



Cornell College

WHITE PAPER SERIES

From President Jonathan Brand

January 2017

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Science and the Liberal Arts at Cornell College

One of the best days of the year at Cornell is the spring Saturday on which we hold our Student Symposium. From early that morning throughout the entire day, the Thomas Commons comes alive with student research. Our students are the experts. We are the learners. Last spring as one example, students presented their research on topics ranging from acoustic levitation to a study of solution-process porous alumina films to an analysis of Beethoven’s *Fidelio* through poster board sessions and faculty-moderated presentations. It is hard to fully communicate how awe-inspiring and gratifying that day is for all of us. It reaffirms why we have dedicated our lives to our students.¹ They amaze and delight. Their work also reaffirms the centrality of research, including in the sciences.

Craig Tepper, professor of biology, highlights the role that presentation of scientific research plays in a Cornell education: “I think it’s important to provide students the opportunity to ‘show off’ their work. [It] makes students realize their research is part of a larger picture. Students also present research outside their majors, which enhances their liberal arts experience and allows them to integrate multiple perspectives into a coherent synthesis. They learn about the collaborative nature of science, and that the data they obtain have broader significance and belong to everyone in the research group. [Ultimately,] the symposium allows students at all levels to show the Cornell community what they are passionate about and what excites them. It puts students outside their comfort level, yet shows students what they are capable of accomplishing.”

¹ You can read more about the 20th Annual Student Symposium, held on April 16, 2016, at crnl.co/symposium2016

It is hard to imagine what Cornell College would be like without the sciences. At one level, we wouldn't have many, if any, successful alumni in the health professions, from the general practitioner to surgeons to physical therapists. None. Nor would we have such an impressive group of alumni who push the boundaries of what we understand about our world through their research. On campus, we wouldn't have students preparing for organic chemistry exams, taking field trips into the prairie, or engaging in one-on-one research with faculty in labs. Student Symposium presentations would be cut in half. Our loss would be dramatic and widespread.

At another level, the sciences are for all students, providing a broader context for the pursuit of knowledge via the scientific method and fostering a variety of skills that consistently rise to the top of the attributes most desired in college graduates. The sciences, thus, serve as one central pillar of a broad education. After all, science has always been a part of the original liberal arts study in classical antiquity, subjects considered necessary for an educated citizen. And, there is a reason for this. A high-functioning democratic society requires **engaged** citizens. Societies don't just happen on their own. People make them happen. How can one meaningfully participate in a democratic society without the orientation and skills to examine information, ask questions, and reach evidence-based conclusions? The sciences, along with other disciplines, offer those skills in spades. For example, the ability to hone one's deductive reasoning skills—testing ideas and theories, which is central to scientific study—is an invaluable ability with applications far beyond simply the sciences.

Sciences have always been a Cornell strength

The sciences were part of Cornell's curriculum from the very beginning. For example, the 1856 catalog presented a four-year program that included eight courses in Latin, six in Greek, seven each in mathematics and science, and eight in what we would consider religion and philosophy. According to William Heywood, author of Vol. 1 of the college's history at its sesquicentennial, Cornell's initial curriculum was very similar to that of colonial Harvard except that Cornell had more offerings in science—matching a late 19th century trend in American higher education.² At this same time, a consummate liberal arts Cornell graduate and professor, William Harmon Norton, namesake of the geology building, taught classics and geology, introducing the theory of evolution from an early date.

Cornell's reputation for providing a high-quality education in the sciences is well established. Our small class sizes and innovative One Course At A Time curriculum dissolved the conceptual wall between the laboratory and classroom long before such integration became a national trend. Close mentoring by faculty and opportunities to focus on One Course maximize the research process as a teaching strategy. Students learn science by "doing" science. And, the results show in our students: Cornell's science students take full advantage of the high impact educational practices available to them, excelling as a group during their undergraduate studies and enrolling at a high rate in postgraduate programs. As one powerful example, Cornell's 2008-2015 medical school acceptance rate is 75.4 percent, compared to the national average of 40.5 percent for the same years.

For many reasons, the role of the sciences has only gained in prominence within higher education over the centuries. To be sure, the substance of scientific knowledge has developed as our understanding of, say, molecular biology or quantum mechanics, has evolved. In this same period, scientific pedagogy has changed as well, as we

² See Vol. 1, pg.42-44, "Cornell College: A Sesquicentennial History."

have increasingly understood ever better ways to help students benefit from the power of scientific study. The science curriculum at Cornell reflects these changes: Cornell science students today enjoy a great deal of hands-on engagement and learning through experience. For them, it is not about the passive transmission of knowledge. Teacher talks. Student takes notes. Student studies. Teacher grades. Today, it is commonplace, particularly at residential liberal arts colleges such as ours, that students work side by side with faculty and with each other in laboratories exploring a particular issue or topic.³ It may be, for example, a study of the relationship between cholesterol and how drugs work (“The Impact of Resveratrol, 1-Octanol, and their Metabolites on Protein Function”)⁴ or one that elucidates the climate history of Nevada (“Characterization of Layer-Bounding Surfaces in a Great Basin Stalagmite Utilizing both Petrographic and High-Resolution Stable Isotope Analyses”).⁵ What is most important is that faculty and students partner in the undertaking, as they seek to comprehend and then expand their understanding of a particular topic.

The block system also may be leveraged to establish experiential learning partnerships with other institutions. Because students can throw themselves into such opportunities for a block or longer, uninterrupted by other classes or commitments, these partnerships offer essential connections between the curriculum and career. Cornell’s Berry Career Institute serves as the springboard for a great many of these experiences. The Institute’s distinctive programs include the Dimensions Program for Health Professions. Our students have participated in Operation Walk, founded by Cornell alumnus **Larry Dorr ’63**, and have interned at medical schools and hospitals, including, the University of Iowa Carver College of Medicine, the University of Iowa Hospitals and Clinics, the University of Chicago Medical Center, Loyola University of Chicago Stritch School of Medicine, and the Children’s Hospital Colorado. Additional internships are fostered and funded by the Cornell Fellows Program, which has supported students as they conduct research at exciting places such as at CERN particle accelerator lab in Switzerland; the Baruch Institute for Marine & Coastal Sciences in South Carolina; Sea World in Orlando, Florida; the University of Georgia Department of Entomology; and the Los Alamos National Laboratory in New Mexico. And, this is just a short sampling. These partnerships are exceptional because they expand the scope of our students’ knowledge in new settings and contexts. They make connections and create important social and professional networks, thus extending students’ on-campus experiences to the “real world.”

What our students and alumni say

One of the greatest benefits of science education is the confidence that it develops in students. For many, it is daunting to even walk into a laboratory—with high-end equipment that looks, frankly, unapproachable and intimidating. However, within the context of the welcoming and intimate setting created by our faculty, students can confront and overcome their uncertainties. **Glorisette Santiago-Rivera ’17** offers a moving account on this point:

“Over this past summer and the first course of the year, I transformed into a true biology major. Through both of these experiences I gained deep knowledge, a tremendous skill set that reinforced my major, and the confidence that will allow me to be successful in any professional setting ... There were many times where I felt that because I could not perform well in the lab portion of classes, I was not smart or good enough to graduate as a biology major.

³ See Thomas R. Cech. *Science at Liberal Arts Colleges: A Better Education?* Daedalus. 128: 195-216.

⁴ See *Measuring the Impact of Resveratrol, 1-Octanol, and their Metabolites on Protein Function*, a research project undertaken through the Cornell Summer Research Institute (CSRI), led by faculty researcher, Assistant Professor of Chemistry Jai Shanata '05, with student researchers MariKate Murphy '18, Aidan Litt '19, and Jennifer Aguayo '18.

⁵ See crnl.co/feltresearch to learn more about the research undertaken by Christopher Felt '16, advised by Professor of Geology Rhawn Denniston.

“When I first started my research with the Cornell Summer Research Institute ... I felt frustrated because ... I felt like I wasn’t understanding the procedures. [My professor] was able to break it down for me and my lab partners in a way that would be impossible during any course. Another aspect that pushed me to excel was the independence my lab partners and I were given. We were expected to figure each procedure out on our own. By the time the Summer Research Institute was over, I had most procedures memorized, and not only that, but I understood in depth how each procedure worked. I felt qualified and prepared for my next experience, an internship being a teacher’s assistant for an introductory biology course. Throughout the course, I was in charge of guiding students through lab procedures. I can say that the biggest lesson learned during this internship opportunity was that the terms ‘learning’ and ‘teaching,’ although they have opposite meanings, have the same purpose and accomplish the same thing. Both professors and students gain knowledge.

“My summer research and my internship allowed me to improve as a student and as a professional ... I have my professor to thank for this huge growth that took place over the course of just one summer. He allowed me to take on this opportunity, not because I had the best grades but because he remembered a first-year student who had interest in his research. He was able to see the potential of one of his students, and had the personal interest of seeing my lab partners and me succeed and grow.”

The sciences also provide students with opportunities to hone many “soft” skills that we and employers know will benefit them for a lifetime. For example, they learn to work in a team structure—exploring a new topic and seeking to understand and then solve a problem. In so doing, they gain a critical ability to collect quantitative data and analyze them. And, they learn to take their ideas and explain them to others, particularly those who may have no knowledge whatsoever of the topic.

Ultimately, there is nothing that I could write that would communicate the enduring value of the sciences at Cornell as well as reflections offered by our alumni. Their firsthand reports say it all. **Lisa M. Utschig-Johnson '90** at Argonne National Laboratory writes:

“Believe it or not, my least favorite subject in grade school and high school was science ... This all changed when I was assigned a college advisor who was a chemistry professor. As a pre-med major, I took chemistry classes and really enjoyed them. I found chemistry to be very mathematical and logical. The summer of my junior year, I did a Summer Undergraduate Research Fellowship (SURF) at the University of Iowa. This was my first exposure to lab research and graduate school. Unlike science class labs (which I did NOT like), I really enjoyed having my own research project. I liked the independence. I liked the excitement of discovery. I liked the creativity of planning and executing my experiments.

“Dr. Bill Deskin was my advisor at Cornell. Looking back, I feel he quietly guided me to where I am today. He encouraged me to do the SURF program. I was from a small town in Wisconsin and had no idea about graduate school. That experience opened my eyes to that possibility. Then, Dr. Deskin mentioned that graduate schools would pay for my education to earn a Ph.D. And when I was applying to schools, he mentioned “Northwestern has a good inorganic department.” I ended up at Northwestern ... with one of the top fellowships. The other three students came from Harvard, Berkeley, and the University of Oregon. This was, in part, due to the recommendations written by my Cornell professors.

“I learned ‘how to think’ at Cornell. Invaluable.

“I learned ‘how to communicate’ at Cornell. Indispensable.

“The liberal arts education made me an independent thinker and enabled me to embrace my creative side as well as my mathematical side. This combination of aptitudes has led me to ‘think outside the box’ and make several significant scientific discoveries.

“None of this would have happened, if it were not for the excellent professors at Cornell and the personal interactions I had with them.”

In the 1970s the late **Bob Replegle '56** was credited with being at the forefront of humane treatment in his field, as he had his entire operating team visit each patient the night before surgery to become acquainted. A person of great insight, Bob shared in a lecture at Cornell during that period, “This is the challenge of the liberal arts college in the next century—bringing scientists closer to humanity by giving them an overview of mankind ... and to science by teaching them the practicality of the scientific method.”

Barbara Bopp '65 considers what she gained from the sciences at Cornell:

“Upon reflecting on the benefits of my science education at Cornell in the 1960s, I would say that the following four characteristics emerged:

- A strong foundation in the basic sciences (biology and chemistry for me) and, through the honors program, a taste of laboratory research. This background was equally applicable for an entry level laboratory job and graduate studies. Of special significance was Dr. Addison Ault’s organic chemistry course which convinced me to combine both disciplines in my career.
- The liberal arts courses which added a breadth to my education. I came to appreciate this more as my scientific work tended to narrow and deepen.
- Learning to organize and communicate my ideas. Since scientists do write reports and research articles, this training proved valuable in both graduate school and the workplace.
- The opportunity to interact with faculty members who were experts in their fields and also dedicated to helping and mentoring their students.”

Barbara’s account is particularly important in that she raises what has always been at the heart of the Cornell experience: **our faculty**. Bill Deskin. Francis Pray. Addison Ault. Truman Jordan. Ed Rogers. Paul Christiansen. Herb Hendriks. Harlan Graber. David Lyon. Bob Black. These are just a few pillars of Cornell’s science program. The stories that alumni have offered on our faculty could, themselves, produce a white paper of an innumerable length. These are our grand figures who elevated the sciences and changed your lives.

Gary Knutsen '69 reinforces the central role our faculty play:

“After the last minute decision to attend Cornell, I certainly didn’t give a biomedical research career any consideration. Who would have thought this farm kid would enjoy Ornithology and Genetics? Those two courses (Professors Lyon and Rogers) come to mind first when I thought about my Cornell science experience. Why? Of course, the knowledge and personalities of the professors were major factors but, moreover, it was the personalized manner in which the courses were presented. I actually believe that these two courses, in particular, and the same could be said for Dr. Pray’s classes, took approaches similar to One Course At A Time long before that concept became a Hilltop reality. Genetics was certainly such an experience in that I had laboratory (and sports) conflicts with the scheduled genetics class, so Dr. Rogers allowed me to take a one-student, one-professor course from him. What an enjoyable learning experience! I dreaded genetics going in, but came out with a sincere appreciation for the science—I regard that academic experience with Dr. Rogers as a highlight of my science experience at Cornell. As for Ornithology, although there were about a dozen students in Dr. Lyon’s Ornithology class, it was exceptionally diverse, and Dr. Lyon’s teaching approach and his obvious personal fascination for ‘bird biology’ made for some really memorable early morning (very early!) outdoor (bird watching) laboratories. Those weekly field trips, when combined with his personalized instruction in the classroom, made Ornithology a truly solid learning experience.

“It’s a bit unfair to single out two, albeit memorable courses (Genetics and Ornithology)—every course I experienced in the sciences at Cornell obviously helped prepare me for the rigorous academics and biomedical career that followed. Following a year of teaching and coaching, I entered the graduate physiology program at Iowa State University and a year later the College of Veterinary Medicine. It was obvious to me, especially compared to my younger classmates, that the Cornell academic foundation I received was a differentiator for me. Although I do believe that most of my classmates at Ames were certainly smarter than I and all had completed rigorous pre-vet undergraduate programs, the integrated sciences and, in particular, the personalized manner in which the sciences were taught at Cornell, provided me with the necessary tools to academically excel and realize a long satisfying biomedical career—nearly 50 years later I remain so thankful for that Hilltop experience.”

What’s next in sciences at Cornell

If I had to identify one weakness in the sciences at Cornell, it would clearly be our facility—West Science Center. Hands down. Take one step into West Science Center, and it is clear that it does not match what happens in the classrooms and labs. At one level, we simply lack sufficient teaching, lab, and faculty research space. At another level, West Science was constructed before Cornell adopted the block plan and does not accommodate possibilities presented by a synthesis of the block plan and the major shift in science pedagogy in the last 25 years. Nor does the facility fully support collaborative and engaged interdisciplinary learning. Indeed, the fact that Cornell’s science programs inspire such remarkable outcomes for our students is a testimony to the dedication of our faculty and staff.

West Science is also a major obstacle to the achievement of our primary strategic goal—comprehensive growth. An aging and cramped facility outdated for science instruction, West Science Center severely limits our ability to recruit and retain high-caliber students, provide current students and faculty with a high-quality setting for teaching and learning, and accommodate enrollment growth in our science programs.

It should, thus, come as no surprise that new and renovated science facilities are central to our current Strategic Plan. A new building and the renovation of West Science and portions of Law Hall comprise Cornell’s \$35 million Science Facilities Project, which will advance the college and our science programs on several fronts. The overarching vision for the new building is that it will enable a world class scientific environment consistent with Cornell’s character. Here are the four items within the general vision. The building will:

- Foster engaged scientific learning and achievement through collaborative interactions of faculty and students, harnessing the benefits of One Course At A Time.
- Be adaptable to meet the requirements of enrollment growth, future technology, and the evolution of curriculum and pedagogy.
- Be unique in its design character to attract new faculty, students, and local and international connections.
- Be a visual emblem for the integration of science in the liberal arts.

Ultimately, our science facilities must rise to the quality of the academic experiences in the sciences. This project meets a critical facility need, all while increasing experiential learning and supporting our newest academic programs in the sciences: engineering sciences and neuroscience. We are currently in the leadership phase of our fundraising for this important project.

As I have noted on many occasions, Cornell is defined, in part, by a deep and pure commitment to our students and their education, and any shortcoming in the opportunities that they have affects us profoundly. Our science faculty and their teaching have not only changed lives but helped our students and graduates to change their own lives

and those of others. We can have no greater aspiration for them. Our imperative now is to complete our Science Facilities Project, thus continuing to provide Cornell students with an exceptional science education as a part of our liberal arts curriculum.

Jean Russell '65 sums it all up perfectly:

“At Cornell, I learned to value the importance of scientific investigation and the ethics of it. Scientific investigation requires us to be exacting and stringent in our approaches, uncompromising as we pursue the truth of the investigation, and observant of the proper level of controls. My ability to undertake scientific investigation was truly deepened at Cornell. It provided the essential groundwork to thrive in the scientific field and well beyond it too. After all, these investigative skills carry through the rest of one’s life. This is why we must ensure that future students have the best scientific opportunities and spaces possible.”



Jonathan Brand
PRESIDENT

*This presidential white paper is part of a series on matters of importance to Cornellians.
I welcome any comments or observations you might have on this white paper topic.
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