Editorials

The Importance of Student Publications and College Admissions

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When I first opened the CalTech Common Application supplement and saw the section dedicated to submitting original research (abstracts not encouraged), I was floored. I had not previously advised a client on applying to CalTech, and I never could have imagined back when I was in high school that I might be asked for original research on my college applications. Yet currently it turns out this idea is not so uncommon. Top university's like Chicago, Columbia and MIT are just a few of the colleges that have opportunities to submit original research or projects in their applications.

I believe that in this day in age rife with grade inflation, statistical problems within some class ranking systems, and with the accuracy and fairness of the SAT often questioned, colleges are looking more and more for tangible proof that students can cut it in a research environment where the memorization and regurgitation of high school must make way for original thought, new ideas, and experimentation.

I imagine many readers of this journal are very bright students who will have no trouble getting into college. However, like most students they are still probably somewhat confused about the process and are interested to hear how their original research will factor in college applications. So let's go through some of the basics of college admission:

1. Grades: The perennially most important factor in any college application is still grades and GPA. Keep in mind, however, that many colleges keep profiles of high school course offerings, as well as current and historical data about applicants from each high school. At top colleges, a GPA itself is not as important as grades within the context of the opportunities that were afforded to a student. Class rank provides some insight into this as well, however, class rank does not always show how much one challenged him or herself (i.e. someone with a 4.0 and no advanced placement classes might have a higher un-weighted class rank than someone who took several AP's and got a B or two.)

2. SAT's: Despite some of the controversy surrounding these tests in recent years, SAT's are still a major factor in differentiating students from their thousands of 4.0 peers. For those applying to science and engineering, two SAT Subject Tests (SAT II's) are recommended in addition to the SAT I: Math Level 2 and a laboratory science. Top schools will want to see scores above a 700 in each.

3. Personal Qualities: Personal qualities, as exemplified through application essays and recommendations, are often the stratifier in the admission process. Top colleges are going to get thousands of applicants with near-perfect GPA's and 2100+ SAT's, so the admissions officers have to ask themselves what makes a candidate special? How much will they contribute to the college environment? The classic extracurriculars – student body president, captain of the lacrosse team, etc. – are still perfectly acceptable ways to appeal to an admissions officer. All things being equal, the student who did these activities will still win out over the student who did not do much outside of academics. But they will not necessarily set a student apart from the pack at the nation's most competitive schools.

Because top colleges see so many students with stellar statistics and the standard extracurricular activities, they have now resorted to adding more and more esoteric essay and short answer questions to their applications like give us your top five search engine keywords, or how would you describe yourself in a Tweet®? The idea is that the originality put into the responses will give insight into the applicant. In my opinion, however, these questions are pretty much nonsense – a way for college admission officers, who are now several generations out of touch with today's student, to make their particular application supplement seem less mundane. But do I think application reviewers really get much from these banal questions? I do not. As long as the applicant does not write something absurd or offensive, I do not think they really make a difference either way.

So what can make a major difference in the third category? Activities that are unique and that concretely show intellectual curiosity and capability. I believe that research without a doubt is one of these activities. Students who complete research not only demonstrate solid foundations in science or engineering, but that they are able to form their own ideas, hypotheses, and follow through on experiments. It shows that they have the inquisitiveness to try something new, and the tenacity to knock on the doors of their science teachers or local professors to get the help or mentorship they need – a quality that will be necessary for success at any research university.

The Journal of Experimental Secondary Science is the only legitimate peer-reviewed high school research publication I have seen. While some high school researchers may have a scientist family friend or high school teacher who is able to attest to their hard work and experiments, very few will have their research commented upon and verified by such an esteemed review board. This will add a huge amount of validity to the research that very few students will have. Heck, I have seen Ph.D.'s who have yet to be published in such a prestigious journal.

So to high school students reading this and considering research as an outside activity – whether it's under the supervision of your parents in your garage, in your high school, or at a nearby college – I cannot recommend it enough. It will expand your mind, contribute to scientific knowledge, and impress colleges along the way… what could be bad about that? And to those students who submit and get published in this journal, congratulations are certainly in order. I have no doubt this will be a big plus for your college pursuits and beyond.

How to Stand Out

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On 2 April 2012, an article[1] in the New York Times covered a recently published scientific study[2] that pointed out the limited usefulness of sequencing a person's genome to determine what diseases will affect that person in the future. Reactions in tweets and blogs were swift and unfavorable[3–6]: professional scientists cried foul, wondering why this study, which they felt was based on potentially flawed methodology and reported results that were not particularly surprising, garnered so much attention.

A branch of biology called statistical genetics has explored the possibility of predicting disease incidence from genetic information for many years, and for many years the answer has been largely the same—no, your DNA does not predict your future health, in part because factors such as the environment, behavior, and randomness also play a role. Yet these prior studies did not receive coverage in the New York Times.

So while statistical geneticist's feathers were justifiably ruffled, one of their own, Luke Jostens a graduate student at King's College (Cambridge, UK), suggested that the community itself should shoulder some blame6. Said Jostens, "if we are annoyed that a bad paper got the message across, then we should be annoyed at ourselves for not communicating our results properly."

This dialogue is relevant to high school science students and the mission of the *Journal of Experimental Secondary Science* because it highlights an aspect of science that is often given short shrift in its practice and teaching—communication—namely, the clear description of experiments and results and the proper contextualization of findings in terms of what has been done before. Why is a particular problem important, and how do new results advance the frontiers of knowledge? I ask myself these questions every day as an editor at a scientific journal that publishes just five to ten top-notch research articles from among >100 received each month. Students should ask these questions every time a new project is started and completed. Writing a report for a laboratory class or a science project forces a student to articulate what was done, why those things were done, and how the result are relevant to Mom, Dad, or someone not immersed in the experiments performed. Publishing is a critical part of the scientific endeavor; discoveries that are not reported, and reported clearly, remain largely undiscovered still.

Taking a broader view, the skills required to write a good scientific paper are applicable to writing a persuasive business plan, delivering a compelling speech, reporting a story in a magazine or newspaper, or even penning the next great American novel. In today's media flood, where potential readers, listeners, or clients are bombarded by vast volumes of information, can you tell a story that stands out based on substance not hype? Can you seamlessly weave what you offer into the fabric of the past, present, and future? In a way, this process is what the *Journal of Experimental Secondary Science* celebrates and provides students with an opportunity to practice—bravo.

1. http://www.nytimes.com/2012/04/03/health/research/dnas-power-to-predict-is-limited-study-finds.html

2. Roberts N.J., et al., The Predictive Capacity of Personal Genome Sequencing. Sci Transl. Med., published online 2 April 2012, doi: 10.1126/scitranslmed.3003380 (2012).

3. http://blogs.nature.com/news/2012/04/questioning-value-personal-genomics.html

4. http://www.lastwordonnothing.com/2012/04/06/what-the-limits-of-dna-story-reveals-about-the-challenges-of-science-journalism-in-the-big-data-age/

5. http://storify.com/Erika_Check/the-power-of-predictive-sequencing

6. http://www.genomesunzipped.org/2012/04/identical-twins-usually-do-not-die-from-the-same-thing.php

The Journal of Experimental Secondary Science

A Young Founder's Take on a Career in Biotech vs. Academia

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I recently made the transition from a purely academic position as a graduate student researcher to the founder of small start up biotech firm. In the year and a half since I made the transition I've begun to see how a career in these two sectors truly differ and the core reasons for their differences. For me, the primary and clearest core differences revolve around the ways that they're structured and funded, and the expected output of each.

Academia, generally fueled by government and private grants, doesn't require that a monetary return on the invested capital be achieved. Instead rigorous, and truly novel research is expected, and the results published in a manner that generates the most impact. In other words the return of the invested resources is expected to be highly impactful and useful science. What this leads to is high quality research, competition within very defined, or "hot" areas, and an output generally measured in quality publications in well regarded journals and speaking engagements in conferences. The publication output in turn allows a principal researcher to make the case for more grants and funding. Because there is never a true end point, the work is never done and as researcher, the workday is often long but the weekly schedules can lend themselves to greater flexibility. Although this structure leads to freedom of choice as to what to explore, and leads to important basic discoveries and a blistering pace of scientific advancement, by design there is no impetus to ensure that the discoveries be converted into useful applications.

On the other hand, there is biotech. Investment groups or wealthy individuals, hoping to make a return on an investment, typically fund these types of efforts. Most biotech groups are picking up the most promising basic leads from academic output and attempting to further refine and commercialize their application. The process is very business-like and driven by the potential market size and profit of the science being developed (a drug, a medical device, etc.) For this reason, several constraints arise- first the pace of the work must meet milestones laid out by the company; second, the experimental findings of a company, no matter how impactful, tend to be kept internally (vs. published) and are protected under the confidentially agreements and intellectual property of the company. And thirdly, as a researcher, one must be constrained by the very clear and specific goals of the company. For most companies there is no excess capital available to investigate other promising findings, and as a researcher one must draw satisfaction not from intellectual freedom to roam, but from the realization that the work is directly leading to life-enhancing or life-saving technology. A perk of the biotech, or other industry jobs, is that pay can be substantially better, however in return, there are clear end goals, output and fixed schedules.

Although there appears to be a nice symbiosis between academia making initial basic discoveries and biotech further refining and commercializing their application. A translational gap continues to exist, and many potentially important academic discoveries are never being fully developed (a waste of resources in the end). In my opinion, this gap stems from the expectations of investors in the biotech industry. Because the likelihood of any one project yielding a successful marketed product is low, the expected return on the investment, which is often substantial, must be very high, on the order of 20-100X the investment. This limits the number of potentially viable projects that get funded (in contrast to tech investment). While the rationale behind this is sound investment principles, it is my view that funding projects that have lower risk but lower potential returns is a solution that is not currently pursued aggressively enough and could lead to a steadier translation of scientific discovery into commercial application, greater job creation and stronger economic growth.