

**UNDERGRADUATE PROGRAM REVIEW:
Earth and Space Sciences
Columbus State University
February 2-3, 2017**

OVERVIEW

ESS is a strong department with impressive cooperation among its extremely diverse faculty who demonstrate an admirable commitment to undergraduate (and Master's level) education and student involvement in research. I found the level of disciplinary integration and cooperation among the ESS faculty especially noteworthy given the broad diversity of fields represented – anthropology, astronomy, ecology, engineering, geology, meteorology, and physics. Faculty research productivity is exceptional given the heavy teaching loads and diversity of classes taught. Faculty morale appears good, although with some understandable frustration over the currently dispersed temporary quarters. This frustration is balanced with considerable optimism about impending co-location in a newly renovated space. Several faculty specifically expressed approval of the guidance provided by the current departmental chair (Barineau). Recent administrative investments (e.g. three new hires, new graduate degrees, renovations, etc.) are recognized as positive signs of the administration's confidence and high expectations for the department.

FACULTY

The 14 tenure and tenure-track faculty are a mixture of more senior members who were originally affiliated with other departments on campus, and more junior members who were specifically hired into ESS. The senior faculty seem pleased with their current placement and appear to be comfortable in their integration with teaching and research duties. More recent hires, especially those three faculty who arrived in Fall 2016, are still in the process of developing courses and research directions that will integrate with and extend the multidisciplinary aspects of the department's educational foci. It is worth mentioning at this point that I was impressed by the obvious dedication to undergraduate education evidenced by each faculty member interviewed. It is especially noteworthy that five of the faculty (Barineau, Cruzen, Keller, Puckett and Shaw) have received teaching and student mentoring awards and the department received the CSU Regents Teaching Excellence Award in 2016. Several of the younger faculty mentioned the teaching focus of CSU as a reason that they sought their position. Most faculty that mentioned research did so in the context of involving students. It has been my experience in research universities, where faculty are hired almost purely on their dedication to research, that a lack of colleagues in closely aligned fields often results in isolation, dissatisfaction, and departure. Yet the faculty in ESS, possibly because of their focus on education, seem far better integrated across a wider range of disciplines, and remain happier and

more fulfilled than I would have expected. I attribute this to the assembly of a rare group of scientific and educational professionals, that I think might be very difficult to replicate.

This is not to say that the faculty did not have concerns about some issues, many of which will be discussed later in “Suggestions.”

- Salary (especially for longer-term faculty)
- Intellectual property rights (for those who want to supplement salary through off-campus development)
- Space (especially adequate lab and storage space)
- Equipment (specifically for research and research-teaching purposes)
- Release time (to develop and submit research proposals)
- Additional faculty lines

STUDENTS

The students interviewed consistently voiced a high level of satisfaction with the faculty, courses, degree programs and the department as a whole. Especially noteworthy was a high level of comradery and sense of community. For example, one student was concerned that most CSU students didn't know about her degree program (geology) and “how great it is.” These attitudes seem closely tied to the high level of personal involvement of the faculty and also to the bonding that has occurred through shared off-campus educational (e.g. “Maymester trip”) and research experiences. Such comradery is associated with several positive educational outcomes: retention of students who might otherwise transfer to other degree programs/universities, encouragement of students struggling with academic/financial difficulties, student continuation in advanced degree programs, and eventual alumni involvement.

Like CSU as a whole, most students in the ESS undergraduate programs were sourced primarily from surrounding counties. Fortuitously, given CSU's proximity to the Georgia/Alabama state line, tuition arrangements have been made to prevent student from adjacent portions of Alabama from being deterred by excessive costs. Still CSU's location limits potential ESS majors. Additionally, like most universities, students entering CSU rarely intend to major in earth or environmental science. Only two of the ESS students interviewed initially declared a ESS major. Most were ‘converts’ after taking a class or being involved in an engagement activity. Since university science degrees are unavoidably heavy with required courses, this means that typical students may not be able to graduate in four years. This is not a problem unique to CSU, but rather one that plagues most universities. For example, at FSU, despite university efforts to track student progress and force students to graduate in a timely manner, most geology majors take 5 years.

Student concerns revolved around

- Recognition (of the excellence of the degree programs, both within CSU and in the Southeast)
- Class Scheduling (rotation of required classes poses a problem for students, especially those entering the major late).

DEGREES

ESS offers two undergraduate degrees: a A.S. in Engineering Studies and a B.S. in Earth and Space Sciences with four separate tracks in Astrophysics and Planetary Geology (from 2009), Environmental Science (from 2011), Geology (from 2009), and Secondary Education (UTeach, from 2009). Minors are offered in anthropology, astronomy, environmental science, geology and physics. Additionally, the department offers a M.S. in Natural Sciences with tracks in Environmental Science and Geosciences (both from 2014).

Enrollment climbed from an initial 58 students in the undergraduate program in 2011 to stabilize between 60-70 students over the past few years. Undergraduate degrees awarded have climbed steadily to 20 in 2015-2016, and in 2013-2015 ESS awarded more B.S. degrees than any other equivalent institution in the University System of Georgia and was on par with Valdosta State and Georgia Tech which are considered comprehensive or research universities.

Individual Tracks

Astrophysics and Planetary Geology, B.S

The department has wisely leveraged interaction with geology colleagues to offer an astrophysics track with a strong planetary focus. Astrophysics degrees are traditionally taught in a combined Astronomy/Physics department with a greater curricular emphasis on physics. Additionally, most departments offering such degrees have much larger faculties with correspondingly greater breadth of expertise. Still ESS manages to offer classes in Solar System, Cosmology, Physics/Chemistry/Geology of Solar System, Astrophysics, and Observational Techniques: a typical suite of courses required in other Astrophysics degree programs. The degree also requires Thermodynamics, Waves/Optics, Quantum Mechanics and 20th Century Physics. Being able to offer such a degree with such a small faculty is a remarkable feat and one of which those involved should be justifiably proud. The lack of courses in such areas as Electricity and Magnetism, Electronics, Analytical Mechanics, or Statistical Mechanics, while not detrimental to the B.S. degree may affect students pursuing advanced degrees at other institutions.

Geology, B.S.

The Geology BS requirements include all the traditionally required courses: Math, Physics, Chemistry, Physical, Historical, Mineralogy, Igneous and MM Petrology, Sedimentology, Paleontology (Fossil Record) and Structural Geology, with electives covering Hydrology and Geomorphology. Being able to offer such a comprehensive collection of courses is especially impressive considering the small size of the geology faculty. Due to faculty limitations Mineralogy, Structural, and Ig/MM Geology are taught on a three semester rotation making a rigorous prerequisite structure and planning of student schedules difficult. Missing is a specific allowance for credit for GIS or a Field Geology course (often taken from another university as a transient student). Both are courses that would be of importance to employers or graduate programs.

Environmental Science, B.S.

Although BS degrees in Environmental Science have not yet developed a traditional set of expected classes, those requires here match those in many much larger major universities: Math (including statistics), chemistry, physics, biology, ecology, environ geology, climate, and water

resources. A surprising and welcome addition is the requirement of quantitative chemical analysis and allowance for credit in GIS. Noticeably absent is a requirement of even calculus 1, an omission that could pose problems for transition into graduate programs elsewhere.

Environmental Science, B.S./M.S.

This combined B.S./M.S. track is an exciting option due to the high demand for such professionals and because the terminal working degree for most professional Environmental Scientists today is the M.S. The course of study is exceptionally rigorous and demanding and therefore not suitable for the average student. There is also the difficulty in funding for those classes beyond the B.S., since the HOPE scholarships are hour-limited and T.A. funding is scarce. Despite the drawbacks, this program could be used to recruit top-notch undergraduates with a commitment to a career in environmental science.

Secondary Education, B.S.

This program avoids the pitfalls of many science education programs by requiring a substantial load of basic science courses: Physics 1&2, Chemistry 1&2, calculus, and five or more courses from upper division ESS offerings. Mentoring by master teachers and practical education instruction and teaching experience make this a solid teaching degree.

The success of these programs is outstanding. As enumerated in the narrative of the ESS Regents Teaching Excellence portfolio, in the past two years 1/3 of all ESS B.S. graduates graduated with honors, 73% of graduates participated in undergraduate research, internship, or senior thesis, about half co-authored one or more papers with a faculty member, and 70% either were employed in a degree-related field or pursuing an advanced degree.

Such diverse degree offerings from a small faculty involve compromises, such as

- Heavy, diverse teaching load
- Scheduled rotation of some required classes
- Limited prerequisite structures which yield upper division classes with unequal preparation
- Limited faculty time for development of research programs

RESEARCH

Faculty research is important to the program for a variety of reason: it brings in external funding to support students and buy equipment, it enhances the reputation of the program and university, and, most importantly, it provides the opportunities to involve the students in an authentic scientific engagement experience. Of the eight faculty reviewed, records indicate an impressive 41 published abstracts and professional publications authored or co-authored by ESS faculty over the past three years, giving an average of more than 5 per person over this time. And many of these listed CSU students as authors or co-authors. Over the same time period, these 8 faculty were instrumental in acquiring grants and gifts totaling \$374,000. And the fruits of faculty research extend beyond the obvious metrics of papers and dollars to include the development and adoption of revolutionary teaching methodology by faculty like Hrepic and Shaw.

Current faculty have expressed concerns about finding enough time to develop research, given the heavy teaching loads. This situation also impacts student progress through degrees because faculty must rotate offering some required classes. Additional faculty lines were mentioned as a solution to these problems.

FACILITIES

The review was conducted amidst preparations for renovation and relocation, so many of the office, classroom, laboratory spaces I viewed were temporary. Given that the close association of the very multidisciplinary faculty is one of the principal strengths of the program, all efforts should be made to co-locate their offices and lab spaces. I was struck that some of the labs (e.g. paleontology teaching/research area) appeared to be a combination of teaching and research space that emphasized exposure of students to active research. In particular, Dr. Schwimmer's teaching lab is reminiscent of a museum, thus making his research accessible.

The Coca-Cola Space Science Center is an exceptional facility in terms of public awareness of CSU and ESS, support for academic recruitment, source of student involvement and part-time employment, and support of student and faculty research – especially for the Astrophysics and Planetary Geology degree program. Its distance from the main campus poses problems in terms of transportation and faculty/student space. If faculty and students are expected to shift easily between CCSSC and main campus, some minimal facilities (desk space, secure storage, internet, etc.) must exist at each location. At FSU, we have a similar situation with the MAGLAB 10 mins away from the main campus, and therefore maintain a few “bullpen” office areas that can be used by faculty moving between the two. Failure to make such arrangement can lead to faculty/students reluctant to visit the other location and eventual loss of collegial interaction.

Almost no program I am familiar with feels that it has enough space or equipment, ESS seems to be managing well within its limitations. Some faculty are forced to share lab space, which can work with sufficient effort in communication and cooperation. All faculty need to remain aware that an equitable distribution of space may change over time as research/teaching needs change.

All of us could bankrupt a small country with our equipment “needs”, but priority must be placed on equipment that directly serves the teaching and student research needs of the department. The chair seems to have a reasonable plan for allocating the limited resources available in line with this philosophy. For example, student microscopes, always an expense for an earth science department, are being purchased in batches so that some funds will be available annually for critical faculty needs. An example of a wise investment is the recent acquisition of a second thin section machine, a device commonly needed by many earth science sub disciplines. This acquisition allows the older device to be dedicated to student training while the newer is reserved for producing research materials. While having two might seem extravagant, FSU currently has none leaving students and faculty spend \$1000's of dollars each semester to have samples professionally prepared (with a 1-2 month wait).

During the review various faculty mentioned a variety of equipment desires, including portable rock drills, 3-D printers, microsatellite cube sets, electronics lab facilities, SEM, Mass Spectrometers, XRD, XRF, and GPR. Some of the less expensive pieces might be suitable for administrative purchase if the faculty can make a compelling case for educational usage. Others

are best subjects for external (e.g. grant) supported funds related to research goals. And some (e.g. SEM, Mass Spec, XRD, XRF) should only be pursued if several CSU departments are willing to commit to continuous efforts at external funding to supply the infrastructure, maintenance, and technical support that such facilities must have to remain operational. Otherwise, the smartest approach is to arrange to utilize facilities at other institutions willing to bear the constant headaches.

SUGGESTIONS

Let me begin by stating that the important strengths of ESS – the broad disciplinary diversity of the faculty and the faculty’s strong commitment to interdisciplinary cooperation, education, and student involvement in research – should not be compromised or strained. The suggestions offered here are intended to enhance and complement these strengths, not conflict with them. Also, it is noted that many if not most of these suggestions came from ESS faculty during discussions and are included for the purpose of encouraging faculty-wide discussion.

Program Recognition

Both faculty and staff have commented on the need for improved recognition both on campus and throughout the Southeast.

Campus

- **SGE:** CSU has an inactive chapter of Sigma Gamma Epsilon, the only nationally recognized earth science honorary fraternity. Students should be encouraged to revitalize this organization.
- **ESS Club:** An ESS club is more of a social organization than SGE and serves to both advertise and recruit into the program by involving students in club related activities such as sponsored parties, outdoor events (field trips, environmental cleanups, astronomical “sky-watches”, etc.), campus sales (rock/mineral/fossil, t-shirts/mugs, star charts, etc.), etc.
- **Research Symposium:** If CSU does not already host a once or twice yearly symposium of poster presentations on undergraduate research, one should be started. EES students should be encouraged to participate and afterward the posters used for display
- **Jordan Hall Decorations:** With a consolidation of faculty in/around Jordan, decorations should reflect program tracks. Possibilities include a “Rock Garden” of large specimens brought back from field trips (with signage advertising Geology), large decorative prints of astronomical images, photos of students in lab/field settings, copies of recent publications or poster presentations.

Southeast

- **Internet Presence:** Today’s technology-savvy students depend almost exclusively on the internet to research schools and departments. ESS’s recent revamp of its website is an improvement, but some changes could better highlight the program’s strength. For example, the faculty page needs formatting to make it more appealing and faster loading. Common format individual faculty pages should be linked to include information about the classes taught, research involvement and recent publications, talks, awards, etc. The focus on student involvement on the home page and the active Facebook page are both good, and should be kept current.

- **High School Outreach Programs:** Because CSU, like most universities, tends to draw students primarily from surrounding counties, if the program wants to increase enrollment, especially of the best high school candidates, the net must be cast wider. Experience at FSU has shown that a high school student that has had a positive living/learning experience on campus will tend to associate that campus with their college expectations. If students can be encouraged to spend time on campus they are more likely to enroll. Summer engagement experiences, with some kind of transferrable college credit (to justify the cost of the class/housing to the parents), are an ideal way to advertise the program through the attendees and also through their friends/classmates.
- **Teacher In-Service Support:** Training middle and high school teachers through workshops or disseminated teaching materials is another great way of increasing program recognition. Make sure all materials boldly display the CSU and ESS logos and contact information.
- **Advisory Council(s):** One (or possibly several) groups of professionals who are alumni or have close ties with CSU can be valuable for providing advice on matters of curricula, employment and outside funding. They also tend to act as “cheerleaders” for the program within their fields.

Program Support

While there are some things that CSU administration can do to improve the program, seeking external support is also important.

- **Space:** Since the CCSSC and CSU’s main campus are separate, “bullpen” office or work space for faculty shifting between the two is important. For earth science disciplines, sample storage can be a problem. Long-term sample storage off-site can help, and may not need to be climate controlled.
- **Release Time:** Given the heavy teaching load shouldered by the faculty and the importance of applying to external funding agencies, paid release time to produce publications and funding proposals is important. Such opportunities could be administered competitively or rotated among interested faculty.
- **Adjuncts and Liaisons:** Adjunct professors provide the opportunity to expand the curriculum, ease scheduling difficulties or provide faculty release time without the commitment of a faculty line. Liaisons with such entities as Ft. Benning may make adjunct faculty, funds, research materials, or students available. Both should be pursued as opportunities permit.
- **Universities:** Many universities both in Georgia and surrounding states, have facilities or faculty collaborators that could be of use to the program. More senior faculty are probably familiar with such resources, but new faculty are encouraged to reach out and explore what is available. Remember, many of these institutions will be eager to help because ESS represents a potential source of graduate students.
- **Contracts and Grants:** Because student involvement in research is an important strength of the program, securing external funds to support research and graduate students is important. Along with release time, faculty need access to training in grant writing for different agencies, help with budgets, and a close working relationship with the Contracts and Grants Office.

- **Donors:** Because current CSU donors are managed by CSU's Giving Office, ESS needs to develop new donor contacts which can be brought in predisposed to fund ESS. Here, the members of the advisory councils (mentioned above) can assist in approaching individuals and organizations about funding specific facets of the program (e.g. student travel to meetings, spring field trip, T.A.'s in the Environmental Science B.S./M.S. program, etc.) with appropriate name recognition for the donor and student "thank you" letters from participants. Although this process often starts slowly, it can snowball.

Program Growth

- **New Faculty:** Many of the concerns regarding heavy teaching loads, insufficient time to develop research proposals, and student scheduling difficulties, can be addressed with additional faculty lines. Given the diversity of degrees in the department and the relatively small size of the faculty, additional faculty hires should be a high priority. Some thoughts were expressed on what the next hire should be (all depending on when this occurs and what positions have been vacated). Suggestions include Engineering and Anthropology-Archaeology. The department should develop a consensus on this issue and re-evaluate that position annually. Having these plans current will help the department move rapidly to take advantage of serendipitous opportunities.
- **Enrollment Growth:** As program recognition climbs the number of excellent undergraduate applicants should increase. At some point the department will be faced with the decision to either limit the majors or increase the faculty. Since a major strength of the program is faculty/student interaction, I caution you not to allow the student/instructor ratio in ESS classes to rise too far.
- **Minors:** One faculty has expressed an interest in developing a Meteorology or Climate minor, which could draw from Environmental Science or even Geology courses.
- **WIMSE:** Women In Math Science and Engineering – the title of the most successful learning community at FSU, established to nurture women undergraduates in those fields. This has proved invaluable to developing and nurturing women in the sciences. ESS has several outstanding female scientists who would make excellent role models (and serve to advertise ESS programs). If interested in establishing something like this, they should be encouraged.

The one obvious constant in all these suggestions is that they will require faculty effort, commitment and time for them to be successful. None should be implemented without discussion and consensus of all involved. My final recommendation is for a faculty retreat to discuss the future of the department and what changes, if any, should be undertaken.