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Frances Arnold wins 2016 Millennium Technology Prize

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Caltech Media Relations

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Frances Arnold, the Dick and Barbara Dickinson Professor of Chemical Engineering, Bioengineering and Biochemistry, has been awarded the Millennium Technology Prize for her “directed evolution” method, which creates new and better proteins in the laboratory using principles of evolution. The Millennium Technology Prize, worth one million euros (approximately \$1.1 million), is the world’s most prominent award for technological innovations that enhance the quality of people’s lives.

Directed evolution, first pioneered in the early 1990s, is a key factor in green technologies for a wide range of products, from biofuels to pharmaceuticals, agricultural chemicals, paper products and more.

The technique enlists the help of nature’s design process — evolution — to come up with better enzymes, or molecules that

facilitate chemical reactions. In the same way that breeders mate cats or dogs to bring out desired traits, scientists use directed evolution to create desired enzymes.

“We can do what nature takes millions of years to do in a matter of weeks,” said Arnold, who is also director of the Donna and Benjamin M. Rosen Bioengineering Center at Caltech. “The most beautiful, complex and functional objects on the planet have been made by evolution. We can now use evolution to make things that no human knows how to design. Evolution is the most powerful engineering method in the world, and we should make use of it to find new biological solutions to problems.”

Directed evolution works by inducing mutations to the DNA that encodes a particular enzyme. An array of thousands of mutated enzymes is produced and then tested for a desired trait. The top-performing enzymes are selected, and the process is repeated to further enhance the enzyme’s performance. For instance, in 2009, Arnold and her team engineered enzymes that break down cellulose,

the main component of plant cell walls, creating better catalysts for turning agricultural wastes into fuels and chemicals.

“It’s redesign by evolution,” said Arnold. “This method can be used to improve any enzyme and make it do something new it doesn’t do in nature.”

Today directed evolution is at work in hundreds of laboratories and companies that make everything from laundry detergent to medicines, including a drug for treating type 2 diabetes. Enzymes created using the technique have replaced toxic chemicals in many industrial processes.

“My entire career I have been concerned about the damage we are doing to the planet and each other,” said Arnold. “Science and technology can play a major role in mitigating our negative influences on the environment. Changing behavior is even more important. However, I feel that change is easier when there are good, economically viable alternatives to harmful habits.”

“Frances is a distinguished engineer, a pioneering researcher, a great role model for young men

and women, and a successful entrepreneur who has had a profound impact on the way we think about protein engineering and the biotechnology industry,” said David Tirrell, the Ross McCollum–William H. Corcoran Professor of Chemistry and Chemical Engineering. “The Millennium Technology Prize provides wonderful recognition of her extraordinary contributions to science, technology and society.”

Arnold received her undergraduate degree in mechanical and aerospace engineering at Princeton University in 1979. She earned her graduate degree in chemical engineering from UC Berkeley in 1985. She arrived at Caltech as a visiting associate in 1986 and became an assistant professor in 1987, associate professor in 1992, professor in 1996 and Dickinson Professor in 2000.

She is the recipient of numerous awards, including in 2011 both the Charles Stark Draper Prize, the engineering profession’s highest honor, and the National Medal of Technology and Innovation. Arnold is one of a very small number of

individuals and the first woman to be elected to all three branches of the National Academies — the National Academy of Engineering (2000), the Institute of Medicine (2004) and the National Academy of Sciences (2008). Arnold is also the first woman to win the Millennium Technology Prize.

“I certainly hope that young women can see themselves in my position someday. I hope that my getting this prize will highlight the fact that yes, women can do this, they can do it well, and that they can make a contribution to the world and be recognized for it,” said Arnold.

The Millennium Technology Prize was first awarded in 2004 and is given every two years by Technology Academy Finland (TAF) to “groundbreaking technological innovations that enhance the quality of people’s lives in a sustainable manner,” according to the prize website. Past recipients include Sir Tim Berners-Lee, creator of the World Wide Web; Shuji Nakamura, inventor of bright blue and white LEDs; and Shinya Yamanaka, ethical stem cell pioneer.

Caltech/JPL bands compete at TechStock 2.0, Bowling For Soup headlines



Photos Courtesy of Hye Joon Lee

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Caltech Y Column

CALTECH Y

The Caltech Y Column serves to inform students of upcoming events and volunteer opportunities. The list is compiled by Neera Shah from information given by the Caltech Y and its student leaders.

Founded by students in 1916, the Y was organized to provide extracurricular activities planned and implemented by students as an opportunity to learn leadership skills and discover themselves. The mission of today's Y remains the same—to provide opportunities that will prepare students to become engaged, responsible citizens of the world. The Y seeks to broaden students' worldviews, raise social, ethical, and cultural awareness through teamwork, community engagement, activism, and leadership. More information about the Caltech Y and its programs can be found at <https://caltechy.org>. The office is located at 505 S. Wilson Avenue.

Upcoming Events

1. Caltech Y Decompression

Saturday | June 4th | 7:00-9:00 p.m. | Winnett Lounge

Stressed during finals week? Join us to decompress with free food — burgers, hot dogs, cookies, fruit and veggies, ice cream, chips and drinks; entertainment — movies; and just hanging out with your friends. It is a great way to relax a little before the last finals of the school year! If you'd like to volunteer to help out, please fill out the form here: <http://goo.gl/forms/X1p1Xt278QfmLLJx2>.

The theme is Minions, and volunteers get a free gift card.

2. Yosemite — Centennial Grove Camping - Hiking Trip

Tuesday to Friday | June 14th - 17th | Cost \$125 | Sign-ups begin Tuesday, May 24th at the Caltech Y — Spaces are limited (payment required on sign up)

Looking for a great way to kick off the summer? Why not join us on a camping and hiking trip to Yosemite National Park and the Caltech Centennial Grove in the Sierra National Forest? The Caltech Centennial Grove is a section of the Sierras containing 5 giant Sequoias, and Yosemite is one of the most spectacular natural places in the world. With three nights of camping and plenty of hiking available this trip is a great getaway.

The trip is scheduled for Tuesday, June 14th to Friday, June 20th, and includes transportation, campsites, and most meals. No camping experience is necessary. The Caltech Y Yosemite Trip is open to all Caltech students. Sign-up begins at the Caltech Y on Tuesday, May 24th. To secure your spot on this trip you must sign up and pay the fee (\$125) in person at the Caltech Y (505 S. Wilson, the house just north of the Credit Union). Spaces are limited.

For more information, contact or visit the Caltech Y or our website: www.caltechY.org.

For more information on Yosemite National Park, check out the National Park website at www.nps.gov/yo

3. Hathaway Sycamores

Wednesdays | 5:30-8:00pm | Highland Park

Volunteer at Hathaway-Sycamores, a group that supports local underprivileged students. There are a variety of ages and subjects being tutored. The service trip includes about an hour of travel time and 1.5 hours of tutoring. Transportation is included. For more info and to RSVP, email Sherwood Richers at srichers@tapir.caltech.edu.

Registrar's office and IMSS work to improve registration

TOM SHERIDAN, BISMARCK WONG
Contributing Writers

Registering for classes has always been a harrowing experience for college students. Even with a major in mind, selecting how the next term will fit into your schedule requires research, thought and planning. The technical aspects of registering thousands of these students in short order is a challenge all schools have to face. Caltech has frequently experienced particularly acute issues with its registration. In a reference to its well-known tradition of "Ditch Day," Caltech students have bestowed registration day with the moniker "Glitch Day."

It has earned the name. Before 8 a.m. on the designated morning, the most dedicated

Caltech students wake up early, ready with plans for what they will take the next term. They log onto REGIS, Caltech's online registration system since 2004, and prepare anxiously for the official opening. At 8 a.m., they constantly refresh the page, waiting for the scheduling tool to open — at which point the system crashes and a majority of students are left staring at either a blank screen or an error page.

Caltech's process of having all students sign up simultaneously for classes, which can be highly competitive to get into due to Caltech's emphasis on small class sizes, is somewhat unique. Harvey Mudd, one of the Claremont Colleges and another school known for its science and engineering curriculum, is of comparative size to Caltech with just 800 undergrads. Rather than having a mad rush to register for classes, it staggers registration over the course of days. The system is semi-random, with seniors registering first and freshman last, with some in-class variance.

Berkeley, a much larger school with over 27,000 undergraduates for the 2015–2016 academic year, also breaks up registration by seniority. However, its system determines seniority by units taken, and registration is further divided into two separate phases to prevent a rush for specific classes. During Phase 1, students are limited in the number of units they can select, and are advised to sign up for the priority classes that they have to take. Phase 2 allows them to modify their schedule with additional units, usually with classes that were not flooded during Phase 1.

Caltech's free-for-all system can lead to extremely high traffic numbers across the server used for registration. During the winter term of the 2015–2016 school year, the servers were inundated with requests and had the worst crash in registration history, forcing the registrar's office to delay the process by weeks and search for a temporary solution. Frustrating delays of a few minutes or more had been common before, but this was the first time the entire registration process had to be reset.

The registrar's office implemented a staggered system after the reset, allowing seniors and juniors to register 20 minutes before sophomores and freshmen. This system, intended as a stop-gap measure, was also implemented for the spring registration to buy IMSS time to implement a new solution

to the scalability issue. The rushed nature of the new system meant that no software had been designed to prevent students from registering early. Instead, it relied on students following the Honor Code to stem the tide of registrations. Impressively, no students signed up early the first term the policy was instituted, and only a few signed up early the second time, according to Debi Tuttle, a systems analyst for REGIS.

The circumstances surrounding the crash were unusual. While there has been no increase in the Caltech undergraduate population, the number of requests to the server has steadily gone up. In previous years, IMSS reported a request rate of around 400 clicks/second. "Destructive testing" revealed that the solid state, 8 GB RAM servers with 6

relatively small IMSS department at Caltech, according to Malek.

The announcement created ripples among the Caltech community, with many students appreciative of the long-anticipated changes but exasperated about the extended wait. "Caltech IMSS takes six years to realize the Cloud is the answer to scalability issues," a senior quipped in an email thread. However, Malek, who is currently overseeing Access Caltech's transition to the Cloud, said that the department has been looking at the cloud for six years now, and that the delay was simply due to technical constraints and having to rehash the entire Access Caltech system over to the Cloud.

One solution would simply be to continue staggering registration, since the

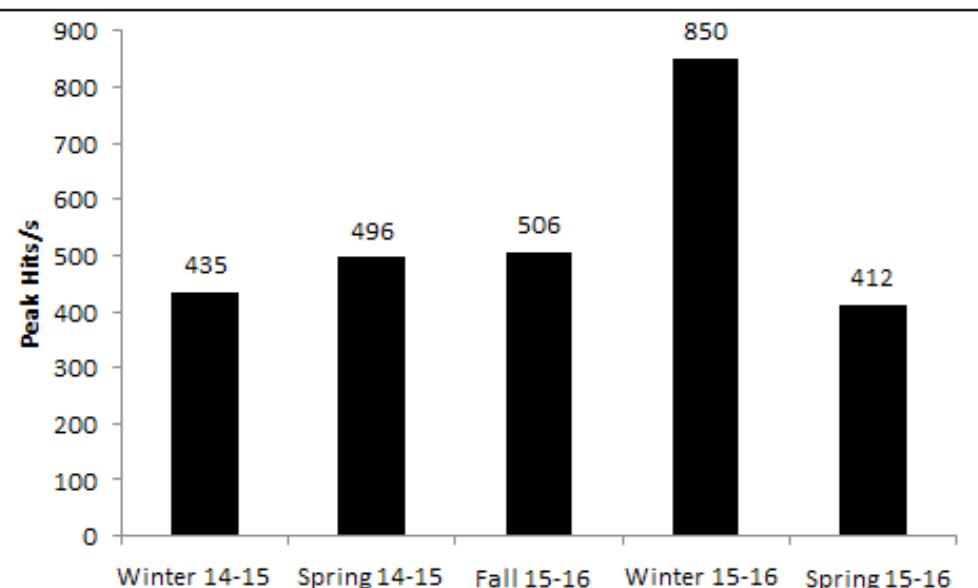
previous terms were successful in keeping traffic manageable, as shown by the 412 combined hits/second for both sophomores and upperclassmen during registration this spring term. However, this would promote biases in registration based on class, as observed in other schools. In any case, as the registrar said when asked whether she had considered

the staggering as a permanent solution, "Once you try to change anything here at Caltech, the student body really is change averse. Any process is viable. I have no bias one way or the other, but my initial reaction was that we should be able, as an Institute, to do this."

One benefit of using Access Caltech in the first place was the direct and complete control over student data, an important issue at any college. As Malek explained, "There's infrastructure as a service, where it's your responsibility to actually architect your application and run it." Another type of cloud-based computing is platform as a service, wherein software is transferred from the user over to the provider, who also runs the servers and databases. The most involved type of service, software as a service, involves simply using applications provided online, like Gmail, where everything is handled by the provider. Because Amazon will provide "infrastructure as a service," there were no concerns about sharing student data, since the Access system would still be completely handled by REGIS/IMSS.

One issue is that the problems with registration might not all be known. Access Caltech, rather than REGIS itself, was identified as the bottleneck, as Peter Ng, an IMSS software developer, explained. "Access Caltech is providing a gatekeeper kind of situation. We haven't seen anything beyond 30 percent utilization for REGIS."

Will expanding the carrying capacity of Access Caltech create a "downstream effect" that will simply change the bottleneck from Access to REGIS? Will the issue have to be solved all over again on the next registration day, with predictable consequences? While there are no guarantees for a smooth transition, the registrar's office looks forward to an error-free future and hopes the move to the Cloud will be the solution students and administrators have been waiting for.



The graph above shows data on hits per second, as reported by Chris Malek of Caltech's IMSS department, for terms when data was available.

Graphic Courtesy of Tom Sheridan and Bismark Wong

It's time to demote Pluto ... again

ORIEL HUMES
Contributing Writer

In 2006, the International Astronomical Union (IAU) voted to reclassify Pluto, stripping it of its status as a planet while establishing a new class of celestial bodies: dwarf planets. While it makes sound scientific sense to demote Pluto from its planetary status, I argue that we should go even further by destroying the designation dwarf planet — a category which is both scientifically useless and pedagogically confusing. Instead, we should call Pluto what it really is: a Kuiper Belt Object.

So why, according to the IAU, isn't Pluto a planet? The IAU has established three criteria for evaluating whether or not an object is a planet or dwarf planet. According to resolution B5, a planet is "a celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to ... [assume] a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighbourhood [sic] around its orbit." The first criterion is fairly straightforward, separating the notion of planet from the notion of a natural satellite or moon. The second is a statement about the size of an object — a planet must be big enough for gravity to be the dominant force sculpting its shape. And the third is, well, confusing. Unfortunately, the third criterion is critical. It is the qualification Pluto fails and it establishes the difference between a planet and a dwarf planet. Planets have "cleared their neighborhood" and dwarf planets haven't.

What the "clearing its neighborhood" criterion comes down to is gravitational influence. Planets, especially large ones like Jupiter, have gravitationally dominated their orbits. Anything that passes too close to Jupiter will either crash into the planet or be ejected from the solar system. In this way, Jupiter clears its neighborhood. The same process works for the other seven planets as well. However, Pluto exists in a belt of similar objects — the Kuiper Belt — where its diminutive size is enough to make it round, but not enough to clear its orbital path.

Because this process is inherently gravitational, it means that the IAU criteria establish two separate size thresholds, both of which must be passed in order to be a planet. Dwarf planets, only passing the "roundness" criterion, exist in a sort of in-between size category, a poor consolation prize to satiate angry Plutophiles. The dwarf planet distinction fails on two counts: it groups together objects with very little in common (other than roundness) and it fails to group together objects that share important physical properties and histories.

There are five objects in the solar system that qualify as dwarf planets: problematic Pluto, our own Mike Brown's Eris, Ceres (the largest object in the asteroid belt) and the two obscure additions of Haumea and Makemake. Pluto, Eris, Haumea and Makemake are all residents of the Kuiper Belt, which lies beyond Neptune's orbit, while Ceres is located much closer to the sun as the largest resident of the asteroid belt, which is between the orbits of Mars and Jupiter. While the Kuiper Belt Objects (KBOs) in this group have much in common with each other, they are vastly different from Ceres, both in composition and history. Ceres is primarily rocky; the KBOs are icy. Ceres, as a member of the asteroid belt, has primarily been influenced by Jupiter, while the KBOs' histories are heavily shaped by the influence of Neptune.

Lumping Ceres together with these other objects has real consequences: it leads to the impression that Ceres is located in a completely different region of the solar system. As an astronomy outreach educator, I have encountered several aspiring amateur astronomers who mistakenly believed Ceres orbited beyond Neptune. The category dwarf planet, then, is misleading, a term that obscures truth.

A categorization that makes more sense is to group Ceres with objects that share its composition and history — the asteroids. Ceres may be an exceptionally large member of the asteroid belt, but this does not warrant the distinction of "dwarf planet." Similarly, Pluto, Eris and their lesser known cousins should be classified alongside the rest of the Kuiper Belt Objects, with which they have more in common than with outlier Ceres.

Superstar astrophysicist Neil deGrasse Tyson advocates for a similar zone-like division of the solar system, separating asteroids and Kuiper Belt Objects. He even goes as far as splitting the planets into two categories — inner planets and outer planets — a division that again reflects the shared composition and history of the rocky planets and gas giants. He implemented this categorization in his design for the solar system exhibit in the Hayden Planetarium before the discovery of Eris, before Pluto's demotion was even up for discussion.

But this division makes pedagogical sense. Simply memorizing a list of planets is not instructive and leaves learners with a rigid and inflexible understanding of science, as the backlash against Pluto's reclassification demonstrates. Teaching the solar system as a collection of different classes of objects opens up a more flexible understanding of science and leads naturally to scientifically relevant questions. Why, for instance, is it that the

Kvelertak's *Nattesferd* strays too far in the wrong direction

NAILEN MATSCHKE
Contributing Writer

Despite the waning cultural relevance of metal as a whole, it has been particularly interesting to witness the resurgence in black metal's influence over the past few years. There are quite a number of current bands blending the hallmark elements of black metal with other genres, including Deafheaven with shoegaze, Agalloch with post-rock, Panopticon with Appalachian folk, and of course Kvelertak with rock 'n' roll.

What is especially interesting about Kvelertak is that while the band's peers have a tendency to write 10-minute progressive epics or two-

minute odes to violence, the group has stuck with a strategy of writing accessible, crowd-pleasing rock that happens to draw on black metal elements for color. For example, Kvelertak's self-titled debut entirely lacks interludes; every track is nonstop riffage, and you won't find any missing tremolo picking, a blast beat or harsh vocals. Likewise, the second album, *Meir* (which fittingly enough means "more" in Norwegian), is nearly indistinguishable except for production value. While this may seem simplistic, the band's skill at this approach quickly attracted attention, as the energetic songs with plenty of memorable melodies make them easy and fun to listen to, while the harsher elements maintained some appeal for metal fans. Neither *Kvelertak* nor *Meir* was a stellar album, but they were enjoyable and stood out.

Kvelertak's third album, *Nattesferd*, was released on May 13, and while it is somewhat

inner planets and outer planets are separated by belt of asteroids? Why are inner planets rocky and outer planets gassy? Such inquiries are more reflective of the true nature of science. Science is not simply a list of facts, but a systematic way of asking questions and organizing knowledge. Shouldn't we, as scientists, strive for terminology that accurately reflects the exciting, ever-changing processes by which we discover it in the first place?

of an evolutionary step in the group's discography, it doesn't impress. The band's approach to this album seems to have focused on emulating aspects of classic heavy metal acts, losing much of the energy and character of Kvelertak's earlier material. The guitar tones are noticeably fuzzier here, while the drums almost never break out into a blast beat, and

that's essentially the only notable example on the entire record. The band's first two albums were perfect for mosh pits and driving down the highway alike, with a free and chaotic spirit that was intense enough to get anyone excited. *Nattesferd*, however, is never bold enough to make anyone uncomfortable and is better as background music more than anything else.

The only thing that does remain relatively unchanged is the screamed vocals, but without the rest of Kvelertak's fury they just sound out of place — like the band didn't know what else to do with its singer. It certainly hampers the attempt to recreate the sounds of some of the classic acts mentioned earlier, as they are known for their extremely



-<http://consequenceofsounds.net/>

these aspects alone greatly dull the sound of Kvelertak's earlier work. There's nothing to suggest that the band members are particularly skilled at their instruments, but in the past they've made up for this with frenetic songwriting that had piercing guitars trading licks constantly and never strayed too far from its black metal influences.

On *Nattesferd*, we instead get a number of limp riffs with a lot of chugging on a single note, and it's only apparent that there are two guitars during brief harmonies. Kvelertak's rocking guitars were the foundation of the first two albums but are purely mediocre here. Some of this is certainly due to the fact that most of the ideas on *Nattesferd* are decades old; "1985" is a dead ringer for a Judas Priest song, and likewise "Nekrodamus" for a Black Sabbath track, while Iron Maiden could easily have written "Svartmesse," "Ondskapens Galakse" or "Berserkr." Not only did these bands do it better, but there are superior acts building on this retro style today — just look at Ghost, for example. On the whole, the direction taken by Kvelertak on *Nattesferd* is uninspired and doesn't do much to grab one's attention.

While Kvelertak's regression to metal tropes is frustrating, it's difficult to underestimate the cost of the black metal influences that made Kvelertak unique. The album opener "Dendrofil for Yggdrasil" does kick things off with a tower of frantic tremolos, thrashing drums and shrieking vocals, but

capable singers that frequently carried the melody. Kvelertak's vocals have no melody, yet the guitar parts are written in the same manner as one would in order to support a vocalist. This album is lacking so much of the personality that made their earlier releases stand out, and what remains clashes awkwardly with the band's new additions, leading to a package which neither invites nor holds up to scrutiny.

On the whole, Kvelertak's third album *Nattesferd* is a thorough disappointment and makes me question whether the band has a future without making drastic changes. It is true that many enjoyed the band's first two releases, including me, but as entertaining and unique as they are, it was troubling that they were effectively the same album. Kvelertak breaks that pattern here, but I feel that their changes are almost entirely for the worse.

Pursuing the played-out heavy metal aesthetic is fairly pointless in this day and age, and the band doesn't even do it well. The guitars are underutilized, the drums are so standard they might as well be electronic, and the harsh vocals stick out like a sore thumb. To add to this, the band had to throw out everything that made it more than glorified rock 'n' roll to achieve its sound on *Nattesferd*. Given the absolute blandness of this album, lacking both originality and passion, I can't imagine many people giving it more than a couple listens.

Katherine discovers the Cameron Sandwich

KATHERINE GUO
Editor-in-Chief

This week, I'll be reviewing a sandwich from Chandler that Cameron Earl, who is the namesake of said sandwich, recommended to me. Being a vegetarian, Cameron came up with a variation on the chicken m a r g h e r i t a , which is a popular sandwich from Chandler's "Deli Epicenter." The sandwich, known thereafter as the Cameron S a n d w i c h , replaces the chicken breast with spinach leaves and avocado. I would have done a punny name involving the fourth Earl of Sandwich, who supposedly invented the sandwich, but I am not that clever.

I didn't really know how to ask for the Cameron Sandwich. The first time, I forgot how to describe the Cameron Sandwich, so I gave an awkward physical description of Cameron and how she ordered this sandwich every day, and Sandra (the sandwich artist) understood what I wanted. After ordering it twice, Sandra now asks me if I want the "special sandwich" and just starts making it. She is truly amazing.

Like its meaty sibling, the Cameron Sandwich contains,

between two halves of a ciabatta roll, fresh mozzarella, fresh basil, and sundried tomato pesto. These ingredients by themselves work together really well. I oddly enjoy the texture of hot, melty, fresh mozzarella in any sandwich, and the basil and tomato pesto make me feel like I'm eating a delicious

friends, but it also paired extremely well with the rest of the ingredients, especially the mozzarella. Also, I got to think about how healthy I was being with every bite.

My only complaint is how the sandwich physically works together. Depending on my luck, sometimes the Cameron Sandwich



Sorry I couldn't get a better picture of the sandwich — I was busy eating it.

Photo Courtesy of Katherine Guo

pizza sandwich. The pesto is so, so good especially.

But what do avocado and spinach leaves add? I was initially skeptical of warm avocado in a sandwich, but its creamy goodness made the sandwich mouthfeel (still don't know about that) experience so much better. Also, avocado tastes super good and goes really well with the pesto and spinach on toasted bread.

Finally, the spinach. Raw spinach and I have never been best

sandwich to everyone, and I've already tried doing that. If you've talked to me in the past week, I probably have discussed the food I've been eating (as usual), but more importantly, this incredibly groundbreaking sandwich discovery. This is a great sandwich for vegetarians to enjoy, but even people without meat-based dietary restrictions, like me, would love it. Stay strong, vegetarians eating on board. The Cameron Sandwich has just entered your lives.

Introspection can be terrifying

KSHITIJ GROVER
Contributing Writer

Growing up is confusing. From the recess-on-the-tanbark depths of kindergarten to the half-filled lecture halls of Ch 3a, no one has ever hesitated to give me advice on how to think — use these colored blocks to understand addition, refer to these diagrams because "A" only stands for "apple," watch these videos, play this educational game — trust us, you'll learn this concept soon enough. Yet, there's one thing that strikes me: I was never taught to introspect. I'm convinced that's hurting me now.

Feeling my way into computer science as a sophomore in high school, I was sure that was what I wanted to do for the rest of my life. Playing around on this touch screen phone? Getting extra computer time instead of just 30 minutes for AIM? Count me in! Never mind the fact that I had no idea what the scale of "life" or even the time between then and college was — I was learning something, having fun and that was it.

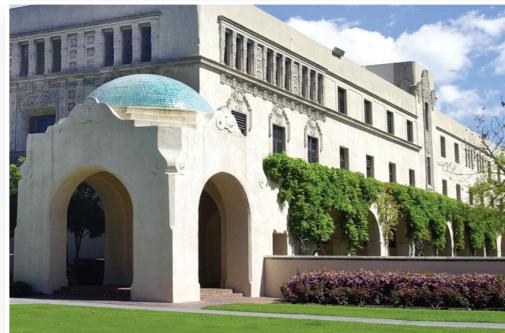
Was that it?

I didn't ask myself *that* question. This trend continued much deeper than that. Jumping into college applications, I went through the motions with my counselors, spent hours in front of the crimson glow of the Common App screen and wrote what I considered were thoughtful essays. Yet, throughout this process, I thought very little about what I wanted — after all, we were all seniors in high school who had to ask to be excused to go to the bathroom. What did *I want*? Who was I turning out to *be*? Were my values and interests really as deep as they once seemed?

These questions certainly seemed out of my league at age 16. Now, you might be thinking, *isn't this the point of the college essays?* These prompts are often worded like "Discuss activities that have contributed to your choice of major." The first thing to pop into your head is a laundry list of pseudo-accomplishments, not an opportunity for reflection. To this day, this bugs me: students spend months trying to articulate an impression of themselves to strangers with only a shadow of a clue of who they really are.

Perhaps I started this with a false premise — maybe introspection isn't something that can be taught. After all, it requires a certain level of maturity and there is no structured way to look inside of yourself (oh, how nice that would be!). On some level, I agree. Experiences like traveling alone, having conversations with friends that challenge your paradigms, being rejected, going to college and writing for the *best* campus newspaper do indeed force you into rethinking yourself as a whole. And yet, there's some tragedy to this in the form of inertia. The later we stop to ask ourselves these questions, the quicker we're heading down a pre-determined path. Over the course of the last few years, I've come to learn that there are aspects of the liberal arts that genuinely excite me and facets of computer science that undoubtedly bore me. Is this reason enough to change the track of my life? Maybe, maybe not — but my mentality has scarcely changed. I'm learning something, having fun and that's it. I'll be the first to admit that introspection can be terrifying.

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SPORTS: '15-'16 RECAP

THE CALIFORNIA TECH

MAY 31, 2016

5



KC was so mad that his eye began to twitch.

Photo Courtesy of Michael L. Wong



So #aesthetic.

Photo Courtesy of Michael L. Wong



Where is the chair?!

<http://gocaltech.com>



The other team just got SERVED. Yeah, I'll show myself out.

Photo Courtesy of Michael L. Wong



The ball must have smelled "foul" for Mark to make that face. Kbye.

Photo Courtesy of Bob Pallermini



Brittany Percin ... How do I begin to describe Brittany Percin? Brittany Percin is flawless. One time she punched me in the face ... it was awesome.

Photo Courtesy of Michael L. Wong



7/10 for lack of symmetry with the diving board.

Photo Courtesy of Michael L. Wong



I envision a small squeal as Rush gently guides the ball to the other side of the net.

Photo Courtesy of Michael L. Wong



The opposition retreats after hearing the roar of this mighty Beaver.

<http://gocaltech.com>



There sure are a lot of people laying down for a sport.

Photo Courtesy of Leo Balestri



You won't! You won't! — One creepy mask to another.

Photo Courtesy of Mark Strumwasser



I'm going to go ahead and say that telekinesis is cheating ...

Photo Courtesy of Michael L. Wong

Fencing jokes? What's the point? Haha ... ha ... ha ... bye.

<http://gocaltech.com>



"You mean we can't hold on to the walls if we're tired ... ?"

Photo Courtesy of Michael L. Wong

ASCIT Minutes

Meetings are every week in SAC 13

ASCIT Board of Directors Meeting

Minutes for 26 May 2016. Taken by Alice Zhai.

Officers Present: Serena Delgadillo, Tim Liu, Sakthi Vetrivel, Kalyn Chang, Robin Brown, Alice Zhai

Call to Order: 12:12 pm

- I. **President Updates:** Serena
 - a. Transition Dinner is on Monday (Memorial Day)
 - b. Current graduating class is the first class affected by the 12-term tuition policy -- survey will most likely be sent
 - c. DONUT website needs to be updated
- II. **ARC Chair Updates:** Tim
 - a. Student-Faculty Lunch happened last week
 - b. Update ARC guide for frosh
 - c. Planning for Student-Faculty conference for next year -- conference is in February, looking for topic ideas
- III. **IHC Chair Updates:** Bobby
 - a. Absent
- IV. **Treasurer Updates:** Kalyn
 - a. Moving boxes on Olive Walk are now available to everyone
 - b. Reminder for student organizations and clubs to spend budget
- V. **Director of Ops Updates:** Sakthi
 - a. Ruddock Frosh Party happened last week
 - b. Made a log of which houses had what resources
 - c. In process of being added to the Club Steering Committee
 - d. Talked to Yearbook Business Managers about budget
 - e. BFP and Techstock are coming up!
 - f. TOTEM 2016 came out
- VI. **Social Director Updates:** Robin
 - a. Dodgers game is on June 4 -- 110 people signed up!
 - b. Rath Party on June 10
- VII. **Secretary Updates:** Alice
 - a. Will gain access to DONUT by contacting Devteam
 - b. Will update glass case on Olive Walk -- ask Phillip or Sean for key

If anyone has any questions or concerns about a section of the minutes please email the appropriate officer. We are happy to answer any questions.

Meeting Adjourned: 12:42pm

REMINDER FROM COUNSELING CENTER:

Meditation Mob
(drop-in mindfulness
meditation group)

Meets every Tuesday
12:00-12:50 p.m.

Bottom floor of Winnett

VICE PROVOST'S OFFICE HOURS

Vice Provost, Chief Diversity Officer and Professor of English, Cindy Weinstein, holds regular office hours. This is an opportunity for undergraduate, graduate students and postdocs to meet and discuss what they'd like pertaining to the Council on Undergraduate Education, Caltech accreditation, the Staff and Faculty Consultation Center, Student-Faculty Programs, the Center for Teaching, Learning and Outreach, the Caltech Diversity Center and the libraries.

There are four appointments per hour, 15 min. each. Sign up the morning of the office hour in 104 Parsons Gates, Vice Provosts' Offices (x6339).

Spring Term Office Hours

12 p.m. - 1 p.m.

Friday, June 3

Caltech Public Events Hiring Ushers

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No experience needed.
Outgoing Personality.
Pay Rate:
\$15 per hour**

Caltech Students only!!

**Contact: Adam Jacobo
626.395.5907
ajacobo@caltech.edu**

The California Tech

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Editors' Farewells: Reflections on the past four years of *The California Tech*

Last year, one of the outgoing editors wrote one final article before graduating. Since Caltech is no stranger to tradition, we wanted to continue this and offer some of our own parting words.

NEERA SHAH

Page Editor, past Editor-in-Chief

What a whirlwind four years it has been, not only trying to get through the academics at Caltech and just college life in general but also trying to find the journalism culture on campus — and keep it alive. During most of my first two years here, I accepted things as they were and did little to fight to keep journalism relevant; I assumed there was little that could be done because it probably would have been tried already. But, complacency could only last for so long, and, thankfully, other members of the Caltech community felt the same way. It feels good to know that we have an ever-increasing group of students willing to dedicate time to publishing a weekly paper.

We always hear “writing is important,” and by now you all probably roll your eyes every time someone says it. Writing papers for a scientific journal is one thing, and papers for humanities classes is another ... but I think writing for *The California Tech* is a third,

very different and important one. Writing for the *Tech* helps bring your voice to the community and makes you a part of significant conversations among your peers and on campus in general.

The past few years have seen the *Tech* become a platform for thoughtful political discourse and a way to jump-start conversations about national and global concerns. It can be difficult to keep your eyes open to life outside Caltech when there's always that next problem set, lab project or application deadline to worry about, but it is important to pause and remain aware of other issues. *The 2016 elections will affect everyone. Social inequality runs deeper than we often realize. Sexual harassment is a relevant issue on campus.* You owe it to yourself and

to those around you, and the *Tech* is here to try to make it a little easier to stay informed, whether you write about these bigger problems, read your peers' thoughts on them or engage in conversations sparked by an article.

On a lighter note, the *Tech* has also been here to allow students

to talk about things they enjoy, from music and art to restaurants around town, and even just share their thoughts about life. One of the newer series, “Humans of Caltech,” has been another opportunity for more lighthearted discussion and getting a closer look at the people who make Caltech what it is.

I hope the *Tech* has been able to make you think, make you smile and make you a little less bored as you take a break from homework to try the crossword puzzles every week. All in all, the *Tech* has come a long way and I only see it going further in the future. I'd like to thank each and every one of you who has ever written for the paper, been part of these conversations or even just picked up a paper and glanced through it.

This has been one of the best experiences I've had at Caltech, and it has been an honor to serve this community through my four years with the *Tech*. Finally, I want to urge you all to continue to make the *Tech* what I know it can be. Keep reading, keep writing and keep connecting.

NEHALY SHAH

Copy Editor, past Editor-in-Chief

because there is always someone willing to help you.

Watching *The California Tech* grow over the past four years has been quite an experience, and I am grateful to those who have had any part in the process. Without the support and involvement of this community — students, staff and faculty — the paper would not be where it is today. I recognize that there is still room for improvement, but I trust that the editors, current and future, will continue to shape the *Tech* into a useful source of information and entertainment for the Caltech community.

There are endless opportunities for you to get involved in something that interests you, whether that is contributing to something like the *Tech* or being part of another club on campus. Take advantage of these, as they will make the stresses of college at least a little easier to bear. And if you can't seem to find something already established, do not hesitate to ask around. The community here is exceptional

CROSSWORD

1	2	3	4		5	6	7	8		9	10	11	12	13
14					15					16				
17					18					19				
20				21		22		23						
	24					25	26			27	28	29	30	
					31		32	33						
34	35	36				37		38		39				
40				41						42				
43			44		45				46	47				
48				49		50		51						
52					53	54				55	56			60
					57		58	59						
61	62	63	64			65		66		67				
68						69				70				
71						72				73				

Across

- 1. Part of the neck
- 5. Database
- 9. Visual display of information
- 14. Zeal
- 15. Reverberate
- 16. Wimble
- 17. Birdcall
- 18. Glows red in a vacuum tube
- 19. Indigent
- 20. A physiological need to drink
- 22. Air current
- 24. Type of spiny tree or shrub
- 26. Variety of kale
- 31. Relative duration of a musical note
- 33. Large semiaquatic rodent
- 34. Baffling question or problem
- 37. Clock face
- 39. A flock of quail
- 40. Appropriate
- 41. Move sideways
- 42. Regret
- 43. Approach
- 45. Bard
- 46. Provide food or sustenance
- 48. Misprints
- 50. Repulse
- 52. Ornamental framework
- 54. Clone
- 57. Orderly
- 59. Two-channel
- 61. Mixed food consisting of greens
- 65. A flat float
- 67. Cereal grain husks
- 68. Form of quartz
- 69. Group of three
- 70. List of names
- 71. Cringe
- 72. Musical instrument
- 73. Ground forces

Down

- 1. Bird shelter
- 2. Hawaiian greeting
- 3. Overwhelming fear and anxiety
- 4. Carve
- 5. Edible round flat seed
- 6. Frozen water
- 7. Display
- 8. Restorative
- 9. Taper
- 10. Chromaticity
- 11. Historic period
- 12. Mississippi tributary, _____ river
- 13. Attempt
- 21. Evidence of past injury
- 23. Baronial
- 25. Sound
- 27. Research workplace, in short
- 28. Obviate
- 29. Variety show
- 30. Machine for extracting moisture
- 32. Type of duck
- 34. Dialog box
- 35. Drama set to music
- 36. Commence
- 38. Modify
- 41. A blank area
- 44. Rodent
- 46. Fractional monetary unit
- 47. Form of math
- 49. Material for starting a fire
- 51. Mechanical device
- 53. Underground den of a fox
- 55. Mistake
- 56. Domain
- 58. Edible tuberous root
- 60. Merely
- 61. Pouch
- 62. In the past
- 63. Jurisprudence
- 64. Consumed
- 66. Evergreen tree

<http://puzzlechoice.com>

Ctrl Alt
Defeat

Hmm...

Hey fresh!
ready for
registration?

Bum Tickley

Sure am!
I really want
to get into
the Chinese
government class!

Oh I just took the
last spot in the class.
Sucks to be a freshy.

Gahhh...
damn staggering...

We'll Miss You

G. Kuo



Monday Punday



This picture represents a common phrase, title, or person.

Think you know the answer? Take a guess at mondaypunday.com/261

Answers to current crossword (p. 7)

C	O	W	E	R	H	O	R	N	A	R	M	Y
A	G	A	T	E	T	R	I	O	R	O	L	L
S	A	L	A	D	R	A	F	T	B	R	A	N
N	E	A	T	S	T	E	R	E	O			
L	A	T	T	I	C	E	R	I	N	G	E	R
E	R	R	A	T	A	R	E	P	E	L		
N	E	A	R	P	O	E	T	C	A	T	E	R
A	P	T	S	I	D	L	E	R	I	U	E	
P	O	S	E	R	D	I	A	L	B	E	V	Y
A	C	A	C	I	A	C	O	L	L	A	R	D
T	H	I	R	S	T	W	I	N	D			
S	O	N	G	N	E	O	N	N	E	E	D	Y
E	L	A	N	E	C	H	O	A	U	G	E	R
N	A	P	E	L	I	S	T	C	H	A	R	T

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