Geology at NOVA: Important ideas that are failing to reach everyone

Part I: No plan for minorities, and the data show it

At Northern Virginia Community College's Annandale campus, we have no department-wide (or discipline-wide, or division-wide) approach to specifically addressing the recruitment and retention of students from under-represented backgrounds. That said, our STEM faculty are a diverse group, as befits the diversity of our region of the country. There are plenty of role models of every stripe for minority students to look up to.

Geology, I'm sorry to say, is the exception to this rule. It's hard to be fully diversified when your program is as small as ours, however the percentages are still stark: As of spring 2014 on our campus, 3/3 full time geology faculty members are white, 2/3 are male. Our lone geology staff member is a white male. Among our campus's adjunct instructors, 4/4 are white, and 3/4 are male. Among all full time geology faculty (at all campuses) across the college, 7/8 are white, and 7/8 are male. College-wide geology adjunct data are not available to me at this time, though I suspect they would look very similar.

Our society does not match this pattern. Our students do not match this pattern. Table 1 shows the demographic breakdown of science, engineering, and mathematics students at NOVA, broken out by discipline:

	Geology	*Engineering*	*Math*	*Biology*	*Chemistry*	*Physics*
Male	55.0%	85.8%	52.6%	38.6%	46.3%	65.4%
Female	45.0%	14.2%	47.4%	61.4%	53.7%	34.6%
% of total STEM	**4.3%**	**3.3%**	**52.8%**	**29.4%**	**9.2%**	**4.3%**
White	58.8%	43.0%	45.6%	45.0%	44.4%	45.0%
Black	10.1%	13.2%	14.9%	16.9%	15.9%	12.8%
Native American	0.7%	0.4%	0.4%	0.5%	0.4%	0.4%
Asian	13.1%	22.5%	18.3%	17.8%	22.9%	24.9%
Hispanic	11.2%	14.1%	14.9%	13.9%	10.1%	10.5%
Other	6.2%	6.7%	5.9%	6.0%	6.3%	6.5%

Table 1: *Demographic statistics (race, ethnicity, and gender numbers) for Geology vs. Math, Biology, Chemistry, Physics, and Engineering for the past five years at 5 NOVA campuses (Annandale, Alexandria, Loudoun, Manassas, and Woodbridge; The Medical Education campus not included, since they do not teach non-medical courses). 274,818 total student course enrollments included, spanning Summer 2008 to Spring 2013. Data compiled by NOVA's Office of Institutional Research in February, 2014.*

A few comments on these numbers:

- Geology at NOVA is male dominated, but it's more equitable than physics and engineering. The math numbers likely reflect a more standardized sample of the College's population, since every degree-seeking student is required to take some math classes, and geology's gender ratio is not too far off (~2.4%) the math distribution.

- Geology, like physics & engineering, is a pretty small piece of the pie. Math & biology dominate.
- Geology at NOVA is dominated by white students, and these numbers are not only far off the math ratios, but they are also the least diverse of any of the STEM fields for which data is shown. Geology has the smallest percentage of black students and Asian students. Geology's proportion of Hispanic students is below the base proportion of the population (as indicated by the math numbers, mirrored by engineering & biology), but it's marginally better than chemistry or physics.

Part II: But geology is important!

The prompt for this essay is about how our "programs" help connect students' learning Earth science to the issues they care about. While that sounds like a noble goal, I'm not sure I can speak to our "program," *sensu lato*. Instead, I can relate information about what happens in my own classroom, and readers should recognize that my colleagues at the Annandale campus (or at the four other NOVA campuses where geology is taught) may be doing something different.

So, with that caveat in mind: I heartily endorse the assumption behind the essay prompt: that learning about the Earth is important, and that learning is easiest when it's tied to pre-existing understanding, particularly when that understanding is of great personal importance to the students. Earth science literacy is a primary goal for my own teaching. Every human being in the world deserves the opportunity to learn what science has to say about their place in the Earth system, and indeed the universe, not to mention space-time itself. I'd argue, in fact, that every human has a responsibility to seek out the scientific learning that informs this perspective. I invoke the reliance of our existence on geological processes and products at every opportunity. This takes many forms, big and small, tangible and esoteric: the miraculous transformation of a flammable metal and a poisonous gas into halite, a mineral that makes French fries taste good, or the cycling of carbon dioxide and oxygen between producers and consumers, or the fireproofing ability of vermiculite, or the best way to cope with volcanic hazards, how ancient photosynthesis drives modern power plants, or why diving under breaking ocean waves is a good strategy to avoid getting clobbered. Examples are endless. Not only does every human depend on geologic resources and actions in every moment of every day, with every meal, transaction, and breath, but it's never going to change, for every human alive today is going to spend the rest of their lives living on this planet, this oblate spheroid whirling in the Goldilocks Zone, an isolated and beautiful prison with 7.1 billion fellow inmates.

So how do I help students understand this? I point it out to them. I remind them of it. Their minds come to me focused on family and friends (other people), wrapped in the gauzy distractions of pop culture, and with a sense of material entitlement and a lack of curiosity into the ultimate origins of things. I find very few who naturally ask questions like, Where did my iPhone come from? Why is that mountain there? Where did people come from? Where did life come from? Once I crack the shell of their calcified perspective, I find they sparkle as new realizations come shining in.

As for "relevance" and "societal importance," there are the obvious answers about geological issues in the news: energy sources, perturbation of the carbon cycle and attendant warming-induced ecosystem

stress / cryosphere destabilization, and hazards, not to mention "stuff" (geologic resources: that which the Earth provides through harvesting and mining). But there's also relevant material in geology beyond what the television talking heads consider important. I'm talking about a sense of place, a sense of connection to epic ancient events, a sense of kinship with organisms long extinct, as well as their modern descendants, both charismatic and insidious. Geology's great contribution to human intellectual thought is its revelation of deep time, and when we tap into that, we attain a sense of the grand sweep of history, and what our time looks like from the perspective of other times. We get a sense of what's a big deal from the planetary perspective, and how that differs from what's a big deal to the gang of self-aware primates with their tremendous dependence on technology for survival.

Probably the greatest single intellectual enhancement we can impart to students is critical thinking. Whether they end up taking a second geology class (or not), majoring in geology (or not), or embarking on a geological career (or not), they need to be citizens capable of independent thought. Being able to recognize the value of data-driven decisions, of the pitfalls of ideology and dogma, is of paramount importance. I particularly emphasize the recognition of logical fallacies in my Environmental Geology course, and it's a major theme in the carbon cycle unit that colleagues and I are writing for the InTeGrate project. Our society would benefit from less jingoism, tribalism, & spin. It would benefit from more rigorous thinking, creativity, & honesty. Science embodies the latter, & pares aware at the former.

As to how all this feeds into the geology program's work throughout the cycle of attracting new students, supporting them through the major, and preparing them for careers, I'm afraid I don't have any great answers. We attract the majority of our students through three principle routes that I'm aware of: Students either have (a) a perception that geology will be easier than some other science option, or (b) an attraction to environmental issues (subcategories include "sexy" hazards like volcanoes or earthquakes and issues related to sustainability of human civilization: climate change, etc.), or (c) a positive experience with geoscience at the high school or amateur hobby level. All of these are external: that is to say, we don't do anything specific to attract students, but this is why they come to us. We don't have a 'major,' so we can't support them through their major, but more broadly, we do offer them additional opportunities (field trips, conferences, research projects, Honors course options), and in many ways, this is how we craft future GMU, JMU, or William & Mary majors from the multitude of students taking geology courses as part of their general education requirements. We mentor them and give them opportunities to push themselves further, and we advise them about where to go for their B.S. degree (mainly Virginia schools, since tuition is so low), and looking beyond for strategies and approaches to jobs and graduate school.

All told, I feel like our department-wide approach is:

- a 'status quo' historical artifact that is neither deliberate nor well thought-out,
- ineffective at capturing a diversity of students that matches the general population, & therefore,
- failing to impart key perspectives from Earth science into the larger community.

We are open to change. It is my hope that the Broadening Access workshop will allow me to bring back new strategies which will catalyze a more inclusive efficacy in our mission.