also used her connections to obtain an Earth Science Week proclamation from the governor, invite a state official to a ceremony for the well, and a donation for videotaping the well drilling.

A second lesson learned is that a great deal can be accomplished by a grassroots effort. Once Alcoa had offered to drill the well a meeting was arranged with the Campus Manager and Vice President for Facilities Management to identify an acceptable location. No one at the meeting asked about approval for the project, probably because it was to be used for instruction and was a donation to the college. In fact, the entire project has moved forward by asking for volunteer help and donations – there has never been a formal plan, grant proposal, or administrative approval.

The third lesson learned is ask for what you need, let as many people as possible know about your needs, and continue asking until the need is met. One need for the project was a geophysical and video log of the well. Phone calls to the state geological survey produced the name of a manager at Schlumberger, an international well logging firm. When the manager learned that a state oil and gas commissioner was speaking at the Earth Science Week ceremony, he was ready (based on a telephone call!) to have a Schlumberger logging truck arrive for the event. Unfortunately the truck got diverted and Schlumberger was unable to schedule a latter date, so the need was unmet. Additional calls and emails to local groundwater consultants produced the name of a fledgling logging firm in San Antonio who wanted to expand their market in the Austin area. The firm donated both a geophysical and video log of the well that are used each semester in geology classes and will appear on the Web page.

A fourth lesson learned is that publicity generates enthusiasm, which creates a positive feedback loop. Enthusiasm for the well project has been contagious – students, staff, faculty, and local geoscientists have all been involved with the project. A technician in the computer science department learned about the project and volunteered to administer the computer server for the well. Another science laboratory technician has taken ownership of weekly pumping and data collection on the well, and a third has assumed responsibility for technological upgrades on donated monitoring probes. Additional enthusiastic support has come from a groundskeeper, electrician, telecommunications technician, graphics artist, and computer programmer.

A final lesson has been to approach the use of technology cautiously and expect that most tasks will take longer and be more difficult than advertised. Without specialized technical support dedicated to the geology program, there are major limitations to using advanced scientific instruments and computer applications. ACC's geology program faces this every semester – from security concerns for the well's Website, to new computers and software, and WiFi bandwidth limitations for using Goggle Earth. Whereas technological advances can be both exciting and educationally rewarding, the frustrations of faculty and staff must be continually addressed or enthusiasm will wane or they may meet resistance.

Engaging in a focused geoscience project, such as a groundwater monitoring well, installation of an IRIS seismograph, participation in the Globe Project, water quality monitoring of a stream, lake or estuary, installation of a weather station, or a survey of potential sources of groundwater contamination can reap a multitude of benefits. They include visibility within the college, authentic experiences for students, community service, and an increase in pride and self-esteem for students, staff and faculty. ACC's groundwater monitoring well project provides a number of lessons on how to accomplish this with limited resources. These include engaging students, non-geoscience staff and faculty, and the community in a well-publicized project; using national events, such as Earth Science Week or Earth Day, to focus attention on geosciences at the college; and continuing to ask widely and often for the needs of the geoscience program.

Joy Branlund
Southwestern Illinois College

A main goal of mine is to show students that everyone can do science, that science can and should be understood by all citizens, and that there are benefits to thinking scientifically. In short, I stress science literacy in my geoscience courses. The purpose of this essay is to address the importance of community colleges in geoscience education. The link between community colleges and science literacy is this: stressing science literacy at community colleges will positively change the way science is viewed an integrated in U.S. politics and society. This bold statement reflects the fact that many adults will take their only post-secondary physical science at a community college. We should not underestimate the roles of community colleges in creating educated and engaged citizens.

I approach science literacy differently in the two courses I teach. The process of science is a focus in Earth Science, whereas the relevance and accessibility of science is stressed in my Physical Geology course.

The Earth Science course, a survey of geology, astronomy, meteorology and oceans and climate, is the preferred physical science course for students needing to fulfill the general education requirement. In this course, I explicitly teach the nature of science. First, students identify what they already know about science. During the first day of class, students are asked to identify whether or not a given question and answer are science (Question: How old is Earth? Answer: That provided by James Ussher). Students then work in groups to compose a definition of *science*. To provide a formal foundation, students read a chapter on nature of science published by the National Academy of Sciences which provides rigorous definitions of scientific terms, like *theory*, *law*, *observation*, *fact*, as well as providing examples (Ch. 3 Evolution and the Nature of Science, in *Teaching About Evolution and the Nature of Science*, National Academy Press 1998). Nature of science is applied throughout the semester. The first and last labs are full inquiry, in which students pick questions and find answers using self-devised hypotheses and experiments. The course content allows for several theories to be studied in light of the observations they explain and predictions they make. Specifically, students take detailed looks at plate tectonics and its explanations of earthquakes and landforms, and then use this knowledge to predict whether or not Venus, Mars and the Moon have plate tectonics. In astronomy, students predict how stars, the Sun and Moon should move in the sky based on the heliocentric theory, and then determine how the theory explains other observations, such as the phases of Venus and stellar parallax. Students even read excerpts from *Dialogue Concerning the Two Chief Systems* and interpret Galileo's logical arguments for the heliocentric theory and against the geocentric theory. In meteorology, students use weather observations to test the theory of pressure and winds, and then use pressure observations (isobars on weather maps) to predict wind directions and relative speeds, and to explain the present weather. Finally, after in depth coverage of these three theories students can analyze theories of atmospheric convection as well as the global warming hypothesis. Throughout the term, care is taken to use science terms, such as theory and observation, correctly and often.

Although nature of science topics are embedded in my Physical Geology course, they are not so explicitly addressed. Instead, the focus is on science relevance: how science (geology) is all around and accessible to us as well as the importance of geology to society. In order to stress the all-around-us nature of science, topics are presented in context. Reading assignments, photographs and/or maps impart information about places where geological processes act and the provided rock samples originate. Inquiry-based activities, often using physical models, allow investigation of geologic processes. Again, use of these models demonstrates how scientific questions can be answered with relatively simple and accessible tools, and stresses that anyone can do science. As an example, to study stream processes, students (a) read an excerpt from Mark Twain's *Life on the Mississippi*, (b) use stream tables to answer questions about stream evolution and factors that affect stream flow and erosion/deposition, and (c) use the stream table to model regional impacts of human changes to the Mississippi (e. g., local levee construction).

When I teach, I'm not out to covert majors, instead I aim to encourage future K-12 teachers to consider science as a focus and encourage all students to do science, especially with their children. Although I have no assessment data showing that the aforementioned teaching approaches improve students' understanding or liking of science, I do have antidotal evidence that students are relatively at ease with science and trust scientific results at the end of the semester. Ideally students will retain these positive views of science, share them with others, and help build tomorrow's scientifically literate populace.

Eleanor J. Camann
Red Rocks Community College

When considering the strategies our program has used to meet some of the challenges associated with teaching at a two-year college, our effective use of non-traditional courses and transfer agreements immediately came to mind. I have only been teaching at the community college level for a couple of years, so I was not the first to initiate these tactics here at Red Rocks Community College, but I have found them to be very effective and think they're practices worth continuing and sharing with others who work in a similar setting.

One of my concerns when deciding to change jobs from a university with a geoscience department and plenty of geology majors to a community college was related to the fact that I would no longer have the opportunity to teach specialized upper-level courses. Along with that, I also feared that I would only be able to teach the same two courses over and over again, leading to boredom. Physical Geology and Historical Geology are indeed the only two geology classes that we currently offer that are typically easily transferable to universities to count for equivalent coursework. In fact, they are guaranteed to transfer to all public schools in Colorado. On the other hand, our other courses usually end up transferring as electives. Since most students taking science courses at our institution are intending to transfer to another school to earn a 4-year degree, they are usually reluctant to take courses that may not fulfill a specific requirement for their degree, because they do not see the immediate benefit. Since there are minimum enrollment requirements for our courses, traditional 3- and 4-credit courses are therefore usually not viable if they are not part of a transfer agreement. As is true at most 2-year colleges, students also don't remain at our school long enough for us to be able to teach upper-level courses.

Therefore, as a way of adding variety and specialization to our course offerings, boosting enrollments in geology courses, and helping to meet our students' needs and wishes, we instead offer a number of introductory (no-prerequisites) 1-credit and 2-credit weekend classes on a wide variety of very specific geologic topics. For example, the courses "Gems, Crystals and Minerals", "Rock and Mineral Identification", "The Great Ice Age", "Continental Drift", "Introduction to Global Positioning Systems", and the "Geology and Evolution of Caves" are currently on the books for the Colorado Community College System (although we may be the only school to teach some or all of them). I am continuing the practice of scheduling them either once a year or every semester. We also offer special topics courses in that same format. This coming fall, "Survey of Mars" and "The Geology of Rocky Mountain National Park" are scheduled. Students are more willing to take these courses out of interest, whether or not they will meet a specific requirement, than they are likely to register for a higher credit course which meets for many more hours. They are also popular as "schedule fillers", for students who just need 1 or 2 more credits to have full-time student status for the purpose of financial aid, etc. Furthermore, because of the condensed weekend time frame, they are popular with people who are working full-time and/or with non-degree seeking students who have an interest in the subject matter. The two mineral classes are particularly useful for K-12 teachers who need a refresher or who are seeking a certificate of specialization. We also schedule one of them just before the big Denver Gem & Mineral show every fall, and both the show and the class typically attract a number of interested "rockhounds" in the local community. Since enrollments are up college-wide and classroom space is at a premium and fully booked during the week, these classes also have the advantage of allowing us to offer more courses than we would otherwise be able to if we taught only traditional courses during weekdays.

From the teaching perspective, one of the nicest things about these short courses is that they can be scheduled so that full-day field trips are possible. They are also ideal for focusing on local geologic features that might not get full attention in broader introductory courses. They add a welcome variety to teaching duties and allow instructors to focus on areas that they are specialists in and/or find particularly interesting. In addition, they are great ways to give students the chance to learn from local experts, and they help build ties between our school and the organizations that employ geologists in the local community. For example, many federal agencies have offices close by, and our caves class has been taught for many years by the head of the caves program for the National Park Service, and our Mars class is being taught by a planetary geologist at the USGS.

The other way we add variety to our course listings and teaching assignments - and manage to attract students to courses that don't fulfill specific requirements - is through our very successful field course program. We offer a 3-credit "Geology of Colorado" class on weekends every summer. More unusually for a community college, I have continued with an ongoing long-term collaboration with others in the Science Department to teach extended field geology/biology courses, in which we have preparatory class meetings during the spring semester and then travel during the time between the end of the spring semester and the beginning of the summer session. Last year we took a group to Hawaii and this year we are going to Costa Rica. The students earn 7 credits, have life-changing experiences, and often become inspired by the hands-on nature of field work to pursue further coursework or even careers in science. Instructors get to work closely with colleagues in an interdisciplinary setting and become knowledgeable about the geologic and biologic features of various different locations. I have particularly appreciated the fact that I get to focus on my area of expertise and teach about coastal geologic processes in these classes, in a way that I normally can't do effectively in the landlocked state of Colorado, where there hasn't been a sea for many millions of years.

The second challenge I would like to briefly address is the need to do everything possible to make sure that our "primary" courses (not the electives I described above) do indeed transfer to 4-year schools and fulfill requirements at those institutions, and therefore meet the needs of our students. As mentioned previously, our Historical Geology and Physical Geology courses are guaranteed to transfer as those same courses to all public institutions of higher education in the state of Colorado. Environmental Science (which I also oversee) does, as well, and I hope to work toward this same status for Environmental Geology. Many students taking science classes at our school have the intention of transferring to Colorado School of Mines (CSM). In fact, we are the largest "feeder" school to that institution. Although that school does not offer courses with any of the above titles, it does require EVERY undergraduate student to take a 4-credit lecture/lab course called "Earth and Environmental Systems" (SYGN 101). So our faculty, administrators, and advisors worked to form a transfer agreement directly with them. For many years, the agreement required students to take two of our 4-credit classes (Physical Geology and Environmental Science) to count for that one course. Last year, to the benefit of our students, the agreement was changed so that now only Physical Geology is required. The assurance of transferability is invaluable in attracting students to that course. The main point here is the importance of general transferability OR, if that is not possible, creating relationships with individual universities to which a lot of students want to transfer.

As described above, transfer agreements and offering non-traditional courses such as our extended field trips and 1- and 2-credit weekend courses have both been effective strategies at making the geology program a strong one at our institution. Other schools could also benefit from these approaches. Anything that can be done to demonstrate that a discipline is viable and in-demand helps to strengthen the case for its continued existence at an institution, even when cutbacks are being made.

Earth Science Literacy: It's Happening All Around You. Use It

Paul Cutlip

St Petersburg College

As with most education, one of the most important aspects of effective geoscience education is making the material relevant to the students' "everyday lives". Without exception the most popular unit I teach each semester is volcanoes (nothing sells quite like death and destruction). But without a doubt, when I am discussing things that the students feel will actually affect them they become much more meaningfully engaged. We are in a unique position in the geosciences, we are teaching topics that are becoming more and more a part of the public policy discussion in this country. From global warming to oil spills geoscientists have something useful to say about a lot of what's in the news, doing so engages our students like little else, and not doing so does them a disservice.

Perhaps the easiest way to make geosciences relevant is to incorporate what's in the news into lectures and other learning modalities. Sometimes I am able to simply use what's going in the world as an example to spark discussion. Other times though, events are just too timely to wait for the appropriate unit. The recent earthquake in Chile following so closely after the earthquake in Haiti provided an opportunity that was simply too good to wait till the earthquake unit. Are earthquakes in Haiti common? Are earthquakes in Chile common? How did the size of the two earthquakes compare? Given the size of the earthquakes why was the one in Haiti so much more devastating? These were questions that the students walked into class with. Answering these questions provided me with the opportunity to talk about different tectonic settings, the scales we use to measure earthquake intensity, and importance of building codes and effective governance in disaster preparedness and response, all within a "pre-made" context that had the students interested before they even walked into the classroom. The students were anxious to know more than the news was telling them and, I think, enjoyed having a sort of "leg up" on the people around them when it came to understanding these events.

Convincing students that what's going on in the news is important is easy. The very fact that it's in the news makes it "important" so all that's left for us to do is explain what's going on. What's far harder, but perhaps more vital, is to convince students that the rest of the material that we're covering is also relevant to their lives. Nevertheless, promoting earth science literacy requires that we do this. There are a few ways I try to make earth science concepts relevant. First I never EVER teach anything without context, I place everything in the real world. As earth scientists ourselves the material we teach in just inherently interesting to us. We need to not forget that this is not the case with our students. I never teach minerals without making sure they understand the economic geologist's adage "look around you, if it wasn't grown, it was mined". Second, as I mentioned before, I always keep current events close at hand when looking for lecture example and case studies. Finally, I turn it back on the students, asking them either in class discussion or as part of a more formal assignment how particular topics affect them. The answers are frequently surprising.

I promote earth science literacy by making sure that students understand that what they're learning involves the "real world" and can be applied to what they see going on around them right now. I try to make sure they understand that science does not exist in a vacuum and that getting the science right potentially makes life better for everyone, while getting it wrong can have dire consequences.

Pamela Gore
Science Department
Georgia Perimeter College

Georgia Perimeter College enrolls more freshmen by far than any single 4-year institution in the State. In Fall 2009, nearly 15,000 freshmen were enrolled at GPC, compared with only about 5000 at the University of Georgia and similar numbers (4000-5000) at several other colleges and universities in the State. While there are 33 Geology majors, fewer than 5 students graduate each year with a Geology degree. The other students transfer directly into 4-year institutions before graduation through our Transfer Admission Guarantee (TAG) Agreements, which guarantee acceptance at one of approximately 40 4-year institutions, when maintaining a particular GPA and amassing a certain number of credits. At one time, we were told by a local University that GPC transfer students performed better and graduated at higher rates than students who started at that university.

Teaching at a 2-year college has a number of challenges. Many of the students are older, so we face issues not typically seen at a 4-year institution. Colleagues at a 4-year school were stating that all first-year students should live in a dorm. My immediate comment was "what would you do with all of their children?" They did not seem to understand my question. Students quite frequently have issues relating to their children – leaving class early if a child is sick at school, for example, or asking if they can bring their children on a geology field trip. A young black male in my class this semester had three small children. Many semesters I have several pregnant women in my class, which makes field trips difficult. This semester I had a young man confined to a wheelchair – we could not take him on a fieldtrip to a local museum because we did not have a van which could transport a wheelchair. Unlike at a 4-year school, many of our students work – and sometimes work "full time" to support their family.

The average age of students at GPC is about 24 years. This semester I had a 63-year-old white female Geology major in my class. The other Geology major I had was an Asian male in his 20's who scored 99% or better on virtually everything all semester.

We have many successful geology students. I heard from one this week who took Geology online with me in 2003, and he emailed that he had just completed his Masters degree in Geology at UGA. He is 42 now - an "atypical" student. He had worked in business until he saved up enough money to go back to school to study geology (which he wished he had studied the first time around).

A white male hairstylist who owned his own salon studied Geology with me online a few years back. He sold his salon, and is now working part-time and focusing on grad school.

Sometimes we don't find out that they are Geology majors until after they have gone. A young white female student covered in tattoos from 2007 wrote to me last year, "I was in your historical geology lecture not too long ago. I just wanted to thank you for introducing the subject to me. While I was in your class I was constantly debating if I wanted to change my History major to Geology. After a few semesters and a study abroad trip to the Andes I finally made my decision. Currently I am in Savannah, GA at Armstrong [Atlantic] University, and they do not have a Geoscience program (strange because of the surrounding environment and coastal erosion and what not...). Anyway, I plan on transferring to a Geoscience program [at another university]. So, thank you again for a great class and helping me find my path!"

In 1992, I taught an older black female student with two children, one of whom was disabled. In the intervening 18 years, she went on to get her Bachelor's, Masters, and eventually her Ph.D. in Geology in 2009. I think she is about 60 now. I helped her get a teaching position at a Georgia university. She reminded me that I had helped her to get one of the AGI Minority Geoscience Scholarships. She summed it up like this:

“I chose GPC because for the first time in my life I was willing to let go of my ego and do what was necessary to ensure my success as a student. That is to start from scratch, get a good foundation in the basic principals of my discipline and related subjects that would be used as I continued my education. My years at GPC were some of the most meaningful, when it came to my education because it was both a rigorous and accommodating program. My professors demanded that I rise, rather than to my personal expectations, to the level of my true ability. They inspired me. Their aid in 1992 had a snowball effect. As I went from one school to another, it was the programs that they introduced me to and encouraged me to engage in that left an impression on what would be funding and research opportunities for the rest of my academic career. You guys teach hard and give much love and guidance. You don't see that in universities. A person can come out of GPC and compete with students at any school in the country including Ivy League universities.”

Something that is somewhat surprising to me is that these students remember the two-year school where they got their start, and they come back to reconnect with their roots. Part of this is the small class size and the individualized attention that we can give to our geology majors. And part of it is that we take students, wherever they are in their life and encourage them. We sit down with them and make a telephone call to connect them to the Geology Department at a 4-year college or university. We put them on the phone and have them talk to the undergraduate advisor. This is a big help to them, and a confidence booster. Once they speak with an advisor at the 4-year school they are energized and excited, and we know we have put them on the track to success.

Prof Richard Gottfried **Frederick Community College**

Associate of Arts In Teaching Degree - Maryland Style
The Role of Geoscience Courses in Maryland's Associate of Arts in Teaching Degree

What better way to encourage greater participation of two-year colleges in geoscience education than to be a part of the teacher training process. Universities and four-year colleges have historically shouldered the responsibility of training teachers. But the number of qualified instructors has not kept up with the demand, especially in the STEM subjects. In response to this situation, Maryland has identified the two-year colleges as partners in teacher education. The result is the Associate of Arts in Teaching degree. This degree is set up so that students can articulate into a four-year program seamlessly.

The "Associate of Art in Teaching (A.A.T.)" means a degree which recognizes mastery in teacher education which encompasses the following:

(a) Meets the lower-level degree academic content, outcomes, and requirements for teacher education, similar to the first two years of a baccalaureate program in teacher education;

(b) Requires evidence of qualifying scores as established by the State Superintendent of Schools on the teacher certification tests approved by the State Board of Education;

(c) Requires a cumulative grade point average of 2.75 on a 4.00 scale; and

(d) If achieved, transfers **(**in total**)** *up to 64 semester credit hours, satisfying all lower-division teacher education program outcomes* without further review by Maryland public and independent four-year institutions. (As a note, this has not always been followed by the four-year institutions.)

This outcomes-based statewide articulation agreement for preparing teachers was developed through statewide collaboration of faculty, administrators, and staff from State agencies in 2001. The first program, the AAT in Elementary Education/Elementary Special Education, was the model for subsequent agreements in other teaching specialties: early childhood education/early childhood special education and secondary education in the fields of chemistry, English, mathematics, physics, and Spanish. Earth Science was also considered (I was on the planning team), but was put off until a later time due to lack of consensus on several points. The agreement allows for *block transfer*, not *course-by-course* transfer.

One advantage to this approach is the direct recruiting afforded to two-year colleges with local high schools. For example, FCC and the Frederick County Public Schools have a working relationship through a Collaboration Council that meets periodically through the year. Potential education majors are identified early and encouraged to visit the campus. Further, education majors attending FCC often volunteer or work as “paid-teacher aids” in the local schools, providing additional “visibility” in the form of mentors to the program.

To complete this degree, elementary students must take three four-credit lab sciences: one biology course, one physical science (physics and chemistry) and one geoscience course. The science courses for secondary majors are prescribed by the particular major.

One of the courses I developed at Frederick CC for the AAT degree is PC 115, Introduction to Geoscience. Topics include geology, meteorology, some astronomy and oceanography. This course is taken by all elementary education majors. It can also be taken by non-education majors as a *gen ed* elective. Some students who have taken this course have gone on to take a full semester of one of the geosciences.

All AAT science courses are taught using a constructivist approach, using hands-on, inquiry-oriented activities and labs. Originally, a major component of assessment was completed through a portfolio process, but this became too time intensive and was dropped as a requirement, although it is still encouraged. Students are also required to present a major lesson to the class and must incorporate state standards such as the Maryland CLOs or the Virginia SOLs.

While the criterion for secondary certification in Earth Science is still pending, FCC currently offers the core geoscience courses. Many of these courses are offered completely online or as a hybrid. Indeed, my online courses are often populated with teachers certified in another discipline who are looking to add an Earth Science endorsement as well.

Programs like the AAT degree offer future teachers a new, more flexible path to achieve their career goals. The key is to approach program like the AAT in a thoughtful manner that will graduate well-prepared students.

Frank D. Granshaw
Essay for Geo2YC planning workshop
Northern Virginia Community College, Annadale Campus
June 24-26,2010

What strategies have you or your program used to meet one or two of the challenging aspects of teaching at a two-year college?

- *Challenge #1 – Networking among community college geoscience educators:*

A major challenge for community college geoscience education is that instructors tend to lack the professional development support available to many university educators. A key part of this problem is that community college geoscience instructors often receive minimal support from their colleges for attending conferences, workshops, or engaging in other professional development activities. In part this is based on budget limitations, but it is also a product of our teaching assignments. We generally teach a broader range of topics and have heavier full-time teaching loads than do our university colleagues. Engaging in professional development is often "extra-curricular activity" we do on our own time and pay for from our own funds. This is particularly true for the increasing percentage of our workforce made up of part-time faculty. Added to this is a general lack of professional opportunities targeted at community college earth science educators. All this creates a situation in which there is little opportunity for community college geoscience educators to interact or collaborate.

To address this issue, I was involved in two efforts involving the Geological Society of America. One of these was to help organize a session on teaching community college earth science at the National Geological Society of America (GSA) 2009 annual conference. I co-chaired this session with Eric Baer of Highline Community College (Des Moines, WA). The second effort was to secure funding from the National Science Foundation (NSF) to provide financial support for 21 community college educators and 7 community college students to attend the national conference and present during the session. One positive benefit of these efforts is that they attracted the attention of both the National Association of Geoscience Teachers (NAGT) and the GSA Geoscience Education Division. As a result, for the first time in the history of GSA, sessions and receptions specifically targeted for two-year college geoscience teachers appeared in a national conference venue. Furthermore, several NSF staff attended the session as well as a follow-up focus group to gather information about how they could better support community college geoscience.

Though the session and the accompanying funding were one-time events they did seem to provide a catalyst for several follow-up events. First, another similar session is scheduled for the 2010 GSA conference in Denver CO, and second, many of the same people who were involved in this session are now involved in the Geo2YC planning workshop scheduled for June 2010 in Annandale VA.

- *Challenge #2 – Supporting new and part-time faculty.*

For many community colleges, part-time instructors teach most or all of the earth science courses being offered by the colleges. In our own district, our geoscience faculty consists of two full-time and nine part-time instructors, with part-time instructors teaching well over half of our offerings. This is for a district having four "full-service" campuses. Though many of our part-time faculty have been with the district for several years and teach one or more courses every quarter, they traditionally receive little or no support in terms of professional development. This means that mentoring of new faculty is provided by either the two full-time instructors or by veteran part-time faculty volunteering their time. The result of this is that until recently new part-time faculty have received very little oversight and mentoring.

Surprisingly, one means of addressing this problem could come from our distance course development. For three years two instructors in the district have been developing and teaching on-line earth science courses. Like many colleges, ours has been seeking to increase on-line offerings. To help provide these additional offerings we expanded our general science (aka earth science for non-science majors) courses from one to two sections a term. To do so we recruited some of our new part-time instructors to teach the additional sections. This allowed us to pair an experienced part-time instructor with a new part-time instructor. The result of this was that the new instructors were able to work with a more experienced colleague, and both were compensated for their time.

Another benefit of our distance course development is that we have been given ready access to the video production capabilities of the distance-learning department. Using their resources we have produced a series of video lectures and laboratory introductions that we use for the on-line courses. This process is a benefit for two reasons. First, both instructors work together to produce the recording, increasing the interaction between the veteran and the new instructor. Second, because we have used the recordings to familiarize other new instructors with labs and other course activities. In talking with our distance education staff about these benefits, we have found them very open to the idea of producing on-line resources (e.g. laboratory demonstrations, topic introductions, etc.) that could be assembled into a web-based professional development "kit" for new instructors.

- *Challenge #3 – Addressing the needs of the "average" student now taking our courses.*

Many of the students taking earth science courses at our college are doing so to fulfill a general education requirement rather than to prepare for a career in the geosciences. Consequently, much of what we do involves helping students develop geoscience literacy. This frequently means working with students who are intimidated by science and may not see the relevance of the geoscience to their lives. We addressed this issue in four ways.

1. We often bring local geology, geohazards, and environmental issues into lectures, labs, and other course activities. Not surprisingly, students seem more interested in geology that they can easily go out and see for themselves, and geologic processes that impact where they live or what they do for a living.
2. We include as much field experience in the curriculum as possible. Many students in our field programs report an increased interest in geology as a result of seeing the geology firsthand.
3. We collaborate with other disciplines to develop and teach cross-disciplinary courses. This is particularly true of some of our field offerings, where we cross-list three and four day field experiences with biology.
4. By utilizing "advanced" students as tutors and mentors. For more detail see challenge #4.

- *Challenge #4 – Encouraging students interested in careers in the geosciences.*

Though many of our students are not geoscience majors, a significant number do express an interest in becoming geologists or some other type of geoscientists. The dilemma here has been to provide additional opportunities that challenge these students given limited resources for doing so. One avenue being developed in our district are honors course that feature additional content and activities oriented towards the needs and interests of such students. While these courses do exist in other disciplines in our district, they are still in the planning stages in the geoscience program.

An alternate strategy which has been successful involves community college / university collaboration. Beginning four years ago, the staff of a program called UCORE (Undergraduate Catalytic Outreach and Research Experience) approached PCC seeking to recruit our students in their program. UCORE is a collaborative effort between the University of Oregon and four Oregon community colleges. A typical UCORE fellow's experience consists of a summer research institute for community college students followed by a year of paid service at their home institution. While the summer institute is meant to encourage interest in STEM (Science Technology Engineering and Math) careers by giving each fellow a taste of what it is to do research, the year of paid service is intended to increase the impact of the program by engaging the fellows in catalytic activities. These activities include tutoring, forming science clubs, doing science outreach activities with local schools, presenting at local science conferences, and talking with other college students about their summer experience.

Though many of the students involved in UCORE are interested in careers in chemistry, medicine, engineering, or material science, the program has impacted PCC's geoscience program in two ways. First, a significant percentage of the research experiences available to students during the summer institute have consistently been in geology. Second, both the present and past UCORE coordinators for our campus have been geoscience instructors. I am the past coordinator. PCC instructor Jill Betts is the present coordinator. Since the coordinator's responsibilities include recruiting new fellows each year and coordinating the activities of these fellows once they return to campus, we are in a position to direct students having an interest in the geosciences into the program, and help those students be an asset to students in our earth science courses.

Challenges and Opportunities in Broadening Participation in Geosciences
Ann C.H. Hadley, Manchester Community College

Manchester Community College is located just to the east of Connecticut's capitol city, Hartford. Our college's service area includes both urban and rural communities. We serve students who are from many different cultural backgrounds and who speak over fifty different languages. To promote student participation in geosciences and environmental sciences, we use several difference tools at the college. These include:

1. science literacy via general education courses and campus activities;
2. a growing Environmental Science A.S. Degree program;
3. informal community internships and service learning;
4. engaging grade 6-12 students and teachers in geoscience activities.

1) Many students at the college enroll in our geoscience courses to fill a general education requirement. And some of them have a bit of science anxiety that stems from a lack of first-hand experiences interacting with nature. So we ease them into things and let them play with all of the rocks, map and equipment such as the stream table that we leave out in the classroom/lab. Every day on the way to class, they walk the Geologic Time Line that is engraved in the floor of our science wing. We keep class sizes small to allow for enhanced hands-on experiences. We have to be sure to find ways to demonstrate how the skill sets they are learning are transferable to other professions, such as with students in our large Business, Accounting and Criminal Justice programs. We show them how paying attention to detail, using the processes of the Scientific Method and experimentation will help them in these fields. Students have even told me that they find themselves driving around town questioning the world around them, wondering "How?" or "When?" or "Why?" in a way that they had not experienced before. They think it's pretty funny when they catch themselves wondering about rocks on the side of the road and talking to their families about them.

We schedule the lab time to immediately follow the class so that we have a 4.5 hour block for extended activities. With budget support from our department, we can provide bus transportation for field trips. This allows (and requires) all of our students to participate in the field experiences. Students are excited when they are able to put classroom knowledge to work in the field. Although Connecticut is a coastal state, many of our students have not had the opportunity to go to the beach. It has been amazing as a teacher to watch some "A-ha!" moments as students pick up crabs and feel the sand moving in the waves at their feet. It makes our discussions about climate change and shoreline erosion/migration a lot more applicable to their lives. And on another trip, students think it is great to be able to kneel right on a dinosaur trackway, measure Eubrontes tracks and calculate the hip height of a Dilophosaurus!

Sometimes students enroll in Introduction to Environmental Science as a non-lab general education class. Many find, after a rewarding experience in the course, that pairing Introduction to Physical Geology with lab is a natural fit. Then they have two courses that complement each other, and they have also satisfied their lab requirement.

2) As our college enrollment has increased in the past several years, so too has interest in our Environmental Science A.S. Degree program. This program has several goals: to prepare students with a strong science foundation for transfer to a 4 year degree program; and to provide students with technical skills, laboratory and field experiences necessary for full time employment. Two new courses on Sustainable Energy are also part of this program. No matter what interest originally got

them started in the program, all participants must take a required group of courses, including Introduction to Physical Geology. Sometimes we get individuals who want to continue a geosciences track when they transfer. Much of the time we are just excited to get students to continue their exploration of environmental sciences.

3) Our Environmental Science A.S. Degree Program Advisory Committee members represent local, state and federal government agencies, non-profit organizations, environmental consulting firms, and state colleges and universities. Committee members help us to shape course content, and they provide us with community resources. They are frequently guest lecturers, and some of them serve as adjunct faculty members. Our full-time faculty members are regularly invited to join these professionals on job-shadowing visits and field trips. This helps us to stay current and connected to local businesses. These connections have also provided students with internships at the USGS, the state DEP, municipal planning and wetlands agencies, and the Soil and Water Conservation Districts. Students have even participated in the Connecticut Business and Industry Association's sustainability workshops. These internships have been the key to converting some of these students to dedicated geology majors!

One way to foster interest in our local resources is through civic engagement. Several sections of our Introduction to Environmental Science course require students to participate in service learning activities for "learning in action" with community organizations and local municipal agencies. Our college programs have become well known throughout the Greater Hartford/Manchester area because our students are working with the community on these special class projects. Many organizations look forward to working with our students annually. Students participate in River Watch sampling and monitoring, soil sampling and nutrient management on local farms, and vernal pool surveys and mapping. Some students provide assistance for campus activities such as electronics recycling, Earth Day events, and the Global Issues Conference on Global Climate Change. Members of the MCC Science and Engineering Club, the MCC Sustainability Team and students in my environmental science classes assisted in an Energy Audit of the college campus.

4) Some who enroll in our geoscience courses have participated in activities that the college has provided for them as students in grades 6-12. For many years, we have delivered presentations and lab activities for local middle school students as part of the Connecticut Pre-Engineering Program. This year we added a new STEM program that brought together middle school girls from 12 local communities. In 1991, I joined resource professionals from around the state to found the Connecticut Envirothon program. Envirothon is a natural resources conservation education program and competition for high schools students statewide. Students work as teams to solve field-based problems in the areas of soils, wildlife, forestry, aquatics and current resource issues. The Steering Committee develops and provides Connecticut-specific resource materials and curricula for participating high school students and teachers/advisors. The Committee also conducts a series of workshops and assembles professional mentors to assist students in preparation for the field competition. The winning team goes on to represent Connecticut at the Cannon National Envirothon competition. We estimate that over 1500 students and teachers benefit from program resources each year.

Jacquelyn Hams Los Angeles Valley College

What strategies have you or your program used to meet one or two of the challenging aspects of teaching at a two-year college?

The most challenging aspect of teaching at my institution is that the students span the entire range of preparedness. Some can perform at the level of geoscience majors, and others do not have basic English language skills, and cannot perform simple mathematical calculations. This makes it particularly challenging to teach the introductory laboratory courses which require students to read carefully, follow instructions, and perform basic functions such as graph reading and simple mathematical calculations.

One strategy I use for the Physical Geology Laboratory class is to allow students to select from a variety of learning tools and formats to achieve their grade. Students earn a grade by completing in-class laboratory exercises, field trips, interactive online laboratory assignments, and a final project. Students must complete the mandatory in-class and online laboratory sessions. The in-class sessions are devoted to the geology basics such as map reading and rocks and minerals identification. The remainder of the laboratory points can be earned by any combination of field trips listed in the table. The field trip points are directly correlated to the credit hours assigned to the course. For example, a field trip worth 3 points correlates to 3 hours. The grading scale is based on 45 points = A.

This strategy has been successful in two ways:

1. Students who are struggling with the laboratory exercises due to weak English or mathematical skills are able to succeed since the entire course grade does not rest solely on the in class laboratory exercises.

2. Students get back to “the field”. At our public institution, we are told that we cannot require students to take field trips and have to offer alternate assignments for students who do not have the means (money or transportation) to participate. The students are able to take the trips that they can afford and some trips (such as those to museums), are self-guided and can be done on weekends and with family members.

An example of the field trip information table typically used in the Physical Geology Laboratory class is provided below.

FIELD TRIP INFORMATION

The mandatory in-class and online laboratory sessions are indicated in boldface type in the field trip table listing. The remainder of the laboratory points can be earned by any combination of field trips listed in the table. **Note: There are no substitutions for the field trips listed in the table. All field trip reports are to be turned in by ____.** You may use the ETUDES course web site to submit your papers electronically. Students should keep a hard copy of each report (including the photograph). **NO LATE FIELD TRIP REPORTS WILL BE ACCEPTED AND NO PARTIAL CREDIT WILL BE GIVEN FOR LATE REPORTS OR REPORTS WITHOUT PROPER PHOTO DOCUMENTATION.**

Laboratory Activity/ Field Trip	Description	Date	Fee	Total Points
CA Oil Museum	Self-guided	Self-guided	$1.00	3
California Science Center	Instructor-guided	11/18	Free w/Imax	2
Finding the Earthquake Epicenter	***Online***	***10/10***		***3***
Gem and Mineral Hall	Instructor-guided	11/18	$5.50	2
IMAX Theatre	Instructor-guided	11/18	$5.00	2
LaBrea Tar Pits	Self-guided	Self-guided	$7	3
Map and Aerial Photograph Interpretation	**In-class**	**9/12**		**3**
Map and Aerial Photograph Interpretation	**In-class**	**9/19**		**3**
MARS online lab	***Online***	***12/12***		***3***
Minerals Identification	**In-class**	**10/24**		**3**
Minerals Identification	**In-class**	**10/31**		**3**
Mitsubishi Cement Plant	Instructor-guided	12/2	None	6
Rocks Identification	**In-class**	**11/14**		**3**
Rocks Identification	**In-class**	**11/21**		**3**
The Time Machine	***Online***	***9/26***		***3***
Tillman Water Reclamation Plant	Instructor-guided	12/5 (class time)	None	2

GEOLOGY 6 STUDENT LAB/FIELD TRIP PLANNER

Lab/Field Trip	Date of Lab/Trip	Fee	Credit (Points)	Required Work	Date Work Completed	Date Submitted

Jan Hodder, Oregon Institute of Marine Biology, University of Oregon, Charleston OR 97420
jhodder@uoregon.edu

I am the director of one of the National Science Foundation funded Centers for Ocean Science Education Excellence (COSEE) www.cossee.org. One of the goals of my center, COSEE – Pacific Partnerships, is to increase the opportunities for community college faculty and students to learn about the ocean. COSEE – Pacific Partnerships is based at marine laboratories in Oregon, Washington, Hawaii and northern California and aims to connect research scientists with community college faculty and students. To date we have offered in-year and summer workshops that have engaged faculty and research scientists in exploring marine biology and oceanography. In these workshops we have covered current research topics and have started to work on developing course materials suited for community college use. We have also developed a research experience program, Promoting Research Investigations in the Marine Environment (PRIME), which provides community college students with the opportunity to work with a researcher at a marine laboratory for an eight week period in the summer. Further information on these projects is at www.coseepacificpartnerships.org. I am a research scientist and educator at the University of Oregon's marine lab and I come to this meeting to learn about geoscience education from the workshop participants. I am interested in exploring how the COSEE network could play a role in advancing ocean literacy at community colleges, and hope to make connections with engaged faculty to further our goals.

The Whole Is Greater Than the Sum of the Parts

Working Together to Teach Geology at Blinn College (Bryan, TX)

Amanda Palmer Julson, Blinn College

When I started teaching at Blinn College in the summer of 1996, I was the second of two part-time Geology instructors. Our classroom/lab was located in a converted strip mall, we had an institutional collection of about two dozen rocks stored in baby-wipe tubs, and we approached each new semester with anxiety, hoping that our classes would make.

Our Geology faculty now stands at 5 full time and three part-time instructors (and we are in need of a few more). We have two classroom/labs equipped with state-of-the-art computer/projection equipment, running water and built-in cabinetry, and a prep room bulging with specimens and other teaching materials. We offer multiple sections of three different courses (Physical Geology, Historical Geology, and Oceanography) to nearly 1500 students per year, on campus, through Distance Learning, and in correctional institutions.

I don't think it's an over-estimation to state that we must be doing something right. Of course, much of our growth is due to the overall success of our institution as a whole. We are the major transfer institution for Texas A&M University, with whom we share a medium-sized college town. We also send students on to other four-year institutions in Texas and other states. However, there's more than just having the support of our college and simply being along for the ride that underlies our remarkable growth.

I think the quality that makes Geology such a standout department at Blinn College is that it's genuine. Students get the real deal from us. We are all passionate about the geosciences, and we bring that into the classroom. We are a very talented collective of slightly eccentric individuals, and we each bring to the table a true expertise and depth of knowledge in our specialties. Every of us could have made the turn on our career path toward the publish-or-perish realm of four-year academia. However, each for our own reasons, we find ourselves in the world of 2YC teaching, where the course load is large, the demands are many, and the majors are few. Nonetheless, we refuse to allow our enthusiasm or creativity to be dampened, and we rise to the challenges every day. Students recognize this earnestness in our interactions with them; they can sense that we love what we do, that it's not just a job for us, it's a calling.

With the tone in our classroom set by our dedication, what happen next? Well, of course there's a syllabus, lectures, labs and quizzes. There has to be some organization and structure to provide a framework for the unfolding of the course content. This is where we, as a group, meet our first collective challenge. Some departments at our college take a lockstep, cookie-cutter approach to their syllabi. Deviations from the charted course are not tolerated. On the other hand, other groups have a more laissez-faire, anything-goes approach. That makes for wild inconsistency between sections of a given course, and generates a host of problems involving student expectations, grade distributions, and transferability of the course to four-year schools. With us, we consciously follow a balanced path between these extremes. As our group grows, this has become an increasingly difficult task. We repeatedly revisit this issue during departmental meetings.

Paradoxically, this ongoing dynamic actually seems to be one of the secrets of our success. We avoid becoming petrified and set in our ways, which would dampen the instructor's enthusiasm and result in boring routine for the students. On the other hand, we have a basic shared set of expectations and outcomes in order to hold our students and ourselves on track, guiding instructional activities in a common direction.

The key to this balancing act is a lot of regular communication among our group and keeping alive the inquisitive spirit inside each of us. We share ideas and materials freely. We innovate and exchange. We collect and distribute. We play as a team. We watch for signs of distress among one another, and lend support and suggestions. We take care of each other.

So far I've said a lot about our faculty but not much about geology. How does who we are and how we work together relate to the growth in our enrollment from a handful to hundreds and hundreds? The answer is that we teach by virtue of who we are. We teach out of experience. We develop activities and teaching materials that make the topics come alive for the students. That makes each instructor's section slightly different from the others. In one section students might learn more about caves, in another impact craters. However, with our shared commitment to the general principles in the syllabus, the "basics" are covered while the "specifics" generate the enthusiasm.

David Kobilka
Central Lakes College

I work at a small rural community college where I am the only full time geoscience faculty. When I arrived here, hired on as an adjunct, enrollment was down college wide and registration for Earth Science classes was abysmally low. Administration had a tenuous commitment to even having an Earth Science department – in semesters prior to my arrival there had been no Earth Science courses offered at all. My first semester department budget did not even cover photocopies. Thanks to the generosity of colleagues I patched together charity from other departments for things like test forms and chalk.

There were 5 Earth Science classes in the department; *Concepts of Earth Science*, *Environmental Geology*, *Physical Geology*, *Minnesota Geology*, and *Oceanography*. The first class I taught on this campus was *Minnesota Geology* as a summer course. That first summer I taught it in a way different to how it had been done in the past – as a field course meeting every Wednesday for 8 weeks. Each time we met, we took an all day field trip. In this way we were able to explore the state studying outcrops and glacial landscapes along the way. Enrollment for that course surged the following summer and every subsequent year the demand for that summer course increased. During Fall and Spring semester the one strong course was Oceanography. In that class enrollment was steady and dependable. But the other Earth Science courses never filled. Surveys, both formal and informal, showed the reasons students took those classes ran the scale from an uninspired “I took this class because I have to take a science course but I hate ______ (insert one of the following; biology, chemistry, physics)”, to the small cadre of the geoscience faithful; rock collectors, lots of interested retirees, one memorable gemologist, and the few students who actually intended to pursue a geoscience major.

If you have read this far you may recognize the story, if not at your own college, then maybe at some other you have heard about. The suite of classes are not unusual. *Concepts of Earth Science*, *Physical Geology*, and *Environment Geology* are tried and true geoscience courses – the very titles of these courses imply a traditional approach to geoscience teaching but, maybe in the minds of the typical scientifically disinclined community college student, dull. Enrollment would not improve without some drastic change, and it would begin with a complete shakeup of the Earth Science curriculum.

Because I was the only Earth Science faculty at my college I was in a position to work autonomously, without a committee, and without worrying about offending long-held beliefs concerning the sanctity of traditional style Earth Science classes. As an adjunct I had not much to lose. If enrollment continued to decline I would be out of a job anyway. The idea was not to scrap the entire Earth Science curriculum and start over. Rather, it was more to re-organize the curriculum. So we retired two classes; *Concepts of Earth Science*, and *Environmental Geology*. We then re-packaged that curriculum to two new classes, one called *Earth Science and the Environment*, and the other, *Natural Disasters*. To compliment that and add variety we proposed one called *Geology of National Parks*, and a 1 credit stand alone laboratory section for *Oceanography.* Later, *Astronomy* was also brought into the Earth Science department. It was formerly a PHYS class, with an algebra prerequisite.   It had not been offered in two years. Making it part of the Earth Science suite of classes, and eliminating the math requirement was a positive change in terms of enrollment for that class, and in the demand for Earth Science courses.

The hope with the new courses was that just their titles would suggest something interesting that did not exist with the old courses. Also, in packaging the Earth Science curriculum differently, the title of the class more faithfully describes what the class is about. While there is nothing intrinsically wrong with *Environmental Geology*, its name implies a fairly narrow focus. Yet increasingly, Environmental Geology textbooks attempt to cover the breadth and depth of all environmental issues, including those that really do not belong under the geology umbrella, like global climate change. Whereas the title *Earth Science and the Environment* is more inclusive. Caution is in order because this can work as a benefit or a disadvantage. In some colleges the title might be too broad, and in a geoscience program where a class like *Earth Science and the Environment* would be one of the elective classes required for a degree, a committee might have trouble agreeing on what topics ought to be covered. But in the two-year college, there are unwritten course goals like piquing interest, collaborative learning, and working a student's capacity for scientific thought. These goals are more prosaic than a lofty recital of Blooms Taxonomy, but they are undeniably necessary. While the higher level thinking skills are certainly written into course goals they are always tempered by the very real need to meet each student at their level, whatever their literacy and quantitative skills. Given an introductory geoscience course with a broad curriculum potential, one has the freedom to choose a balance between breadth or depth. In my experience probing fewer topics but to greater depth and detail is far more interesting, and productive. But in the process, one must carefully choose the topics you will tackle over the course of a semester. Not being constrained by a course with a narrow focus allows one to rapidly respond to the issues of the day. For example my Summer 2010 Oceanography course will focus heavily on the BP oil spill in the Gulf of Mexico.

These new courses were proposed from 2004 to 2007. They were offered to students for the first time beginning in 2005 through 2009. So from concept to completion is a spread of five years. In fact the course development part is by no means "complete," as of this writing in May of 2010. But the results of the work thus far I believe revived the Earth Science department, and laid the groundwork for my becoming a full time faculty here. Today, all of the new classes fill reliably. For some, extra sections are opened to meet high demand during peak registration. There are now 3 Earth Science faculty – 1 full time (myself) and two part-time. While the economic downturn in part has helped in the success of these new classes, they were first offered in a time of declining enrollment college wide, yet in the new Earth Science classes enrollment leaped forward.

One could argue that it is not enough to just package a course in an attractive way for the purpose of filling seats, but consider this. Students commonly enroll for a class on the name alone. Even though you provide a detailed course description, some students have no idea what the course is really about. I have observed this in all my classes where I have gotten responses that suggest a confusion for example of Astronomy with Astrology, or that Oceanography is about fish. Geology is about rocks, and Natural Disasters is about, uh, thunderstorms? But even so, each student comes to class on the first day with a certain investment in the class. On the low end is cynicism, that "I'm only in this class because I hate dissecting frogs" attitude, but on the high end there is a real belief that the class will be interesting, and . . . "fun." There, I said it. A course in an attractive package lures in more of that student investment up front. Call it "anticipation capitol." Of course you have to make good that capitol every time the class meets, hopefully so it gains interest at least until mid –semester. But to begin with more of it up front makes it so you have fewer people to convince that science is a good thing once the course begins. What's more, you can start in right away with real challenges for the students, and more will stay with you for the long haul. I like to think of every time my class meets as an event. I am constantly thinking of how I can better convince each student that it is worthwhile to invest time and energy into the next event. I think of it as a product, and that each student adds their own value to it. I think of it as a group project, and that everyone in the class has something to gain from each student's participation. But none of that can happen unless they click *Add to Cart* for my course when shopping for classes for their next semester.

The message here is threefold:
1) If you want to broaden participation in the geosciences you first have to get students in the classroom, preferably already interested.
2) Although it seems like a marketing trick, putting your curriculum in an attractive package can bring positive results.
3) The easiest part is that attractive package. The work comes after –designing and implementing a new course with the goal of holding student interest for the entire semester takes years.

Turning challenges into opportunities: Teaching geoscience at a two-year college

Karen Kortz, Community College of Rhode Island

There are many challenges with teaching geoscience at a two-year college, including, among others, lack of funding, lack of time, few (if any) courses beyond the introductory level, and the diverse student body. Although I could write about all of these challenges, I will focus on the diverse student body and how I use that challenge and turn it into an opportunity to better teach geoscience.

Two-year college students are a very diverse group, in many senses of the term, since they have a wide range of backgrounds, experiences, goals, and achievements. Two-year colleges are themselves very diverse, so keep in mind that my generalities do not apply to all two-year colleges. Nationwide, two-year college students are approximately one-third minorities and over one-half women. There are also a significant number of students with disabilities. Many two-year college students have families with children and/or full-time jobs, in addition to attending school (either full or part time). There is a large range of ages, and many students are returning to school after time away since high school graduation or an initial enrollment in college. Many students are attending school with the practical purpose of immediately getting a job upon graduation, others have the goal of transferring to a four-year school, and others are taking a few courses here and there for personal reasons. Some students attend two-year colleges because they have no where else to go or nothing better to do, others are attending to save money compared to a four-year school, and others already have degrees but are pursuing other interests. Two-year college students are predominantly local, and many have no plans to leave the area in which they grew up and are attending school.

It is our job, as instructors at two-year schools, not only to teach our diverse students, but also to engage them so they finish the class with more knowledge and interest in earth science than what they began with. It is my opinion that these challenges of diversity can work to our advantage in teaching two-year college students, and I expand upon this below.

The diversity of backgrounds and experiences allows for richer classroom discussions and deeper learning experiences, since students can bring their own familiarity into discussions or learn from a classmate when talking about many different aspects of the geosciences. This diversity also creates a greater impetus for the instructor to use a wide range of teaching strategies, since the students have varying learning strengths. Because two-year college instructors are focused on teaching, we can devote more time and effort to include the results of geo-education research by making classrooms student-centered, active learning environments. Examples of techniques I successfully use during lecture include think-pair-share, ConcepTests, Lecture Tutorials, jigsaws, gallery walks, and small group discussions, and these are all described on various SERC websites.

The diversity in goals of two year college students results in a need to teach knowledge and skills that are useful to people who will not necessarily be geologists. Many students take a geoscience course to fulfill a general education requirement, so one of my top priorities is to create geoscience-literate students with skills they can use outside of the classroom, such as critical thinking and oral communication. For example, I emphasize concepts instead of vocabulary (as done by ConcepTests and Lecture Tutorials), and I include student presentations as important parts of the course. Since students tend to be job-oriented, I take advantage of this goal by emphasizing the many jobs in the geosciences to encourage students to see geology as a career rather than just a general education requirement.

The diversity of achievement in college courses also requires creative and innovative teaching. Using a variety of teaching techniques (such as those listed previously) takes advantage of the variety of learning strengths of the students. Students can teach and learn from each other when discussions are included as part of the class. In addition, multiple, non-threatening assessments help students understand what they know and do not know, and what they need to do to reach the desired level of achievement. For those students that are high-achievers and want extra challenges, I work with them to do small-scale research projects (based on my own geoscience education research or collaborations with four-year schools) or advise them when they participate in unique programs (such as participating in NASA's Reduced Gravity Student Flight Opportunities Program). It is extremely rewarding as an instructor (justifying all the effort) when initially low-achieving students succeed in the course.

Finally, two-year college students frequently have a lack of diversity in the area in which they live and have traveled. Because most students will continue to live locally, emphasizing local geology increases their interest in the subject, and field trips to neighboring locations will give them a sense of familiarity. In my courses, I discuss not only the rocks and geologic history of the area, but also local environmental and hazard issues, so students will be able to make better informed decisions in their communities.

In summary, although the diversity of students in two-year colleges can add challenges to teaching them, these same challenges can result in the improved education and experience of all students.

Lynsey LeMay
Thomas Nelson Community College

An earth science class in high school is often the last time students have had any geoscience experience prior to taking an introductory physical geology class at a two-year college. Because of the age diversity at a community college, that last earth science experience can sometimes have been over ten years ago. As a result, in my experience, many students do not recall basic earth science topics, including how earth science impacts their daily lives. Whether preparing future geology majors, or simply promoting earth science literacy, making earth science relevant to students is something that I believe has a lasting impact on all students.

Some students have taken a geology course at Thomas Nelson Community College with absolutely no interest in earth science at the beginning of the semester, only to completely change their intended major to geology. While this is thrilling for an instructor, what is even more exciting is knowing that this change in interests is often in large part because the material presented was in such a way that students could actually understand how geology affects them and the world around them daily. The relevancy of earth science is one aspect that I try to focus on, and continually revisit throughout the semester. When students can see geology as the world around them, not just as rocks and mineral pictures in a textbook, students are more apt to take an interest in the material.

Throughout the semester, I have student complete assignments in which they are required to look up actual data on a variety of topics. An assignment early in the semester has students research uses for minerals. In an online class, each student is required to research a mineral, reporting to the rest of the class common uses for that mineral, its market value, where it is mined, and general properties. In response to one students report, another wrote this comment just the other week, “Too often we take the products we use for granted never realizing the great effort it takes in making these commodities. I use a few of these products on a daily basis, make-up being a priority. It gives me a totally different perspective of these products and the work put into providing me with these items.” Comments such as this are not uncommon. Students have a whole different appreciation for minerals when they understand the many things that they do for our society.

Another assignment in which students are required to access current data involves earthquakes. Phenomena that often result in destruction always seem to catch the attention of many students. However, what is surprising to many is that the earthquakes reported in the news are a very small percentage of earthquakes that occur all over the world. Using real-time data from the USGS Earthquake Hazards Program, students are asked to find the number of earthquakes occurring in the United States and compare it to the number occurring world-wide. In addition, students are asked to make a connection between locations of earthquake occurrences and plate tectonic boundaries. Students are amazed that thousands of earthquakes, though many are quite small, are occurring weekly, and in places where they live or have lived. No longer does it seem like only something seen on the news.

Field experiences often have a great impact on students’ perception of the geosciences. While scheduling sometimes makes it difficult, I try to incorporate a field component in all of my classes. Sometimes it is simply a day in the field where I conduct class, and incorporate real world examples, at a place that fits with the topic, such as the beach on a day in which we would be discussing coastal processes. Other times, a field trip may include data collection that must be analyzed and synthesized in a final report. Students consistently report that field experiences help them "make sense" of the material. It allows them to see geology and the dynamic earth at work. Earth science literacy is increased when students can fit a particular idea into something that they are already familiar with, and field trips are often wonderful ways in which students can make those connections. It is on trips like this that students become engaged, even those that by all appearances were disengaged previously, and start asking questions, and sharing experiences of their own.

Assignments like these not only offer students opportunities to work with data, it reinforces the idea that science is something that they can do, and understand. For those interested in pursuing a geoscience major, they have had an experience in reading technical literature, working with data, and synthesizing it. This is a skill that will be revisited and further refined in future classes, but it is a task that will likely not seem as intimidating. Many students have approached me after completing assignments like those mentioned above only to tell me that they not only enjoyed the assignment, but want to continue learning about it, following the changes taking place. So while I'm not creating whole classes of geology majors, I'm definitely creating classes of those more interested in the world around them.

Suki Smaglik
Central Wyoming College

What have you found to be most successful in broadening participation in the geosciences at your institution and what made it successful? Consider what aspects of this success are translatable to other two-year colleges.

Its hard to believe that when I arrived at Central Wyoming College ten years ago that geology had not been taught here for almost twenty years, and then only occasionally. Here we sit in the place that many geology camps bring their students to learn their field skills. There were two courses on the books: Physical and Historical. The year prior, the University of Wyoming (our only public 4-year institution) removed the prerequisite for Historical and made them both entry-level courses. While we don't have to follow everything that UW does, it makes transfer easier for our students to transfer if we do follow much of it. As at most institutions, entry-level geoscience courses serve a mixed population of potential majors to general studies, and it is always challenging to make the information relevant to all. (But that is the topic of a different essay.)

In order to broaden participation in the geosciences I decided that I needed to offer some other courses that would interest more people and turn them on to the awesome world around them. With the other half of my load in chemistry, I didn't have much leeway to add other courses. So, I decided to focus on field experiences and introduced three short courses that allowed enough flexibility for me to stay engaged while teaching and the students while learning.

One course is a 3-day 1-credit field-trip course to Grand Teton and Yellowstone National Parks at the end of September each year. The course varies routes and students can earn up to 2 credits by repeating. It is run in conjunction with Student Activities and often draws more than 20 students, from traditional freshmen to senior citizens. We stay in motels rather than camp as many of our international students want to attend but have never camped, and it can get quite cold at that altitude in the fall. Another course is a variable credit course entitled "Geologic Field Excursion: <you name the place>". We have had trips to the Big Horn Mountains, Red Desert, Wind River Mountains, Grand Tetons and many other parts of our state, ranging from 4 - 10 days. Out-of-state trips to the Black Hills, Death Valley and Hawaii but have been offered but never garnered enough students to make the course go. All cited the expense so I am working on some creative ways for financing future trips. For two years CWC has tagged along with the UW Geology Rocky Mountain field trip that is sponsored by ConocoPhilips. That brings the cost down enough for students to attend. It also gives CWC students the chance to meet with professors, upper division geology majors and graduate students at the school they are most likely to transfer to. The other course offering is a "topics" course called "Geology of Wyoming: <you name the topic>" that is variable up to 3 credits and is usually offered as an evening course in the second half of the semester for students needing to pick up some credits to remain full-time, or in the summer as educator courses. Topics range from Energy, Volcanoes, Rocks, etc. to regional geology of specific localities. There is usually a half-day or one-day trip involved.

None of the above courses have prerequisites. Do I like this? Certainly I do not. I wish each student had to have some background in rocks, stratigraphy and tectonics, but I would never have enough students to take the course if that were the case. So, they are all "just in time" teaching courses. Those that do have some background appreciate what they know even more. This can make the course both challenging and rewarding. The "excursion" course is at the sophomore level and requires a fair amount of writing; the other two courses are at the freshman level and concentrate on making observations before interpretations.

Has this strategy worked to increase participation? Absolutely. Attendance has more than doubled and many students take more than one of these courses or take them more than once. Those who are interested in geoscience as a career take everything we have to offer. This may not be enough for them to be juniors in their major when they transfer but its keeps them in touch with why they are interested in geoscience. The easiest thing about using this strategy was the "build it and they will come" approach. Out west here, most people enjoy the outdoors. Those that venture to the Rocky Mountains from other parts of the country or to America from far-away lands have a romantic sense of adventure and are looking for opportunities to see and understand what the rocks and landscapes mean. However, without the support of the CWC administration, this growth in our program may not have been possible. At least one-third of my load is now composed of these smaller, shorter classes. It often makes my load appear lighter than some others. Anyone who has run a field trip knows what added work logistics and safety bring. In this time of decreasing budgets and a push toward larger class size, my academic dean is getting pressure to delete courses such as these from the offerings. Thankfully, he realizes that these smaller classes are what hook students into taking the longer courses, and maybe even science careers and thus appreciates their value to the CWC mission to "provide lifelong learning opportunities beyond the boundaries of time and place." And, they're fun to teach!

Using conceptually-based interactive teaching methods at two- year colleges
Jessica Smay, San Jose City College

What strategies have you or your program used to meet one or two of the challenging aspects of teaching at a two-year college?

One of the main strategies I use to meet several of the challenging aspects of teaching at a two-year college is to use conceptually-based interactive teaching methods. This strategy helps address the issues of 1) lack of resources, 2) teaching a very diverse student body with non-majors, under-prepared students, and students with diverse learning strategies, and 3) keeping the course of introductory Geology fresh and exciting for me and the students.

The conceptually-based interactive methods I use include Lecture Tutorials and Conceptests. Lecture Tutorials are purchased by the students in the form of a workbook they bring to class each day. After I lecture on a topic, I have the students turn to the related page and work in pairs to complete the worksheet. These worksheets focus on misconceptions, helping the students build scientific understanding of the concepts. Conceptests are multiple choice questions included in my PowerPoint lecture where I ask the students to vote on the correct answer, and if necessary discuss their vote with peers and vote again.

During a time when the Physical Sciences Department has minimal funds, it is important to find ways to make the classroom interactive without spending too much money. Neither of these activities cost the school much money (except a small fee to print out voting cards with the letters A B C and D printed on them). Conceptests are frequently used in other schools in conjunction with a clicker system. The voting cards I use are much cheaper, and they are equally effective, giving me feedback about my students' progress and giving the students feedback as to how well they know the material. It is not necessary to purchase an expensive clicker system to do these things.

Without funds to pay graders or TA's, it is difficult to assign extensive homework. These methods help to prepare students for exams and give them the feedback they need to help them determine what they need to study. Because some students prefer being tutored by a fellow student than by the instructor, the interaction between students gives them a chance to get answers to their questions without the need to pay for a TA or tutor.

The student body is extremely diverse at my school (similar to many community colleges), and I have found that the students come in with a wide range of backgrounds, interests and goals. These interactive teaching methods allow the students to use different skills to learn the concepts involved. Depending on the particular Lecture Tutorial or Conceptest, the students may use listening, speaking, writing, sketching, and labeling skills, each of which may help the student learn the concepts better.

The benefits of using these conceptually based interactive methods extend to many different groups of students. Under-prepared students get feedback as to how well they understand the material and what they need to learn. Students who will not major in science have the opportunity to see that science is not memorizing science vocabulary, but is more conceptual. Future teachers may be inspired to use similar techniques when teaching science or any other topics.

The group work also allows the students to bring their own personal background knowledge into the discussions, which enriches the experience in a way I cannot do by lecturing in the front of the class. Recently I had students talk about local superfund sites polluting the groundwater and nearby flood protection structures being built in the downtown area. They were directly involved in projects that relate to geology, so the other students in the class and I all benefited from these discussions. The interactive nature of the class allowed these students to be comfortable with bringing up this information.

As I teach introductory geology for the 25th and 26th times this fall semester, it is important to continue to convey excitement about the topic to my students. It is easier for me to do this in shorter lectures with interactive breaks in between to avoid the tendency to begin to drone on (or at least that is probably what it sounds like to my students). Activities such as Lecture Tutorials allow me to mingle with my students and get to know them and remind myself that this is the first time these particular students have been introduced to these amazing geological concepts and that these ideas are really exciting!

In summary, teaching with interactive techniques has helped to address the challenges of several of the challenges that may be an issue at a two-year college. The low cost of Lecture Tutorials and Conceptests help reduce the cost of running my classroom, which is important at my community college. The diverse student body benefits from a variety of teaching methods that address their many learning styles. Both my students and I benefit from the way it generates excitement for the topic through discussion and deep thought. I continue to enjoy teaching introductory geology, and based on student feedback, my students really enjoy taking this course.

John Taber, IRIS (Incorporated Research Institutions for Seismology)

Supporting 2 Year College geoscience education

The Incorporated Research Institutions for Seismology (IRIS) has over 100 member research universities and institutions dedicated to monitoring the Earth and exploring its interior through the collection and distribution of seismological data. There is also an Educational Affiliates (EA) membership category for institutions that teach seismology and other Earth sciences but do not necessarily share the professional research interests of the traditional consortium members. The objective of this membership category is to cultivate a base of institutions committed to excellence in geoscience education through the co-development of E&O activities designed to address their needs. By becoming an EA member of IRIS, institutions gain entrance into a community of educators that is connected to the excitement and cutting-edge results of the research community. EA members pursue their common interests and goals within the IRIS community, and enjoy benefits such as discounts on seismometers and access and input to E&O programs. For example, community college members have taken part in educational seismograph training workshops and have subsequently integrated the use of the seismographs, which are capable of recording earthquakes globally, into their teaching. Educational Affiliate members have also been sponsored to attend the bi-annual IRIS science workshop.

The IRIS Education and Outreach Program's mission is to advance awareness and understanding of seismology and geophysics while inspiring careers in Earth sciences, and providing resources for community colleges is an area we have identified for increased focus in the coming years. We have some resources available at www.iris.edu/hq/programs/education_and_outreach/resources that can be used at the 2 year college level and we are currently working on a new set of introductory level exercises and presentations that will be based on the questions posed in the *Seismological Grand Challenges in Understanding Earth's Dynamic Systems* (Lay *et al*., 2009, www.iris.edu/hq/lrsps/). One of my goals for the workshop is to learn from the participants as to how IRIS can better serve community college faculty and students both by adapting existing materials and creating new products.

IRIS E&O has also been closely involved with the Earth Science Literacy Intiative, which led to the creation of a document outlining the key concepts in Earth science that a literate public should know, building on similar successful projects in the Ocean, Atmospheric and Climate science communities. The process involved considerable input from the research and education community and included two successful workshops; first an online community workshop for 150 invited scientist participants and 200 scientist and educator observers, and then a writing workshop for 35 scientists and educators from academia, K-12, and representative agencies. After two additional open review periods, the document outlining the Big Ideas and supporting concepts of Earth science was published in 2009 and is available electronically and in hard copy at www.earthscienceliteracy.org.

JoAnn Thissen
Nassau Community College

One of the best ways to promote earth science literacy is to immerse students in their learning, to put them in situations where they must learn, not just the concepts, but also the language of science and the process of science. I teach two standard lecture/lab courses and one field course. None of these courses have prerequisites but students have previous learning as part of their Earth Science Regents level courses taught in New York State junior or senior high schools. When they come into my classes they have already been exposed to the language of science but have no real idea what it really means. They just wanted to pass the Regents exam so they could graduate. Now they're challenged to use this previous learning to apply it and become active participants in their learning. Now they are challenged to *see* the world they live in.

Our school has an extremely diverse student population of about 22,000. These are students who leave their homes, drive their cars to school, go into the building, drive to work, drive home, etc. They never really look at their environment, it's just something they have to pass through on their way to ….someplace. Just the words "hands-on, real life earth science" may as well be spoken in Martian for all it means to them. My goal is to introduce them to their world – to get them to *see* their world differently. I face the challenge with confidence in my students and a high degree of enthusiasm for my subject.

My Field and Laboratory Geology course is offered during the summer intersession for ten straight days starting the day after spring term ends through Memorial Day. This course is a total immersion course. We spend every day in the field. We use the tools and technologies used by professional geoscientists. We collect samples and bring them back to the lab for analysis.

We are lucky enough to live in an area with amazingly diverse geology. We live on an island created by continental glaciation. The terminal moraines form the backbone of the island, school sits on the outwash plain and of course, we have a system barrier beaches. We are very close to New York City with its complex metamorphism and not very far from New Jersey and Connecticut's Mesozoic Rift Basins with their lava flows and dinosaur tracks. Plus- they've all driven over the George Washington Bridge crossing the Hudson River Estuary and coming face to face with the Palisades Sill. The field course takes advantage of opportunities presented by the local geology.

The first half of this course is a study of Long Island geology. Students do a study on Point Lookout, a local beach on one of our south shore barrier islands that has been badly affected by erosion. They study the affect of jetties, measure and profile the beach and collect sediment samples that they take back to the lab for course-grain analysis. The study incorporates a statistical component as well as the use of specialized computer programming and spreadsheets for analysis and graphing. The residents of the village of Point Lookout come out every year and talk to the students about how their research is helping the residents understand their beach. This validates their work and puts it into the category of real life and not just an esoteric school assignment.

We then visit Caumsett State Park, north shore beach that is glacially controlled sitting at the northward base of the Harbor Hills moraine. They do an in-depth study of the complexity of the moraine, measure the beach and collect samples there to compare them to the south shore beach sediments. This leads them into a study of sediment textural maturity. They also compare the effect of erosion on a different type of shoreline within a totally different environment.

The second half of the course focuses on the NYC Metro area geology. We start by studying the bedrock that forms the basement rock of Long Island and upon which all the sediments that make up the island sit. Here they can map the glacial striations left as the ice sheet moved over the bedrock. We visit several sites around the five boroughs making a simplified geologic map of the area with its complex formations. They go from NYC across the Hudson to see the Palisades Sill up close studying it from its base to its top. They are amazed when they also see glacial striations on the top of a sill that was formed deep underground at a time when dinosaurs roamed the area. We follow the igneous formations in the Mesozoic rift basin of the Newark Basin in New Jersey, visit a retired zinc mine that tunnels through 1.3 billion year old Franklin Marble and finish the course by walking in the footsteps of dinosaurs in the Mesozoic rift basin of the Connecticut River valley. At Dinosaur State Park they conduct a study of dinosaur tracks measuring foot length, stride length using this information to mathematically calculate the hip height of the animal and to determine whether it was walking, trotting or running. They also examine the ripple marks, drag marks and other environmental indicators to determine paleoenvironment at the time the dinosaurs roamed this place.

My fall/spring lecture/lab Physical Geology course continues the study of Point Lookout and Long Island geology giving us an in-depth multi-year study. Because the NYC metro area sites are not easily accessible during the regular term my Historical Geology class projects vary from year to year. This year, fall and spring, students drew cards out of a “hat”. Each card represented a geologic time period. They were then “hired” as the head of marketing for an ecotourism company. Their job is to create a brochure of their time period from the point of view of it being the PERFECT vacation. They are told to “think ‘Jurassic Park’ not Great Adventure” and are told “In lieu of payment you will be given points towards a grade in a 4 credit lab science course. These credits will be applied towards your next pay raise. The better your grade, the bigger your raise.” But it’s not as simple as that. They are given weekly assignments to write two page papers on the geology, oceans and atmosphere, flora and fauna of their time period. These scientific facts must be included in their brochure. They must choose a “theme” and must include the science. Otherwise they are free to be as creative as they want. At the end of the term they must all present to the class and act as “salespeople” to “sell” their location. This project incorporates scientific research with computer skills.

I am also the founding faculty advisor to the Earth Science Club. We have speakers from many disciplines of geoscience, researchers, graduate students, local community leaders and Nassau Community College students who have done internships present to the club. We also go on field trips and local geoscience meetings.

Every term I hear several students tell me that they have become inspired to go on as either Geology majors or Earth Science Education majors – a career they never thought to pursue before they took one – or all – of my geoscience courses. My institution does not have a Geoscience major or a Physical Science major (Geology is taught in the Physical Sciences Dept) but my school does have an education major for which I serve as an advisor. Because we’ve had an increase in students interested in pursuing a career in the earth sciences, I am presently working on creating a major in Geoscience that will have a Geoscience Education component.

Learning from Outside

William Van Lopik
College of Menominee Nation

What have you found to be the most successful in broadening participation in the geosciences at your institution and what made it successful? Consider what aspects of this success are translatable to other two-year colleges.

Teaching geoscience in a tribal college has its own challenges and mazes that must be circumvented. These difficulties often relate to the meshing of two different unique forms of teaching and learning. The predominant native student body has a different "way of knowing" than the non-native professor who has been steeped in the objective, predictable knowledge system of western science. These differences are best characterized by the difference between indigenous knowledge and the scientific method. I am not one to say that one is better than the other, only that they are two distinct perspectives. An integration of the two is required in order for students to appreciate and understand the geosciences. The symbiosis between these two ways of thinking is called "integrative science." The challenge for the instructor is to design and teach their class in such a matter that is receptive and interesting based upon the students' way of learning.

My experience is that native students are very much in tune with the complexities, patterns and inter-relationships within the natural world. Hunting, fishing, logging and gathering are integral parts of their lives. However, many have great difficulty with the standard geoscience courses and try to avoid taking science courses unless they absolutely have to. During my eight year tenure at the college I have explored techniques that engage the students in geosciences activities. I have found that learning becomes more meaningful when they are able to utilize all of their senses. Lecturing and reading about the geosciences is one way of learning, but engaging your senses outside of the classroom opens up many more ways of knowing, which frankly is more akin to how native students have learned about the world prior to entering your classroom. I would like to cite a few examples how I have done this.

The concepts involved in global positioning systems and geographic information systems are tough for students to understand who have limited computer skills. I try to bring some fun to the learning of these systems by sending the students out into the forest on a scavenger hunt equipped only with a simple GPS device and few instructions. They get excited about the experience and the potential that this equipment can have as a tool for learning the geosciences. In a short time, they learn the power of this instrumentation in learning about the natural world.

On another exercise I team students up with local foresters and natural resource specialists. They go into the forest for two hours. They are required to identify and document all the trees, plants, insects and animals that they find. They see, touch, listen and smell each species that they come across. They are also required to note the geographic association of each species to its' surrounding environs. The foresters attached the scientific name to each species and the students explain their understanding of the organism.

In the physical geography class the students are given sling psychrometers. I ask them to go outside, go in the school basement and then to the top floor to take readings to determine relative humidity. Before they take the readings they are asked to smell the air and get a sense of humidity levels on their skin. Then they are told to use the psychrometers and see if the readings verify their senses.

Finally, in another class I have the students conduct a waste stream analysis of all the trash that our college generates in a week. They empty everything out of the dumpster and then sort all of the contents into piles of compostable materials, recyclable materials and landfill materials. The exercise is designed to raise the awareness of the students on issues regarding solid waste management and landfill issues. The research is shared with college officials and has been helpful in setting waste policies. It is an activity that no student soon forgets and is much more powerful than sitting in the classroom discussing solid waste issues.

These activities resonate with the students and they remember what they experienced years later. It also meets their need of learning by doing, observing and being physically involved. I have come to realize the importance of these types of activities in my own college. I believe that experiential learning has great potential in other 2 year colleges. Community colleges are noted for their wide diversity of students from various cultures. As instructors, we must be very aware that all students learn in different ways and we cannot resort to one particular method of teaching.

David H. Voorhees
Waubonsee Community College, Sugar Grove, IL

- What are one or two examples of what you've done that has been successful in terms of promoting earth science literacy, developing the geoscience technical workforce (students entering the workforce following their associates degree), and/or preparing future geoscience majors?

Developing and improving Earth Science and science literacy is one of the key driving motivations of my in- and out-of-class activities. Recent surveys (Pew Center, 2009, National Science Board, 2010) suggest an unreasonably poor understanding of basic geosciences. For example, in the these surveys, 28% of the participants responded that the 'sun goes around the earth', 31% said that humans and other living things have existed in their present form since the beginning of time, and about half (49%) said the earth is getting warmer "mostly because of human activity, such as burning fossil fuels". Low scientific literacy is just part of the overall poor background that my typical earth science students have when they come into my classroom.

To improve the scientific and earth science literacy of my students, Waubonsee faculty and staff, and the Waubonsee community, I have been coordinating and developing a program called 'Asset Earth' since 2006. It consists of a series of two or three free lectures per semester on topics that are timely and controversial. The title 'Asset Earth' allows us to present topics over a broad range of topics, from earth science & geology to biology, and meteorology that are selected to improve overall scientific literacy.

The lectures are hour-long presentations that are designed for a non-technical audience modeled after the weekly colloquia that most research universities have in their departments. The presentations are often followed by informal 'meet-and-greet' sessions with the speaker, who will sign books they have authored or others that are provided in a display coordinated with the bookstore or student group, posters (if an IRIS presentation), or mingle while enjoying refreshments. There is no budget for speaker honoraria, so I have to cultivate local speakers or those whose expenses can be paid by their sponsoring agency. A presentation in 2006 by Dr Seth Stein, as an IRIS/SSA Distinguished Lecturer who spoke on *Giant Earthquakes: Why, Where, When and What we can do,* which was part of the grand opening ceremony for our new Science Building, became the unintended beginning of this program. Evaluations and comments made it clear that this was informative and entertaining event, and should be repeated. Following this moment of inspiration, we have since then had an additional IRIS/SSA Distinguished Lecturer, a series of presentations on global climate change, evolution (to coincide with Darwin's 200^{th} birthday), astronomy (to coincide with the International Year of Astronomy) and sustainability. A list of presentations is provided in the table that follows this essay.

Critical to the success of this program has been the strong partnership with the Community Education Department at Waubonsee. They have provided endless logistical support for advertising and facility usage, and travel expenses for an exceptional speaker, Capt Jon McBride, USN Ret, Captain Space Shuttle Mission 41G. Working with the Community Education Department provides access to resources for promotion and logistics beyond the simple mailings, campus posters, and other motivational strategies provided by the Earth Science Department and Waubonsee faculty. Promotional materials are mailed to the entire Waubonsee community in the non-credit course schedules, as well as individualized letters to surrounding high schools, and 2 and 4 year Colleges and Universities with Earth Science or Geology faculty.

I would assess the success of this program in developing the scientific literacy of Waubonsee students, faculty, staff and community in several ways. From a student perspective, the 'newspaper articles' that I ask my students to write as their extra credit for attending these events always include positive comments on their quality and informative nature. During the post-presentation 'meet-and-greet' sessions, I usually have several members of the audience who are part of the Waubonsee community express their gratitude and interest in the event, and their desire for continuation of such events. A more tangible assessment is the continued attendance, which has been increasing from near 60 or 70 to over 100 per event.

As to preparing future geoscience majors, I have recently cultivated a student by displaying a poster I received as a GSA Campus Rep, and help her to reach her goal of becoming a volcanologist. She expressed interest in attending the 2009 GSA meeting in Portland based on seeing that poster, and I was also able to provide funding for her to attend the meeting because I gave a paper in the session *Geoscience Programs at Community Colleges: Models for Success and Innovation,* in which presenters were able to fund students through an NSF grant to the conveners of the session.. While at the conference, she was able to network with volcanologists and schools that will help significantly her in her future education.

Date	Presenter	Title	Format
Sep 2006	Dr Seth Stein, IRIS/SSA, Northwestern University	Giant Earthquakes: Why, Where, When and What we can do	
Feb 2007	Karl Schulze, WCC David Voorhees, WCC Chris Hooker, WCC Dan Ward, WCC	*Global Warming: An Inconvenient Truth*	Film Lecture and panel discussion
Feb 2007	Brian Ekdale, WCC	*10 Days in Malawi*	Film
Mar 2007	Karl Schulze, WCC	Tornadoes: Lessons learned from a Storm Chaser	Lecture
Apr 2007	Kathleen Westman, WCC Jim Powell, Red Cross	New Orleans: Reclaim or Rebuild?	Film and discussion
May 2007		Alternative Energy fair	
Oct 2007	Dr. Brian Atwater, IRIS/SSA, USGS	The Orphan Tsunami of 1700 -A Trans-Pacific Detective Story	Lecture
Feb 2008	David Voorhees, WCC	Global Climate Change and the IPCC	Lecture
Apr 2008	Dr. Paul Loubere, NIU	Waterworld: Global Oceans, Ice and Climate Change	Lecture
May 2008	Dr David Goldblum, NIU	Slowing Climate Change: Our Responsibility, Our Options	Lecture
Oct 2008		**The Second Annual Renewable Energy Fair**	Day long Fair
Nov 2008	David Voorhees, WCC Dan Ward, WCC Rabbi Samuel Mann Rev Bill LaFountain	*Flock of Dodos: The Evolution-Intelligent Design Circus*	Film and panel discussion
Feb 2009	Brian Fox as Charles Darwin	The Darwin Voyage of the Beagle	Presentation of re-enactor
Sep 2009	Joseph DalSanto, WCC	Space Shuttle	Lecture
Sep 2009	Joseph DalSanto, WCC	The View From Earth: 400 Years of Astronomical Adventure	Lecture
Oct 2009	Dr. Jason Steffen, WCC, FERMILAB	Finding Other Earths	Lecture
Oct 2009		The Third Annual Renewable Energy Fair	Day long fair
Nov 2009	Dr. Leon Lederman, FERMILAB	Telescopes and Microscopes: Tools and What We Know About the World	Lecture
Feb 2010	Dr. Andrew Petto, U WI Milwaukee Dr. Paul Nelson, Discovery Institute, Biola University	*Unlocking the Mystery of Life*	Film and panel discussion
Mar 2010	Capt Jon McBride, USN Ret, STS-41G Pilot	To Outer Space and Back	Lecture
Apr 2010	Sallie Greenburg, Midwest Geological Sequestration Consortium	Carbon Capture and Storage in the Illinois Basin	Lecture

National Science Board. 2010. *Science and Engineering Indicators 2010*. Arlington, VA: National Science Foundation (NSB 10-01), pdf available at http://www.nsf.gov/statistics/seind10/c/cs1.htm, accessed 19 May 2010

Pew Research Center for the People and the Press, 2009, *May 2009 General Public Science Survey*, 98 p, pdf available at http://people-press.org/report/528/, accessed 19 May 2010

Becca Walker; Dept. of Earth Sciences and Astronomy, Mount San Antonio College, Walnut, CA

What are examples of what you've done that has been successful in terms of promoting Earth science literacy?

As a community college geoscience professor, the majority of my students are non-science majors, enroll in my courses to satisfy a general education transfer requirement, and do not intend on continuing in geoscience. Although I am thrilled when former students return for a second course, I teach with the assumption that for most of my students, this will be their last—and in many cases, only—exposure to Earth system science at an institution of higher education. As such, I believe that promoting Earth science literacy in all of my courses is essential and have thought deeply about how to infuse Earth science literacy into my curricula in ways that my students find intellectually engaging and useful. I have provided a few examples of strategies that I use—some are more time and labor-intensive than others—and forms of assessment.

Strategy #1: addressing misconceptions perpetuated in pop culture and the media.
My students and I have frequent opportunities to discuss misconceptions about the Earth system, a major component of Earth science literacy. I want my students to understand, and be able to convey to others, that the lithosphere is *not* floating on a molten layer of the Earth, tsunami are *not* huge "tidal waves" that manifest themselves as walls of water in the open ocean, scientists do *not* know what the results of an experiment will be before performing the experiment, and so on. I believe that explicit classroom discussions of geoscience misconceptions make my students think carefully about the Earth system and develop a more accurate understanding of Earth processes. Addressing a particular misconception often leads to tangential discussions and student questions that may not be as relevant to the topic as one would hope. It is challenging to find a balance between avoiding abrupt terminations of discussions and covering the material in the course outline of record. I have made the decision that in my general education courses, I am willing to sacrifice a small percentage of planned course content if it means that my students have their questions answered and leave the course with a more accurate understanding of geologic processes.

Assessment: Initial assessment of student misconceptions requires little time or labor: before we discuss a particular topic, I ask students to record and submit (anonymously) what they know about the topic. If the topic is a geologic process or phenomenon (examples: volcanic eruption, formation of sand dunes), I also ask them how/why the process occurs. These data allow me to target pre-existing misconceptions more efficiently during class. Assessing student understanding of misconceptions after we have discussed the topic is equally straightforward in the context of exam questions. For objective questions, this might be as simple as a multiple-choice question about a particular topic with three correct statements and one misconception. I have also used written questions on exams that involve misconceptions. For example, "Your friend is taking geology and tells you that earthquakes occur when the plates shift. To help him/her better understand the cause of earthquakes, provide a scientifically accurate explanation of where and why earthquakes occur."

Strategy #2: assignments geared toward a general audience
I teach linked lecture/laboratory courses in Earth science and oceanography. The Earth science section is an Earth science lecture/laboratory course for preservice teachers. After their field trip, each student prepares a field trip portfolio geared specifically toward a general audience. For the Earth science portfolio, the audience is inservice K-12 teachers doing reconnaissance for a

geology field trip. For the oceanography portfolio, the audience is a student about to enroll in an introductory oceanography course. I instruct my students that a non-scientist should be able to read their portfolio and understand the geologic features and rock types present at each field stop as well as the general geologic history of the field area. I believe that the ability to accurately convey a particular Earth science concept to a non-science audience has implications for Earth science literacy.

Assessment: I provide students with the grading rubric for the portfolio prior to the field trip. The "appropriate for the intended audience" category comprises roughly 10% of the portfolio grade. I explicitly state verbally and on the rubric that "audience-appropriate" includes scientific accuracy, appropriate vocabulary, clear definitions/explanations that non-scientists would understand, and labels and/or captions on images orienting the reader to what the image is showing.

Strategy #3: projects that require synthesis, application of course concepts, and debate
In some of my courses, I have developed final projects that involve a local problem and require students to synthesize course concepts in order to formulate an opinion about the problem. Often, these projects involve a role-playing exercise in which students must present evidence to support their opinion. For example, my oceanography students evaluate whether or not commercial and residential development should continue on the Palos Verdes Peninsula. Students are randomly assigned roles, including a physical oceanographer specializing in tsunami hazards, a geologist specializing in rock types and landslide hazards, a hydrologist specializing in water quality and availability, and a marine biologist. They are responsible for using their scientific content knowledge to evaluate the evidence in their specialty (I provide them with an extensive list of web resources, ranging from peer-reviewed journals to news articles, to get them started with their research), decide whether or not the evidence warrants continued development in Palos Verdes, and participate in a mock City Council meeting to convince the council member (me) to vote accordingly. In addition, students must design a position statement—papers, pamphlets, and brochures are all examples of acceptable position statements modes—summarizing their argument and using supporting evidence.

Assessment: I use rubrics to evaluate the City Council meetings and position statements. During the City Council meetings, I play the role of a non-scientist and ask a variety of questions about their argument and the scientific evidence that they present. This dialogue allows me to interpret their level of understanding of the Earth science concepts they used to formulate their opinion.

Katryn Wiese
Professor of Geology and Oceanography
Chair, Department of Earth Sciences
City College of San Francisco
50 Phelan Ave. Box S50, San Francisco, CA 94112
kwiese@ccsf.edu; 415.452.5061
http://www.ccsf.edu/Earth

What have you found to be most successful in broadening participation in the geosciences at your institution and what made it successful?

Community colleges are the location of choice for community education (post graduate), job certificates, and future graduates looking for the most affordable educational path. As such, we have the unique opportunity to become an integral part of a community and serve it at all levels. We are educators in a wide range of capacities – and our doors are open to all. We work with K-12 teachers and their classrooms; local science workshops; local news organizations; local parks; municipal services; politicians; and surrounding 4-year institutions to which our students transfer.

Most community colleges serve a large, diverse group of students – of all races, ages, and economic backgrounds. We are on the front lines with students who have lots of life experience and want to understand their planet better or who are lost and looking for something that interests them and that can guide them towards a successful, rewarding career and life path. As such, we have the opportunity to turn many students on to the Earth Sciences, and if not produce future majors, at least produce future voters, educators, and community contributors who are well versed in the scientific method and basic understandings about how their planet functions.

By making my department as open a resource as possible, by cooperating in outreach opportunities throughout the community, by helping all my current students see geoscience education as important and exciting, I am broadening participation in the most effective way possible.

So what are some of the specific ways that my particular department makes geoscience education exciting and open to all? First and foremost, we have great instructors teaching our courses – who get the highest evaluation marks and demonstrate their own passion and enthusiasm for what they teach. (A natural enthusiasm for one's subject matter – enthusiasm that bubbles over and infects a classroom – is one of the best ways to improve success and participation in a class!) We are committed to helping our students succeed in our courses and get hands-on experience with a wide range of skills. And we consider that part of our job at the community college – not just teaching geosciences, but providing as much guidance as possible to our students on how to be successful in our and future classes. More details:

- We have an active **Earth Sciences Club**, which hosts optional field trips, talks, and social events to both create a sense of camaraderie and community in a student's geoscience educational journey and give students an extra-curricular opportunity to explore geoscience (without grades or pressure).
- We have a robust **peer-mentoring and tutoring program**, with 10 hours per week of open study sessions in our main department lab rooms. Students can use these study sessions to work with other students from the class or seek help from previous students (study session leaders/tutors). Often students attend just to figure out how to study better – how to read the textbook better, take notes better, etc. And our peer-mentors (future majors) get to keep their hands in the science even as they take the Physics, Chemistry, and Calculus classes they require for their programs. Many of our peer mentors are paid. Some are volunteer. Some already have degrees.

- We are lucky to have many students who act as our **ambassadors** – many already with bachelor's, master's, and PhDs, but with the love for geoscience that comes from a life-long interest outside their main career. These students are incredible resources for us as teachers and for our students. They provide the patience that we sometimes don't have. And they demonstrate and encourage when things get tough, because they've been there themselves. These students are from the community and choose to volunteer as a way of staying in touch and active with the science and work they love.
- Our website and instructors offer students information and advice on **transferring** and being successful in a completion of bachelor's and master's degrees. We give information on local college departments (transfer requirements, website links, etc.). We have relationships with folks at most of these colleges, so we can help direct students to the best place to get their questions answered.
- We develop policies for our classes that are **flexible yet rigorous**, to allow for students to juggle the many responsibilities of their lives, but also understand the expectations that will come in the workforce and their future education (of course many of our students have come from the workforce, and they already have many of these skills).
- We have a **diversity of students**. And since our students learn from watching and working with each other, they each share their unique set of skills; they each demonstrate their own strengths. Our younger students who might be lost get inspiration from the older students who are focused and hard working, with a purpose. Many of our students find themselves learning most through working with and helping other students (either during or after they've taken our classes).
- We advertise our efforts and resources through a variety of methods:
    - Campus events (our club's participation)
    - Open House workshops and events
    - Word of mouth from students who have already taken our classes
    - Good relationships with counselors/advisors throughout the college
    - Providing expertise/advice/quotes for articles in college and local newspapers and organizations.
    - Hosting campus-wide open lectures
    - Developing and maintaining large displays that engage students who pass in the hallways – and that extend well beyond our own classroom
- Our instructors have open office hours and build **connections** with our students. If a student wishes to, they can develop a relationship with an instructor that lasts forever, getting guidance, tutoring, recommendations, career and transfer advice, etc.

Our transferable, general science-credit classes (Physical Geology, Physical Geography, and Oceanography) are always waiting room only. We serve many hundreds of students a semester. Once they enter our classes, they enter our sphere of influence. We give them opportunities to engage in geoscience education in a multitude of ways. We show them our science from many sides. In the end, we pull them in through satisfying transfer requirements. We keep them by making our classes engaging, exciting, and rigorous (so they leave with a sense of accomplishment), and by helping them to succeed. And we help create a community that they can consider themselves a part of as they continue onward in their educational journeys.

Much of what I've described is applicable to all academic settings. What's unique about the community college setting is the sheer number of hours we put in with our students, the potential diversity of our student body (depends on institution), and the focus we have on education that allows us to reach a larger number of students. We are a good testing ground for new assessment techniques, interactive activities, and other innovative strategies for engaging students. And what will help us most is going back to the most important tool in our arsenal – helping to create and develop enthusiastic, expert, talented teachers.

Wendi J. W. Williams, Ph.D.
E-Mail: wwilliams@nwacc.edu or wjwilliams@ualr.edu

NorthWest Arkansas Community College
Math & Science Division / Geology Program
One College Drive, Bentonville, AR 72712
Campus Website: www.nwacc.edu

University of Arkansas at Little Rock
Department of Earth Science
2801 S. University Avenue, Little Rock, AR 72204
Campus Website: www.ualr.edu

Recognizing Opportunities: Expanding Earth Science Literacy by Understanding the Role of Community Colleges in U.S. Higher Education

"Over the years, I've come to view community colleges and other two-year institutions as the Cinderella story of our education system--doing the hard work, quietly, without much fanfare. They provide a pathway to the American dream for millions of people, whether they enter the workforce immediately afterward or decide to continue their education."

William D. Greene, Chairman and CEO
Accenture (Forbes, 2008)

GEOSCIENCE COLLEAGUES CONTRIBUTING THEIR TALENTS AT COMMUNITY COLLEGES

Two-year colleges provide a skilled graduate-level educated faculty focused upon teaching. Natural or physical sciences faculty have graduate training in their subject areas. Many 2-year colleges require at least a Master's degree for any faculty science division hire or require a minimum of 18 graduate units in the discipline (depending upon the State and/or institution). A growing number of faculty have earned Doctoral degrees (upwards of 10%, with the greatest number achieved by adjunct faculty; AACC, 2009). Numerous faculty are "shared" by 2-year and 4-year institutions, working combinations of part time and full time at both types of institutions simultaneously (e.g. this author). Community college faculty professional development emphasizes pedagogy and androgogy techniques for diverse populations. These faculty play an important role in the training of students in introductory laboratory science courses by offering smaller class sizes (generally 30 or less students per faculty), and providing more personalized "active learning" instruction. Pre-service teachers, particularly primary-levels, can receive suitable strategies in instruction modeled during content classes (Fathe and Kasabian, 2009). It is interesting to note that participants of the American Geophysical Union workshop on Earth Systems Science (AGU, 1996) grasped that most students begin their college training at 2-year institutions, however many of the articulation agreements for transfer to 4-year programs granting baccalaureate degrees are controlled by 4-year institutions. This has the effect of restricting community college faculty in the use of their collective expertise and ingenuity in delivering contemporary Earth system science curriculum (AGU, 1996).

NATIONAL IMPORTANCE TO UNDERGRADUATE EDUCATION OF Diverse Populations

The National Science Board communicated six main priorities to the Transition Team for then President-Elect Barak Obama with regard to STEM education. Important to note is that 2-year institutions are included in the stakeholders mentioned for improving STEM-related communication, coordination and collaboration between K-12 teachers, students, parents, and administrators by better bridging with higher education institutions, informal science education organizations, business, and industry to promote 21st century-needed learning and development of STEM skills (NSB, 2009). In the United States, approximately 65% of all graduating high school seniors decide to attend college after graduating. Of those students, 30% matriculate to a community college setting (NCES, 2009a). The National Center for Education Statistics reports there are 15.6 million undergraduate students enrolled in approximately 4100 degree-granting public and private institutions (NCES, 2009b) within the United States and its territories (American Samoa, Guam, Northern Mariana Islands, and Puerto Rico). From those institutions, about 1,800 (UT, 2008) are community colleges enrolling just shy of 12 million students with 6.7 million enrolled in academic credit courses (NCES, 2009b). Forty percent of these students enrolled for credit attend full time. Community colleges enroll 44% of all undergraduate students nationally and up to 39% of the country's international students (AACC, 2009).

The American Association of Community Colleges (AACC, 2009) reports the average student age is 29 years old, with almost 50% of this population being 21 years or younger. Women are the majority at 58% and ethnic/racial minority populations are approximately 40% of the 6.7 million enrolled. Thirty-nine percent are first generation college students. Students that begin their coursework at community colleges have diverse goals: to obtain some college coursework credit only, to obtain an Associate's degree, and/or to transfer units (with or without completing an Associate's degree) to a bachelor's degree-granting institution. U.S. Department of Education studies indicate that 75% of the high school seniors beginning at community college intend to transfer (NCES, 2008). Further, many with initial goals of just earning an Associate's degree become more prone to continue their education after experiencing successful semesters, gaining confidence or realizing the potential a bachelor's degree offers. "Students who transfer from community colleges to four-year institutions graduate at the same rate and succeed in their jobs on par with students at four-year colleges and universities who did not transfer" (NACCTEP, 2009).

STRATEGIES TO INCREASE STUDENT NUMBERS IN GEOSCIENCE AND/OR TEACHER CANDIDATE TRAINING

Community colleges are particularly important due to their often dual-roll of being part of a "formal" higher education system as well as part of the workforce development system (EOPCEA, 2009). It is very important that our geosciences community recognizes the opportunity for improved outreach to potential majors and non majors through our community colleges. Since nationally 44% of all undergraduates attend community college, then potentially 6.7 million students will enroll in their introductory science and mathematics courses during that time. Awad and Mattox (2009) discuss the merits of recruiting students to undergraduate programs by attracting well-qualified high school students into college credit courses while they are still juniors and seniors. A number of community colleges and an increasing number of 4-year institutions have such dual-credit and/or dual-enrollment agreements in place for a variety of disciplines. The GSA Education Committee is aware of such programs, including the Illinois College of Lake County example discussed in their article, and sees these "bridges" as a way to recruit high school students into undergraduate geosciences programs since there are no Advanced Placement courses in Geology to attract this population.

We must remember that the majority of U.S. students are not exposed to geological content after 8th grade. The early "core" college science requirements for post-secondary students should be tapped as a way to provide "early" exposure to geosciences as a viable vocational track. Also within the current pre-college system in the United States, we need to understand that an estimated 2 of every 5 teachers complete some math and science courses at community colleges (NACCTEP, 2009) during their degree programs. The Trends in International Mathematics and Science study (TIMSS) provides an important measure of K-12 student achievement comparing students globally on key indicators. According to the 2008 TIMSS, poorer students continue to lag behind affluent in 4th and 8th grade mathematics and science achievement in the United States. The data provided from TIMSS over the past number of years is an indicator that the U.S. is falling behind in the competitive global market. We need improvement in K-12 teachers skilled in STEM instruction at both the primary and secondary grades (Fathe and Kasabian, 2009).

> *"Greater than 20% of all teachers begin their college careers at two-year institutions and nearly half of all teachers complete some of their science or mathematics courses there."*
>
> Fathe and Kasabian (2009)

This presents an astounding number of teachers we need to teach earth science literacy. The U.S. Department of Education data indicates there are over 5 million K-12 instructional staff in both public and private schools nationwide. According to transcript studies, community colleges played a role in more than 50% of the nation's current classroom teachers, often providing the only technology training and general content courses they received in their undergraduate careers (NACCTEP, 2009). Community college experiences provide a foundation for pre-service teacher upper level instruction, as well as provide pathways for post-baccalaureate workforce to switch careers to become certified teachers (NACCTEP, 2009). At least one type of alternate teacher certification path is present in all 50 states and the District of Columbia, with approximately one third of new teachers hired coming through these routes. The simple fact is, train the elementary, middle childhood and secondary level teacher candidates to recognize the far-reaching relevance of earth science literacy, as that expressed through the "Big Ideas" and create a more "topic comfortable", competent set of advocates in our pre-college students' experiences. More teachers trained in the geosciences/earth sciences within the pipeline will increase the probability that geosciences will be used as a vehicle for the required teaching of integrated content and technology skills across course disciplines. Perhaps more teachers would then request to teach specific courses in geology--thus creating a synergistic effect in our school system structures. Increase the number of messengers to promote the vocation.

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(Essay prepared May 2010.)

James (Jim) Wysong

Hillsborough Community College – Brandon Campus

Tampa, Florida

Hillsborough Community College, like many large metropolitan community colleges in close proximity to major universities, has a high ratio of Associate in Arts (A.A.) to Associate in Science (A.S.) degree seekers. At the particular campus where I teach, that ratio approaches 9:1. Not surprisingly, the majority of students enrolled in the geosciences courses that we offer[i] are seeking to fulfill general education requirements for a generic liberal arts A.A. or for a non-science university parallel A.A., rather than taking those courses for a terminal geosciences related degree or a university parallel degree in a geoscience major. Our college does have an Environmental Science Technology A.S. degree; however, most of the geoscience related courses required for that program are restricted to students in the program, and thus constitute only a very small part of our total enrollment.

In a 2008 review of data gathered to track the progress of our A.A. graduates as they progressed on to four year institutions, fewer than 5% entered programs related to the geosciences (including geoscience education). While we believe that there is certainly room to increase that percentage, the fact remains that the majority of our enrollment consists of general education students, and therefore our institutional goal has been to focus on broad science literacy themes in these courses. As the college-wide General Education Committee Chairperson since 2000, I have been an active participant in shaping those goals and objectives, while at the same time looking for ways to increase student interest in the geosciences (and other sciences) as career choices.

In formulating what we wanted to do to reconcile the general education science curriculum with the myriad of STEM initiatives and proclamations of the last decade, we decided on a rather simple path. Our belief is that engaging general education science courses – with their “captive audiences” – are the ideal place to recruit science majors. To “close the deal” we actively recruit interested students to join our science club (which offers subsidized field trips and activities) thus granting us further opportunities to mentor and advise them. This model seems to be working; however, we are still gathering data to see if we are truly getting more students to choose science as a major.

What has emerged from the collective efforts of those of us teaching geoscience courses at the Brandon Campus of H.C.C is a curriculum designed to engage students with visually interesting presentations, meaningful lab experiences[ii], and information that is presented in a manner that stresses its relevance to their lives now, and in the future. This does not mean that the curriculum is “watered down” or all about pretty

PowerPoint® slide shows. What it means is that the question in the mind of the vast majority of non-science majors taking a science course - "why do I need to learn this stuff?" - is addressed in virtually every class meeting. Like it or not, we do have to "sell" the subject, and we are dealing with a generation (at least among traditional college age students) who have grown up and come of age in one of the most anti-science periods in the recent history of our nation[iii].

Overcoming "science anxiety," overcoming the lack of preparation prior to entering college, and dispelling the negative perceptions and stereotypes created by the popular culture are all challenges. How do we address these? The first step is by directly dealing with these topics on day one, and then by continuing to address them throughout the remainder of the term. The very first activity that I use in my classes is based on a short essay that I have prepared which is entitled, *"Science as a Way of Knowing."* In that lesson we talk about what science is, and how it's done, and then have some fun discussing conspiracy myths and pseudoscience. This breaks the ice and sets the tone for the entire term. It also makes clear the message that I am trying to send about the class: *it's more about thinking and understanding, than memorizing trivial facts*. The reality is that there are still some facts (presumably not trivial) to learn and know, and some first level - knowledge-oriented questions that will be a part of the student assessments. More importantly though, every lecture also contains "thinking questions," that address the deeper concepts and ideas that will be on the tests as well.

I am quick to tell students that like life, not all parts of our subject matter are equally exciting. With a bit of effort though, virtually every topic and concept that is part of the typical geoscience curriculum can be connected to something that has the potential to engage students – there is a whole world of examples out there to use. The major strands that represent our "relevance approach" include: natural hazards, resources, human-environment interaction, and science and society issues. Connections[iv] between these subject areas and daily life abound, and I actively use them, both as examples, and as ways to keep the students interested. My experience is that this works well to teach science to general education students and to introduce some to what may become their life's work.

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[i] At H.C.C. we regularly offer the following geosciences courses: ESC1000/L – Earth Science, GLY1010/L – Physical Geology, MET2010C – Meteorology/Climatology – all of which fulfill general education requirements.
[ii] The science faculty has fought hard to keep a lab requirement as part of the general education curriculum.
[iii] I highly recommend the book: *Unscientific America – How Scientific Illiteracy threatens Our Future*, by Chris Mooney and Sheril Kirshenbaum, for an overview of the problems we face in dealing with science literacy.
[iv] Those of you familiar with the work of the British author, James Burke, will appreciate the choice of the term "connections." His style is illustrative of creatively using a narrative approach as a vehicle to teach science.

Increasing Participation in the Geosciences at El Paso Community College

Joshua Villalobos, Department of Geological Sciences. El Paso Community College, Mission del Paso Campus.

Community Colleges currently serve 44% of all undergraduate students and 45% of all of all first time freshmen in the US_1. The combined low cost and flexibility of community colleges has also meant that they accommodate a large percentage of minorities entering higher education. Hispanics now constitute 15% of the general population and 19% of college population in the US_1. This increase has led to more Institutions being designated HSI (Hispanic Serving Institutions) by the federal government, where at least 25 percent of the full-time-equivalent students are Latino.

These facts illustrate the potential community colleges hold to encourage STEM (Science Technology Engineering and Math) majors to minorities as well as non-minorities. But the reality is the number of STEM degrees awarded at CC has not followed the same trends in $enrollment_1$. Student research is the key to having students participate in STEM fields. This, unfortunately, is a simple task with a complex solution.

Having students involved in hands on research is fundamental in having them understand the potential of what a particular STEM field can provide. Regrettably, unlike our university counterparts, community colleges do not have the financial, administrative, or infrastructure support needed for research.

Like many community colleges, El Paso Community College (EPCC) is experiencing a stage of rapid and exciting growth. EPCC currently enrolls 27,000 students with 85% of the student body being Hispanic. More than 130 programs of study are offered including an Associate of Science degree in Geological Sciences. In our effort to increase majors in Geology at EPCC, we have taken several small steps over the past three years.

Attrition rate-

El Paso Community College is often used as a “stepping stone” for students to prepare for a four-year college (primarily the University of Texas at El Paso or New Mexico State University), gain credit, or to test the waters of higher education. Many times, our students leave EPCC and start a four-year institution without ever receiving their Associates. Many of these students do not realize they have either earned enough credit to receive their Associates, earned enough to get multiple Associates, or are simply lacking one or two classes to complete their Associates.

State funding in Texas, as in most states, is based on graduation rates, not class enrollment. Therefore, once a student leaves EPCC without receiving their Associates and transfers to a four-year institution, EPCC receives no credit for federal aid from the State of Texas for that student. Therefore, the four-year institution will receive state recognition once the student receives their Bachelor Degree, even though EPCC is responsible for up to half of the college credit the student earned.

In order to increase the number of students receiving their A.S. in Geological Sciences at EPCC, we implemented a "2+2" program. Working closely with the Curriculum Offices at EPCC and UTEP and the Geology Department at UTEP, we developed a Degree plan that would:

-Allow a student to complete their basics (up to 65 credit hours) and therefore complete the first two years of a four-year degree while getting their AS degree at EPCC.

-Allow the student to then spend the last two years of their BS taking upper level courses at UTEP and only pay the higher tuition rates for these last two years.

-Ensure all courses taken in the AS degree plan for Geological Sciences at EPCC would count for credit in the BS Geological Sciences Degree plan for UTEP.

- The format and style of both the EPCC and UTEP degree plans were identical to minimize confusion, redundancy, and anxiety of transferring students.

The simplicity of the degree plans allows EPCC geology instructors to easily mentor students interested in becoming geology majors at EPCC and illustrates a path for a BS degree at UTEP. In the past 2 years since the introduction of the 2+2 program, we have gained 10 geology majors at EPCC two of which have continued at UTEP under the Geological Sciences BS degree program. Some of the students who developed an interest in Geology late in the time spent attending EPCC wound up having accumulated enough credit, under the new degree plan, for not only an AS in Geological Sciences but for other Associate degrees as well (in one case 3!).

Student Research-

Undergraduate student research is an essential component of an institution's ability to grow the number of STEM majors. Unfortunately, unlike our university counter parts, many community colleges lack the required components needed for faculty to apply for funding or faculty are not encouraged to do research. The administrative mentality of "Community colleges are for learning not research!" within our institutions is often engrained but fortunately can be changed.

Applying for funding for our projects was not easy. Several administrative reasons on why student research might not be a good idea were given but we came up with solutions for each of them:

- **Time** - CC faculty class-loads do not permit time to conduct major research.
  Solution: Development of **Geology 2389: Investigations in Physical Science**- This course allows students to explore geology while working closely with an instructor. They may study GIS, soil pollution, mineral exploration, or a topic chosen by the student and instructor. This course allows the student to investigate and learn geology using research.

- **Cost**- CC do not want financial obligation for laboratory equipment up-keep or maintenance.
  Solution: The total amount received for equipment and supplies has been less than $1,000 and require no up-keep or maintenance. Often, government agencies and universities store still useable research equipment as surplus that can either be given to community colleges or sold at a discounted rate.

- **Facilities**- Most CC were never planned to incorporate research labs or facilities.
  Solution: All research is conducted in the field and requires little to no classroom time.

- **Funding sources**- Research money in not in a CC budget.
  Solution: Projects were developed in conjunction with UTEP and participating research institutions in order to use or rent more expensive research equipment. Projects were designed to be cost effective and use as little money as possible. Two grants were submitted to NSF through the Western Alliance to Expand Student Opportunities (WAESO). Both grants included student stipends, supplies, rental fees, and equipment and each came under $3,000 for the total funding amounts.
  A key step that helped in funding of the projects was serving on a NSF grant review panel. Serving on a panel allowed for a greater understanding on how to write, prepare, and find grants. Reviewers are not limited to university PhD's and often have several CC faculty involved in the process.

The key to overcoming these obstacles was to understand the aversion or lack of understanding of student research at certain administrative levels. Not all research projects require vast amounts of time, resources, or funding. But all students should have the opportunity to experience quality research at a 2yr. institution to foster the curiosity of majoring in a STEM field. The ability for a Hispanic Serving Institution (HSI) or Community College to allow undergraduates to conduct hands-on outside research is a key factor in increasing their awareness and participation in STEM fields. Even with a modest amount of funding, huge strides can be made for minority and non-minority students attending community colleges to become interested in and majoring in STEM fields. Below is a brief description of what the EPCC Geological Sciences Department recently did to increase the number of Geology majors using student research.

In Fall 2009, a Physical Geology class project was undertaken by El Paso Community College to investigate the hydrology of a mitigated wetland in El Paso County, Texas. Students made simple field observations and came up with hypotheses of possible sources of water for the wetlands. As a result of this preliminary class project several students became geology majors and wished to continue their investigations.
Further investigations of the site required a small amount of funding in order for two individuals, Marc Lucero and Raul Gonzalez, to continue their research. With the money provided by WAESO, these two students have been able to:
- Conduct detailed weekly investigations of the water quality in the wetlands at 14 selected sites.
-Collaborate with two major universities (Texas A&M and UTEP) in their research.
-Be the first community college students to present their findings at the University of Texas at El Paso's Department of Geological Science 24th Annual Research Colloquium.

As a result of their presentation UTEP's Department of Geological Science has offered to help further their investigation this summer. With the continued support by WAESO, they will be using geophysical equipment provided by UTEP as well as receive training and mentoring by a faculty member.

Currently there is a waiting list for other students to participate in field research at EPCC. We are hoping that we can continue with our success and our collaboration with UTEP and continue to learn new ways to improve the rates of STEM majors at two and 4 yr. institutions.

[1] Quality Education for Minority (QEM) Network Follow-up Workshop to HSI-STEM Outreach Forum Overview of NSF Programs and Proposal Opportunities. Las Vegas, NV. 2009.