
SMALL DEPARTMENTS WITH BROAD MISSIONS

CHALLENGES AND STRATEGIES FOR MEETING THE
NEEDS OF GEO MAJORS WITH DIVERSE CAREER GOALS

BARBARA TEWKSBURY

*DEPT. OF GEOSCIENCES,
HAMILTON COLLEGE*

THE LANDSCAPE OF SUPPORTING SCIENCE AND MATH IN GEO DEPARTMENTS AT SMALL COLLEGES

- I looked up the requirements for a geology major & prerequisites for geo courses at 25 small geo departments in the US
- List includes 14 of the 2020 US News 20 top-ranked liberal arts colleges* (6 of the 20 have no geo dept)
- I added 11 more strong geo departments**

*Williams, Amherst, Wellesley, Pomona, Bowdoin, Carleton, Middlebury, Washington & Lee, Colby, Smith, Hamilton, Vassar, Colgate, Wesleyan

**Bates, Beloit, Bryn Mawr, College of Wooster, Colorado College, Dickinson, Lafayette, Macalester, Mt. Holyoke, Oberlin, St. Lawrence

THE LANDSCAPE OF SUPPORTING SCIENCE AND MATH IN GEO DEPARTMENTS AT SMALL COLLEGES

- All are small, liberal arts colleges
- All but one are undergrad only in geo
- Average total enrolled ~2000; graduating ~500/year
- Average of 11 geo majors graduated annually in 2017; median 12
- Min of 2, max of 23 graduated annually in 2017

*Williams, Amherst, Wellesley, Pomona, Bowdoin, Carleton, Middlebury, Washington & Lee, Colby, Smith, Hamilton, Vassar, Colgate, Wesleyan

**Bates, Beloit, Bryn Mawr, College of Wooster, Colorado College, Dickinson, Lafayette, Macalester, Mt. Holyoke, Oberlin, St. Lawrence

THE LANDSCAPE OF SUPPORTING SCIENCE AND MATH IN GEO DEPARTMENTS AT SMALL COLLEGES

- Strong undergraduate teaching programs
- Expectations for faculty research
- Involvement of undergraduates in research
- Students who are well-prepared for grad school

*Williams, Amherst, Wellesley, Pomona, Bowdoin, Carleton, Middlebury, Washington & Lee, Colby, Smith, Hamilton, Vassar, Colgate, Wesleyan

**Bates, Beloit, Bryn Mawr, College of Wooster, Colorado College, Dickinson, Lafayette, Macalester, Mt. Holyoke, Oberlin, St. Lawrence

85% OFFER ONLY ONE DEGREE IN GEOLOGY

- Many have no choice because college is accredited only for BA
- Are supporting science/math courses required for major?
 - Ranges from none to 4 courses (~ evenly split among the 25 schools)
 - Most offer choice of math, chem, phys; some include bio, stats, comp sci
- Do geo courses have supporting science/math prerequisites?
 - Core courses: most have NO supporting science pre-reqs
 - Elective courses: some upper level ones do; most don't

ONLY 15% OFFER BOTH BA AND BS DEGREES IN GEOLOGY

- Those offering BS as well as a BA
 - Require either 1 or 2 semesters each of math (typically calc), phys, & chem
 - BS requirements designed for students who plan to be geoscientists
- Do geo courses have supporting science/math prerequisites?
 - Core courses: most have NO supporting science pre-reqs
 - Elective courses: some upper level ones do; most don't
 - Why? Supporting sci/math courses would be *de facto* requirements for BA

THE BOTTOM LINE

- In the vast majority of these 25 top-ranked departments:
 - The only courses with supporting science pre-requisites are upper level elective courses
 - Geo majors are not *required* to have the supporting courses in math, physics, chem, etc. that graduate schools typically require
 - Every department web site advises majors headed for academia or industry to take full suite of supporting sciences and math

WHY AREN'T SUPPORTING SCIENCE/MATH COURSES REQUIRED OF *EVERY* GEO MAJOR?

- Number of incoming students intending to major in geo is small – typically 1-3 students out of 500
- Could yield enough majors at school with 5000 incoming students, but not with 500
- Graduating a handful of majors/year is not sustainable
- Departments run the risk of being closed down
- Small departments can't rely solely on walk-ins – they **HAVE** to recruit

SMALL DEPARTMENTS NEED BROAD RECRUITING

- Most departments can't increase numbers by recruiting *only* future geoscientists, especially with competing environmental programs
- Recruiting by simply broadening the umbrella
 - Welcoming all students interested in the Earth regardless of career path
- Recruiting by expanding the departmental mission
 - Actively recruiting outstanding students who will go into the world and do good things with their geo knowledge
- Need flexible curriculum for both

HOW DO DEPARTMENTS ADDRESS SUPPORTING SCIENCE/MATH IN A FLEXIBLE CURRICULUM?

- For students headed to geo careers: academic advising
 - Consistent advice, early and often
- For all students: teaching content/skills in a geo context
 - The Math You Need, When You Need It (serc.carleton.edu/mathyouneed/index.html)
 - The chem/phys/programming/GIS when you need it
 - Elective courses in applications of X to geoscience (geochem; geophysics, GIS; MatLab; geo stats) – limited by both faculty expertise, teaching load, & #s

HOW DO DEPARTMENTS ADDRESS SUPPORTING SCIENCE/MATH IN A FLEXIBLE CURRICULUM?

- Undergraduate research projects
 - Faculty have lower teaching loads and higher research expectations but no grad students
 - Most departments can accommodate all students interested in research
 - Research opportunities for first- and second-year students
 - Senior thesis commonly required of all geo majors

WHAT COULD WE DO THAT WE'RE NOT DOING?

- Partial credit/partial semester mini-courses on quantitative applications in geo
- Zoom for multi-institutional courses that any one small school could not mount independently (both for staffing reasons and student interest reasons)
- Zoom for conversations with alums – what did you find invaluable/essential? What did you wish you had done/taken?

WHAT CAN'T WE DO?

- Majority of departments on list graduate one geo major for every 30-40 undergraduate degrees conferred
- At that rate, a large university conferring 5000 undergraduate degrees in arts and sciences should graduate 125-160 geo majors annually.
- In 2017, there were only 6 departments in the country that graduated that many (Penn State, Texas A&M, Univ. of Houston, Mississippi State, Univ. of Washington, and UT Austin). All others were under 100, most well under.

WHAT CAN'T WE DO?

- No disagreement that students going on to academia or industry need strong quantitative preparation
- BUT – we cannot design curricula that address only the needs of future geoscientists
 - The numbers argument: we will struggle to have viable departments
 - The mission argument: we *should* welcome geo majors who don't have geo career trajectories but who will go on to use their strong geo background to make better personal decisions and to make a difference in the world.
- We can't adopt a one-size-fits-all curriculum

WHAT DO WE NEED?

- Current perspective on what is needed for geo professionals (e.g., outcomes from this meeting)
- Creative ideas for integrating stronger preparation in quantitative geoscience *in the context of what is possible* at a range of institution types