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Original Paper

US Presidential Awards: An Outcomes Analysis

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Abstract

Around 99% of U.S. Presidential Awards for mentored student research in science go to college level mentors like Steve Oppenheimer. We have an opportunity here to describe the research and mentorship outcomes of two US Presidential Awardees. One is Steve and the other is a high school teacher, Dominique Evans-Bye, who also achieved a US Presidential Award for mentored student research in science. Dominique is one of only about two at the high school level, of hundreds in decades given at the college level. Because of the rarity of high school Presidential award winners, we show here what can be done at the high school level. And we show how vastly different, yet similar, university and high school programs can be. We believe that this paper is the only one ever to explore university and high school mentored student research in one place. We also review high school student research from the New Journal of Student Research Abstracts and show that it is sometimes every bit as good as university level research and should be considered an important part of the U.S. research effort. This may be the first time such a statement has been made. This review from our lab should help others understand what goes into a U.S. Presidential Award, the highest White House mentoring award in the nation, administered by the National Science Foundation. The important accomplishments of Dominique will help high school and middle school teachers enhance their student research programs if they choose to do so. Motivation is key.

1. Introduction

A recent paper in this journal (Note 1) focused on Dominique Evans-Bye's Presidential Award and Terri Miller's and Orenda Tuason's student research abstracts. Dominique's project examined the possibility of past water on Mars with collaboration with experts and funding, as done at the college level. Here we continue exploration of Dominique's program and other high school level student research as well as college level research. We examine the nuts and bolts of the logistics of Presidential Awards at both the high school and college levels.

2. Main Body

We show exciting research by Dominique's, Terri's and Orenda's students, as examples of the hundreds of students at the high school and middle school levels who publish in the New Journal of Student Research Abstracts (Notes 2-29).

But motivation, in addition to collaboration and funding, is key in having students do a level of mentored research of high enough quality to earn a US Presidential Award. Motivation is essential at both the high school and college levels. Most instructors do not have the motivation to do what Dominque, Terri and Orenda have, as it takes a lot to do the collaboration, obtain funding and use their background. While we do not have a paper from this lab on high school motivation, we do have one on college level motivation (Note 30). Steve owns the copyright. Here it is.

(#s) refer to references for this motivation paper and not for overall paper.

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Motivating College Students: Evidence from 20 Years of

Anonymous Student Evaluations

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Abstract: The career outcomes of hundreds of college students, mostly biology majors, mentored by U.S. Presidential Awardee (PAESMEM) Steven Oppenheimer, over a 47 year period, at California State University, Northridge, were tracked and recorded. The motivational strategies that putatively helped lead to these career outcomes were gleaned from 20 years of anonymous student evaluations. In addition, evidence is presented that the motivational strategies, in some cases, were a likely cause of student career success and not just correlated with it. The student evaluations suggest that boundless energy, enthusiasm, clarity and organization keep students excited and engaged, helping to motivate them to succeed. Motivation at the pre-college level is also discussed, as by the time students enter college their career

choices are often already made. These programs helped win a U.S. Presidential Award, the highest U.S. Award for student mentoring.

1. Introduction

Steven Oppenheimer, received a U.S. Presidential Award for science student mentoring presented by President Obama at the White House [1-7]. This award is the highest U.S. award for science student mentoring. The award was primarily based on hundreds of documented distinguished career outcomes of Steve Oppenheimer's mentees, summarized by Herstein (2016) [1]. In this paper the specific student evaluations from 20 years of anonymous student comments are reviewed and the specific motivational strategies to help students succeed are summarized. These strategies are discussed in the context of global thoughts on motivation and how individual faculty motivation fits into other factors that keep students motivated and engaged [8-9]. The relationship between faculty motivational strategies as being causal versus being correlated with student success is discussed [Note 8], as is motivation at the pre-college level, perhaps most important of all [10-11].

2. Methods

This paper gleans from about 20 years of required anonymous student evaluations of California State University, Northridge biology professor Steven Oppenheimer, how the motivational approaches used affected the students in their own words. An abbreviated version of student evaluations can be found using Google (at Rate My Professor, Steven Oppenheimer, California State University Northridge). Most of the evaluations concern the upper division majors biology course Embryology, Biology 441, and some are about the lower division mixed majors, non-majors course Biology of Cancer, Biology 285. The actual 20 years of evaluations can be obtained by contacting steven.oppenheimer@csun.edu.

3. Results and Discussion

Motivational strategies from student evaluations.

While the quantitative evaluations were all at the top of a 5 point scale, they do not capture the flavor of the motivational strategies used. Some of the verbatim (some shortened) comments by the students over the 20 year period were as follows:

fun and interactive, offers research opportunities, passionate, inspirational, patient, motivating, clear, interesting, organized, treats students with respect, positive vibe, very approachable, easy to understand, cares about

student success, straightforward, enjoys teaching, great sense of humor, understand more in other classes because of Dr. Oppenheimer's teaching, engages students, best professor ever, very clear, makes sure students understand, keeps us focused, I always enjoy coming to class, optimistic, very good communicator, excellent knowledge of the topic, definitely keeps us awake, intriguing and engaging, encourages questions, love his energy, the best class I ever had.

Some additional flavor of Steve Oppenheimer's philosophy of motivation was presented at the White House on Jan 6, 2010, when Oppenheimer was recognized by President Obama, NSF and the White House. The official White House/NSF brochure produced for the Presidential Award ceremony said of Oppenheimer: Putting into practice his belief that laboratory research experiences should be available to all interested students, he has developed an open door model that encourages students of all economic strata and ethnic groups to participate in his research. His record has proven true his often-stated expectation that any interested student can succeed in scientific research and can go far into the professional career ranks of science, including the Ph.D. and M.D. (a copy of this NSF/White House produced brochure can be obtained by contacting steven.oppenheimer@csun.edu).

Specific example of motivation putatively causing a specific career outcome.

The documented career success of so many hundreds of students mentored by Steve Oppenheimer played a key role in the U.S. Presidential Award as noted by the NSF Presidential Award peer review panel. The evidence presented is mostly correlation and does not provide any clarity on causal relationships. Serendipity has provided an example that gets more into possible causal relationships. This is about one student, of several, who made a donation to the university of student scholarship (s) in honor of Steve Oppenheimer. But in this case an astute reporter unraveled how motivation by Steve Oppenheimer led to her acceptance to Stanford University Medical School (and is now a co-director of emergency medicine at a large Los Angeles Hospital). Here is some of her story in her own words [8]. Her daughters asked, Mom, how did you become a doctor...In unraveling 20 years worth of layers she remembered Dr. Oppenheimer. She decided to make the gift to the university because she said Dr. Oppenheimer changed the trajectory of her life. It began when she took Oppenheimer's undergraduate embryology course Biology 441, the main subject of the anonymous student evaluations presented above. After that she worked in Oppenheimer's research lab. [7]. She said being in Dr. O's lab as an undergraduate was awesome. He encouraged every person that walked into the lab to do everything they wanted to do and helped them find ways to do it. She said Oppenheimer's encouragement made a profound impact on her life...He gave me the confidence to apply to medical school. He gave me the study skills, research skills and knowledge base to succeed. He said you're the best and you can become a doctor if you want to be one. He gave me the confidence to apply to medical school He changed the trajectory of my life. See the great article about this student that is provided here (Camacho,

2018) [8]. It's hard to assign causality to motivational strategies. But this story comes close.

Here follows the Camacho (2018) [8] article. It is important to present it in its entirety to truly provide the details of how Steve Oppenheimer's motivation does the job.

In emergency rooms across the United States, nurses, doctors and hospital staff know never to say the "Q" word. The dreaded word isn't "question," "quarrel" or "quick" — it's "quiet."

It's a rare time for an emergency room when the phones aren't ringing and patients aren't arriving, but that can all change in minutes, according to an ER superstition. As soon as someone remarks, "It's going to be a quiet night, isn't it?," everything changes: Ambulances flood the ER with patients until it's bursting.

As a doctor of emergency medicine and Co-Medical Director of Burbank Emergency Medical Group at Providence Saint Joseph Medical Center in Burbank, it's a situation that Celina Barba-Simic '92 (Cell and Molecular Biology) knows all too well.

Barba-Simic's only access to medical care as a child was the busy county emergency department, which "normalized" long waits, chaos and language barriers for the alumna.

When she decided to pursue a career in medicine, emergency medicine was the only specialty she considered.

"Attending to people at times of crisis represents the greatest privilege of medicine," Barba-Simic said. "I am most grateful to be able to alleviate anxiety and have an impact on patients' acute medical needs..."

Barba-Simic always knew she wanted to work in medicine, but she never imagined that learning not to say the "Q" word would be such a valuable lesson — nor did she know that she would be drawn to the fast-paced world of emergency medicine.

Her path became clearer when she took a human embryology course with — and later joined the Center for Cancer and Developmental Biology of — esteemed biology

professor Steven Oppenheimer at California State University,
Northridge.
His influence on her was so profound that Barba-Simic
recently made a gift to the CSUN College of Science and
Mathematics to create the Dr. Celina Barba-Simic Biology
Scholarship in Honor of Dr. Steven Oppenheimer.
The annual scholarship will provide one award for an
undergraduate student with demonstrated financial need who
is also conducting laboratory research in the College of
Science and Mathematics' Department of Biology.
She decided to make the gift, she said, after her daughters
asked her a tough question: "Mom, how did you become a
doctor?"
"One day they just asked me how I did it," Barba-Simic
said. "And I really tried to unravel all of those layers of skills
and education." Higher Education Research 2019; 4(2): 42-45 44
In unraveling 20 years' worth of layers, Barba-Simic
remembered her inspiring professor of human embryology.
"Dr. Oppenheimer at CSUN gave me the comfortable,
accessible starting point where I could really start building
those skills and seeing that there are possibilities," she said.
"He was absolutely essential."
Her Time at CSUN Oppenheimer, who has mentored
thousands of students during his 40-year tenure as a CSUN professor,
said that Barba-Simic stood out when she was an undergraduate.
"Celina had sparkle, spark and enthusiasm seldom seen in
students," Oppenheimer said. "The combination of her
enthusiasm and my enthusiasm made for great success.
Celina's spark was inspirational."
After getting to know the professor — now emeritus —
Barba-Simic joined the famed Oppenheimer lab. "Being in
Dr. O's lab was awesome. He made it approachable and
hands-on," she said. "Everything was accessible. He
encouraged every person that walked in there to do
everything they wanted to do and helped them find ways to
do it."
In the lab, Barba-Simic helped research cell surface

carbohydrates in adhesion and migration, to explore how cells' surface sugar-containing receptor sites change during development. The study aimed to determine the function of those carbohydrates in order to find causes of cancer-cell spread. Barba-Simic said the professor's encouragement made a profound impact on her life.

"You walk in and he's saying, 'You're wonderful and you're the best!' It was life-changing, his teaching and his classes," she said. "It prepared me for medical school. I knew I had the study skills, the research skills and the knowledge base [to succeed]." Although she learned many things from him, the most important idea the professor instilled in Barba-Simic was this: You can be a doctor if you want to be.

"I reflected on the impact my time in Dr. Oppenheimer's lab had on my career," Barba-Simic said. "He gave me the confidence to apply to [medical school]. Dr. Oppenheimer changed the trajectory of my life." MOTIVATION!

Overcoming Barriers

A first-generation college student born in Mexico and raised in Pacoima, Barba-Simic and her parents came to the U.S. when she was three months old. She started working at the age of 15 and had two jobs by the time she was 16. She used her wages to pay for essentials.

"When I was graduating high school, I brought the UC application to my mom and was like, 'How many of these boxes can I check off?' I think the applications were around $50 each," Barba-Simic said. "And she said, 'Oh, honey, we can't afford that and you can't move away from home.'"

Financial and cultural constraints led Barba-Simic to CSUN, where she initially enrolled as a physical therapy major. Once at CSUN, she encountered cultural barriers to her education from well-meaning family and friends.

"I knew I wanted to be a physician, but everybody told me, 'Oh, don't be a doctor. It takes too long and you're going to get married anyway,'" Barba-Simic said.

Despite the financial and cultural barriers, Barba-Simic paved her way to medical school by volunteering at the

Veterans Affairs Sepulveda Ambulatory Care Center, just a few miles east of campus, doing research and participating in on-campus organizations such as Chicanos for Community Medicine.

At the end of her undergraduate time at CSUN, Barba-Simic received multiple awards including Graduating Student of the Year Award from the Department of Biology and the Minority Achievers in Science Student of the Year Award.

She also received multiple scholarships, fostering her appreciation of the financial needs of low-income students and later inspiring her to make a gift to aid those in need.

Barba-Simic made the gift to her alma mater in hopes of supporting "CSUN students that share similar challenges and career goals."

As an involved undergraduate, Barba-Simic applied for — and later received — the National Institutes of Health Minorities Access to Energy Related Careers grant, with Oppenheimer's encouragement, she said.

"The grant paid for two years [of undergrad], so I was able to stop working," she said. "In the summer, the grant allowed me to conduct research in a Department of Energy lab and use the skills that Dr. O taught me.

"I was lucky to be at Lawrence-Berkeley National Laboratory working under Dr. Levy ... where my job was to irradiate mice brain cell cultures, subjecting them to different levels of radiation and testing Bragg peaks using the linear accelerator. This was but a small part of the research that Dr. Levy used to perfect proton therapy for high-precision treatment of brain tumors and vascular malformations," she added.

Perseverance

After graduating from Stanford Medical School, Barba-Simic completed a three-year emergency medicine residency at Harbor-UCLA Medical Center, where she started work as early as 4 a.m. and ended as late as 7 p.m. — the following day. This meant Barba-Simic often worked 38-hour shifts and 120-hour weeks.

On top of extremely long hours, in the first three months of her residency, Barba-Simic became pregnant with her first child. She went to her fellow residents and asked to switch schedules around so that her vacation was at the end of her first year.

"Once I switched it all, I went to my residency director and said, 'I have a plan.' I did not miss a day," Barba-Simic said. "I actually went into labor my last day. I guess you're so used to, as a minority, working harder and trying to prove yourself that it's just part of you."

At the start of her residency, she was one of two women in a class of 12, but she didn't let that disparity discourage her from accomplishing her goals and realizing her full potential.

"You make it happen," she said. "I'm kind of tough — I think that's the Pacoima in me." MOTIVATION!

Steve's NSF Presidential Award committee evaluated data on student co-authored publications and student career outcomes.

SOME OF STEVE'S STUDENT CO-AUTHORED PUBLICATIONS

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Please Note: Most of the co-authors on these papers are students. These are only the full length peer-reviewed papers from the Oppenheimer lab. Published abstracts and national presentations are not included.

Here are some of Steve's student career outcomes.

UPDATED LIST 2020/SOME MOSTLY LONG TERM RESEARCH MENTEES AND OTHER MENTEES OF STEVE OPPENHEIMER AND WHAT HAS BECOME OF THEM (many completed Masters (*) and have published with Steve). Most are accurate. Best guesses or past positions for some. Some inadvertent duplications may be included.

Tim Jordan, D.M.D., Dentist *

Loren Knapp, Ph.D., U Chicago *

Wayne Shepard, Dentist *

Dan Connolly, Ph.D. Johns Hopkins,

Scientist, Monsanto *

Marie Roberson, Ph.D., UC Davis *

Dorothy Haskett, Research Associate *

Jim Meyer, Senior Scientist, Amgen *

Tony Neri, Ph.D. UC Irvine, Vice President Preclinical Division, Miikana Therapeutics *

Robin Hale, retired, was Director of Special Applications Research, Rockwell *

Gary Toedter, Ph.D., UC Davis, Senior Scientist, Manager, Coulter Electronics *

Bob Nystrom, Ph.D. UC Davis or Colorado State *

Chuck Sternburg, Ph.D., UC Irvine, Professor, Riverside Community College *

Carol Koprowski, Ph.D. USC, Professor or Adjunct Professor USC *

Bob Freeman, Ph.D., UCLA(?) *

Martin Grodin, Research Associate *

John Scordato, Ph.D. USC *

Paul Aunchman, Environmental Pollution , Health Inspector *

Bill Childress, ran computer firm *

Chris Capelle, M.D. *

Richard Behringer, Ph.D., Professor *

Steve Sorenson, D.D.S. *

Bill Saxton, Ph.D. U Colorado, Professor *

Peter Thompson, M.D. *.

R. Clay Steiner, M.D. *

Mina Alikani, Lead Specialist, Cornell In vitro fertilization program *

Stanley Liang, Ph.D., Harvard *

Karen Simpson, USC Dental School *

Julie Gorchynski. M.D., Clinical Medicine Director, UC Irvine now Texas, Professor, BIG CSUN DONOR *

Elias Azzam, Research Associate *

Susan Crowther, Professor, College of the Canyons *

Larry Tawa, M.D. *

Sheryl Fulop, D.V.M. *

Heber Becker, UCLA Medical School *

Karen Berg, M.D. *

Dana Nojima, Ph.D., U Minnesota *

Phil Patenaude, K-12 teacher *

Arunas Banionis, M.D. *

Pradnya Kuwwadekar, Research Scientist *

Miriam Golbert, Professor, Community College *

Debra Kowal, Forensic Technologist, Community College Instructor *

Helen Fredell, K-12 teacher *

Jerome Puttler, K-12 teacher *

Linda Esmaili, Research Scientist *

Marci Spiegler, Community College Instructor *

Mohsen Saidinejad, Ph.D. pgm *

Greg Bentley, Research Associate *

Alice Stanboli, Biotechnology Research Scientist *

Mehrnoosh Saghizadeh, Biotechnology Research Scientist *

Tanya Borisavljevic, M.D. *

Sandra Matsumoto, Ph.D., U Utah, Industry Scientist *

Ani Issaian, Cal Tech Electron Microscopy Facility Director *

Ron Roque, Pollution Inspector, City of Los Angeles *

Pat Krueger, U.S. Forest Service Scientist *

Valerie Dunn, Research Scientist, Industry *

Michael Daily, M.D. *

Brian Salbilla, Research Associate? *

Norman Lautsch, Research Associate? *

John Slack, was in med school *

Majid Heydarizadeh, Ph.D. pgm *

Ana Garcia-Flack? *

Mary Keens, Criminologist *

Miguel Rocha, Research Associate *

Bibi Aguero, Research Scientist, Industry *

Tun-yin Joseph Yeh, Ph.D., U Utah *

Cynthia Hochman, D.V.M. *

Vern Traxler, Criminologist *

Jessy Philip, Criminologist *

Virginia Latham, Senior Research Associate *

Pavanjit Chhabra, D.D.S. *

Audra McKenzie, Research Associate *

Paul Narguizan, Ed.D. or Ph.D. USC Professor or Adjunct Professor *

Houman Vaghefi, M.D./Ph.D. Chicago Med? *

Tharenee Sakhakorn, D.D.S.? *

Bernard Hunwick, Ph.D. pgm? *

Vanessa Navarro, M.D. *

Sheri Walker, M.D.

David Khatibi, M.D. *

Lital Kirszenbaum, D.V.M. pgm UC Davis *

Lyla Ngo, Medical School *

Evelyn Soriano, was in Ph.D. pgm

Lily Welty, Ph.D. or Masters pgr UCSB *

Eileen Heinrich, Ph.D. UCLA, postdoc *

Ziba Razinia, Ph.D. pgm Yale, post doc. U Penn *

Hesam Hekmatjou, was in Harvard Dental School

Astrid Hernandez, K-12 teacher

Anna Martinez, Stanford Medical School

Luis Rodriguez, Ph.D. Cornell, Senior Scientist NIH

Monica Tully, K-12 teacher *

Maria Abundis, UCSD Medical School

Juan Carlos Pelayo, UCSF, M.D.

Edward Yamoah, UCSF M.D.

Gayanee Weerasinghe, Johns Hopkins/NIH Ph.D. pgm

Marcella Barajas, U Minnesota Ph.D. pgm

Arash Razi, NYU Dental School *

Karina Garcia, West Virginia U Masters pgm

Nasim Monajemi, M.D. pgm

Claudia Garcia, Ph.D. Harvard, Senior Scientist

Sabino Herrera, D.V.M. UC Davis

Karen Brannon, M.D./Ph.D. pgm U Kansas

Celina Barba, M.D. Stanford Medical School,

Emergency Room Physician, co-direct, Emergency Department

Rhodelio Cruz, Ph.D. UC Berkeley *

Jeanette Ducut, Ph.D., UCSD, postdoc

Karolin Abedi, Pharmacy School

Rashad Riman, Dental School

Stephanie Gipson, Criminologist

Juan Sosa, Medical School

Melena Grigorian, Phg.D. pgm

Edna Francisco, Science Writer

Liat Attas, Medical School

Talin Haritunians, Ph.D. pgm

Cecil Addy, M.D.

Krystal Jarvis, Laboratory technician *

Linda Brunick, Ph.D. pgm

Monica Londono, Research Associate

Mike Kaliko, Chiropractic pgm *

Maribel Alvarez, Ph.D. pgm UC Irvine

Karineh Petrossian, Ph.D. pgm City of Hope *

Jennifer Nnoli, Ph.D. pgm, Sloan Kettering

Rashad Riman. Dental School

Christine Le, Dental School *

Arjang Naminik, Dental School *

Arbi Keshishian, Dental School *

Evelin Adamian, Dental School

Rabin Ebrahimi, Pharmacy School

Souren Basmadjian, Pharmacy School

Mike Astete, Dental School

Jehan Murugaser, M.D.

Stacy Tanaka, K-12 Teacher

Ignacio Saldain, K-12 Teacher*

Oliver Badali, Cosmetics Scientist

Rowena Bada, Nurse

Azalia Contreras, Community College Instructor*

Pouria Parsa, M.D.

Massoud Agahi, M.D.

Mary Haghi, M.D., Pediatric Endocrinologist

Neema Oroomchi, Medical School

Ardy Khou, Dental School

Sina Samie, Medical School

Anush Margarian, Pharmacy School

Marie Gonzalez, Pharmacy School

Allen Tabibian, M.D., FACC, Cardiologist

Ralph Buoncristiani, D.D.S.

Stephen E. Jones, M.D.

Andy Solkovits, M.D., Assoc. Professor UC Davis

Erica Dent, Master of Health Administration pgm USC

Jenieke Allen, admit.Ph.D. pgm*

Justin Dreyfuss, Ph.D. pgm, USC*

Diana Naderi, admit MD pgm

Brian Idoni, Research Tech II USC*

Margaret Lemell (Aranda), M.D.

Richard Karout, Pharmacy school

Arbi Keshishian, Dental School*,

Tiffany Smith, PA program

Christine Le, Dental School*

Arjang Naminik, Dental School*

William Dalrymple, Osteopathic School of Medicine

Ziba Razinia, Ph.D. Yale, Postodc U Penn*

Earl Sandroff, D.M.D.

Susan Wensel, Monsanto R&D*

Kim Krach, M.D.*

Sokuntheavy So, Research technician

Oliver Badali, Cosmetics industry chemist

Collete Bibayan, admitted 2 pharmacy schools

Vanessa Navarro, M.D., Family Practice San Diego*

Mark Sussman, Ph.D., DISTINGUISHED PROFESSOR SAN DIEGO STATE

Herry Budiyono, Hospital patient analyst*

Claudine Bulan, Cytology Training Program, Wisconsin

Houman Vaghefi, MD, Ph.D, Radiation Oncologist*

Poria Edalat, Dental School

Lauren Michaels, Veterinary School

Basmah Akhter, Pharmacy School

Nareeneh Zadori, Pharmacy School

Eileen Heinrich, Ph.D. UCLA, now staff scientist at City of Hope*

Jordan Vallejo, h.s. summer res 2yrs, Purdue University, mechanical engineering

Niosha Edalat, USC Dental School and Admissions Ambassador

Forooze Rashidi, Instructor College of the Canyons*

Odette Arman, In vitro fertilization clinic embryologist*

Mark Colgin, Clinical laboratory technologist

Drew Edelberg, high school research student, B.S. Berkeley, Ph.D. Program, solid state physics, Columbia University

Maria Atikyan, Masters in nursing program

Alexandra Mokh, Instructor/Professor, LA Valley College*

Pam Klein, M.D., Vice President Clinical Development at Genentech

Tina Askari, research associate*

Hurig Katchikian, medical school*

Marianna Muradyan, pharmacy school USC

Lana Darghali, pharmacy school

Lusineh Mirzakhani, admitted to pharmacy school

Evelyn Adamian, dentist

Ofelya Tonyan, accepted Western University of Health Sciences

Jigar Patel, medical school

Jenieke Allen, Ph.D. program Cedars Sinai*

Krystal Jarvis, teacher*

Hamid Davoudi, college teacher, PA program*

Forooze Rashidi, teacher*

Odette Arman, In vitro fertilization embryologist,*

Ronik Khachatoorian, Ph.D. UCLA, postdoc UCLA

Mirey Qubrosi, Technical Associate, product testing research

Oryla Wiedoeft, EdD, Teacher, Asst. Principal,

Jouliana Davoudi, Dental school USC*

Debrin Yahya-Kashani, CSUN Nutrition Masters program

Yukiko Kanda, Masters program in social work

John Sobhani, research associate UCLA

Tiffany Smith, PA program* USC Keck School of Medicine

Suprita Singh, Ph.D. program Penn State*

Hye Na Kim, research assistant

Ignacio Saldain, HS teacher*

Jung Suh, Amgen quality control analyst

Krystal Jarvis, Research associate*

Careen Khatchitorian, Ph. D pgm, UC Riverside

Marina Hernandez Vergara, K-12 teacher

Ravneet Gill, MD pgm

Hamid Allatabakhsh, dentist- periodontist

Anita Aloian, Optometry pgm, Western University

Eddie Karabidian, USC Dental School*

Hamid Davoudi, PA program*

Pam Klein, M.D., Oncologist, Head Biotechnology company

Noreen Warner, PA program

Lenny Mayorga, Lenny, USC Dental School

Edmund Petrossian, Med School

Nomiki Kolettis, Ph.D. pgm UC Riverside, now research associate

Yukiko Kanda Petrus, Masters of Social Work pgm CSUN

Anasheh Ghazarian, research technician

Sokunttheavy So, research technician

Hiensen Hiesmantjaja, Med School

Armin Sarkissian, Med School

Ivette Ramos Ortega, med school, 9-19-14, remarkable testimonial sent

Virginia Hutchins Carroll, laboratory manager College of the Canyons*

Samantha Arvizu, technical associate

Mai Phan, csun M.S.pgm, research associate

Gayani Weerasinghe, passed bar, patent attorney

Miriam Golbert, Chair, Biology Department, College of the Cabnyons*

Heghush Aleksanyan, csun M.S. pgm, teaching assoc, medical school

Alex Kandel, law school-Berkeley

Helen Chun, Ph.D. and postdoc UCLA, Assoc.Prof., Chair Biology, CSU Dominguez Hills

Karina Garcia, Ph.D. program, history

Rod Blourtchi, admitted medical school

/PA program

Brandon Wallace, medical school

Samantha Arvizu, technical associate ThermoFisher

Jing Liang, research associate Weizmann Institute*

Shabnam Sorooshiani, dental school

Elizabeth Aquije, UCLA School of Medicine

Carol Chavez, UCSF dental postbac pgm

Magy Eskander, admitted to pharmacy school

Haike Ghazarian, Ph.D. pgm, City of Hope*

Heghush Aleksanyan, medical school*

Ralph Buoncristiani, D.D.S.

Mona Kelvani, admitted to pharmacy school

Carol Chavez, accepted Roseman Dental School, Utah

Nomiki Kolettis, Research Associate Genentech

Anasheh Ghazarian, Los Angeles County Sheriff's

Crime Lab technologist program

Destinney Cox, accepted CSUN Biology Masters

M. Larijani, emergency room physician

Alice Chalikian Kouyoumdjian, Chiropractor

Sayeh Behnia, admitted to pharmacy school

Mai Phan, Career Protein Chemist*

Jim Bollinger, Dentist

Christina Irikyan, clinical laboratory scientist

Jouliana Davoudi, Dentist, graduated from USC

Dental School*

Bermans Iskandar, pediatric neurosurgeon, University of Wisconsin

John Sobhani, admitted USC Dental School

Haike Ghazarian, Ph.D. City of Hope, Postdoctoral Fellow*

Salmeen Andkhoy, registered nurse

Stacy Tanaka, teacher, Magnet Coordinator, new Medical Magnet at Northridge Middle School.

Jasper Chang, Loma Linda University School of Pharmacy

Karen Pastrano, accepted UC San Francisco and Pittsburgh Schools of Dentistry and Pittsburgh Ph.D. program

Jenieke Allen, Ph.D. *

Justin Dreyfuss admitted Rosalind Franklin, Medical School*

Massoud Agahi, M.D. Vascular Surgeon

Maribel Alvarez, Ph.D

Celina Barba, M.D., Stanford, Co-director Emergency Medicine, Providence St. Joseph Medical Center Burbank, Scholarship donor to CSUN in honor of Dr. Oppenheimer

Raff Khechoumian, accepted Masters pgm Rosalind Franklin University of Medicine and Science

Dayana Tobar, Ventura County Medical Center Residency Program

Karoline Rostamiani, tenure track community college professor

Yun Lee, accepted to pharmacy school

Karoline Rostamiani, tenure track community college professor

Carol Chavez, DMD, Roseman University College of Dental Medicine

Kristel Crocker, Accepted into Clinical Laboratory Scientist Training Program

Byron Aquino, Accepted into Clinical Laboratory Scientist Training Program

Regie Canta, Accepted into Clinical Laboratory Science Program

Dominique Evans-Bye, U.S. Presidential Award recipient, high school teacher and superb student research mentor

Arya Saleh, M.D., Internal medicine

Peyman Saadat, M.D., reproductive endocrinologist

It all started…

In 1969 at Johns Hopkins, Steve Oppenheimer’s research career began with a paper published in

The Proceedings of the National Academy of Sciences, U.S. (PNAS) that was considered by many to be the first strong evidence implicating cell surface carbohydrates in intercellular adhesion done in a cancer cell system (Oppenheimer, et al., PNAS Vol 63,1395-1402 (1969)).

Now, we will present some of Dominique's, Terri's and Orenda's mentored student research projects. For those interested in viewing what can be done at the pre-college level, you might look at the published student research (2-29). Dominique's, Terri's and Orenda's work are examples of what can be done at the pre-college level.

Surveying High-Risk Fire Areas: Mapping Homelessness Via Infrared Sensors

Daniel Bet Sarghez, Matthew Keshishian, Gabriela Marcucci, Vahe Haleblian, and D. Evans-Bye (teacher)

Anderson W. Clark Magnet High School 4747 New York Ave., La Crescenta, CA 91214

ABSTRACT

Our CubeSat (small cube satellite) mission was to document homeless encampments within a high-wildfire-risk area and to determine if they are occupied or not by using infrared remote sensing. First, we evaluated a FLIR infrared sensor on a Parrot ANAFI unmanned aerial vehicle (UAV) to show proof of concept. Our evaluation proved that IR could identify homeless camps. Next, we built a CubeSat from the XinaBox XK90 and Arduino IoT Bundle Kits. However, our CubeSat went through numerous revisions to fix problems, including removal of the XinaBox. The flight-ready version of our CubeSat used an Adafruit MLX90640 infrared sensor in it to determine where people have set up residence within the high-vegetation region of Hansen Dam Recreation Area. Since this area is Federal Aviation Administration (FAA) Unmanned Aircraft Systems (UAS)-controlled airspace, we used a tethered weather balloon to fly our CubeSat. We imported our data into ArcGIS Online for analysis to determine where camps have been established. Frequent fires are common in this area due to heavy dry brush and a large homeless population that often starts fires for cooking and warmth. The risk is intensified during the fall, when Santa Ana winds are common. The purpose of this mission was to evaluate the use of an infrared sensor to identify homeless camps in high-fire-risk areas in order to save lives and nearby property. Our research question was: Can an aerial IR sensor be used to document homeless encampments in wildfire-prone areas? Our hypothesis — an IR sensor in our CubeSat would be able to identify homeless encampments — was accepted.

INTRODUCTION

The U.S. Department of Education developed the Career and Technical Education (CTE) Mission: CubeSat as a national challenge "to build technical skills for careers in space and beyond" (CTE Mission: CubeSat). As part of our Honors GIS and Remote Sensing class, we submitted a proposal to build a CubeSat with an infrared sensor to identify homeless encamp- ments within high-fire-risk areas.

Homelessness has been a persistent problem in the Los Angeles area, with L.A. County seeing a 13% increase in homelessness from 2019 to 2020 (L.A. Homeless Services Authority). COVID-19 exacerbated this issue, as costs for common goods rose and many jobs were lost (L.A. Controller).

Another incessant problem the region faces is wildfires. California is plagued by frequent droughts, causing extremely dry vegetation in many areas. Arid areas, combined with a growing homeless population and strong Santa Ana winds, make L.A. County a hotspot for wildfires (CAL FIRE).

The confluence of these issues occurs when homeless people settle in high-fire-risk areas in L.A., such as the Hansen Dam Recreation Area. This creates a twofold problem: frequent fires caused by people residing in homeless encampments, and risk to those in the area who may be unaware a fire has started. This is due to the homeless either lighting fires to stay warm or cook food, or discarding materials such as lit cigarettes, which endangers themselves and others.

Our proposal was chosen as one of five national finalists, and we were provided a $5,000 budget to fulfill our mission. Our research question was: Can an aerial infrared sensor be used to document homeless encampments in wildfire-prone areas? Our hypothesis was that an infrared sensor in our CubeSat could identify homeless encampments in the Hansen Dam area.

Our group initially intended to fly a drone over our survey area, but after conducting a site suitability analysis we found that our survey area overlapped with FAA UAS-controlled airspace, which is a no-fly zone for drones. This is because there are three airports in close proximity to our study area. To overcome this, our group changed our launch method to a weather balloon that remained tethered to avoid air traffic.

The purpose of this mission was to evaluate the use of an infrared sensor to identify homeless camps in high-fire-risk areas in order to save lives and nearby property. Our research question was: Can an aerial IR sensor be used to document homeless encampments in wildfire-prone areas? Our hypothesis was: If we used an IR sensor in our CubeSat, then we would be able to identify homeless encampments.

MATERIALS AND METHODS

Before starting our project, we evaluated an infrared FLIR sensor by flying a Parrot ANAFI UAV over the Willoughby Preserve in Ventura in an effort to obtain a proof of concept of our mission. After obtaining a proof of concept, we chose to study the Hansen Dam area because it fit best within our parameters (*Figure 1*). This area is an open space, has a lot of dry brush, is within a high-fire-risk zone, and is known to harbor camps of homeless people. To determine areas that could be imaged with a drone, we used a site suitability analysis that was created in ArcGIS Online (*Figures 2 and 3*). To begin with, we wanted our study area to be within a 15-mile radius of Clark Magnet High School to keep commuting distances short. This was achieved by adding a 15-mile buffer radius around the school. Since our data had to be collected from the air, we needed to take into consideration and map any FAA UAS-controlled airspaces in our 15-mile buffer zone. Next, we mapped open spaces (green areas) in which a drone or payload- carrying device could fly, and ruled out the open spaces that reside in controlled airspaces for drones, but kept them on our list for a weather balloon. After determining the open spaces in which we could fly, we ascertained which areas are considered to be moderate to high-risk fire areas (orange hexagons), and defined any intersecting open spaces within wildfire-risk areas (*Figure 2*). Running these geoprocesses identified the open spaces that met all of our criteria, shown in purple (*Figure 3*).

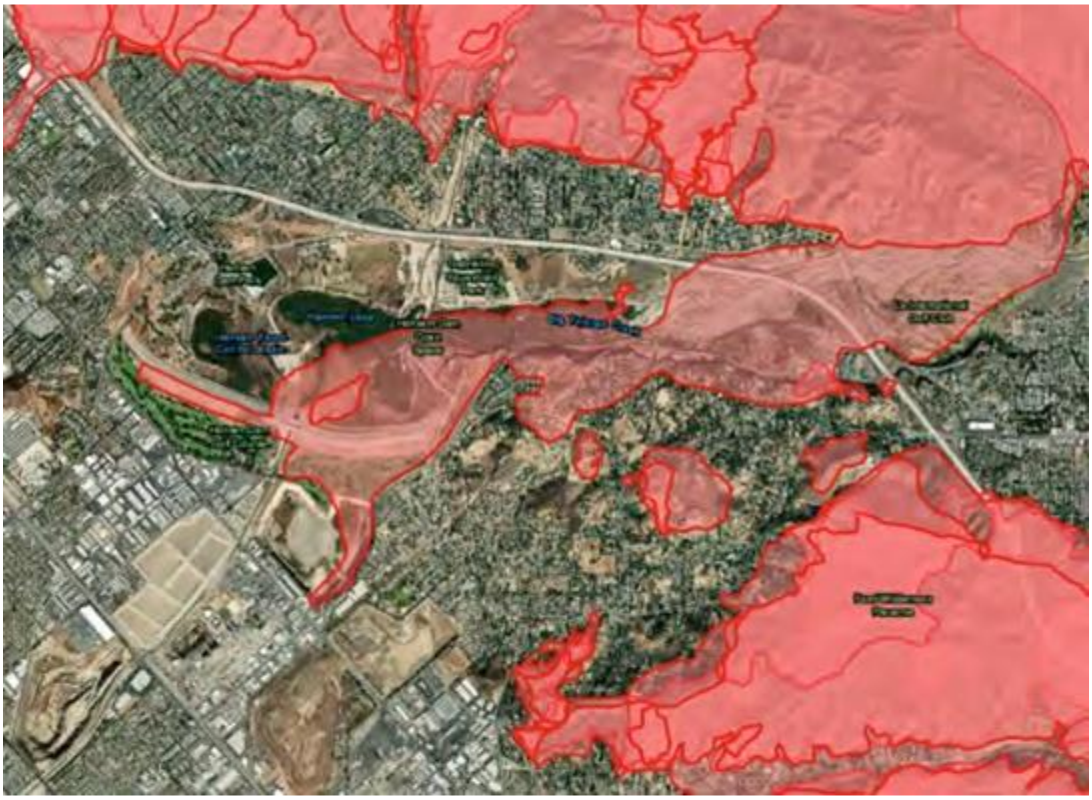

Figure 1: Map of our study area that displays the fire risk present there

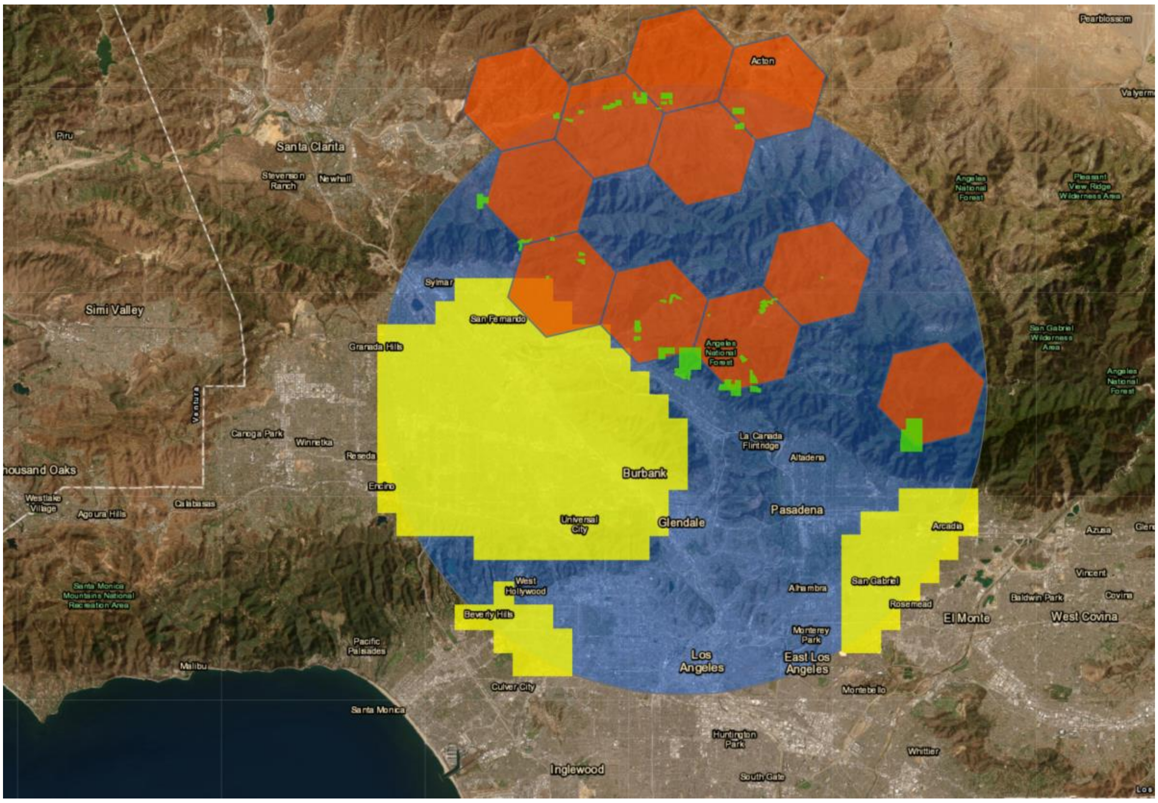

Figure 2: This is the site suitability analysis we ran to determine sites that met our criteria and could be surveyed with a UAV.

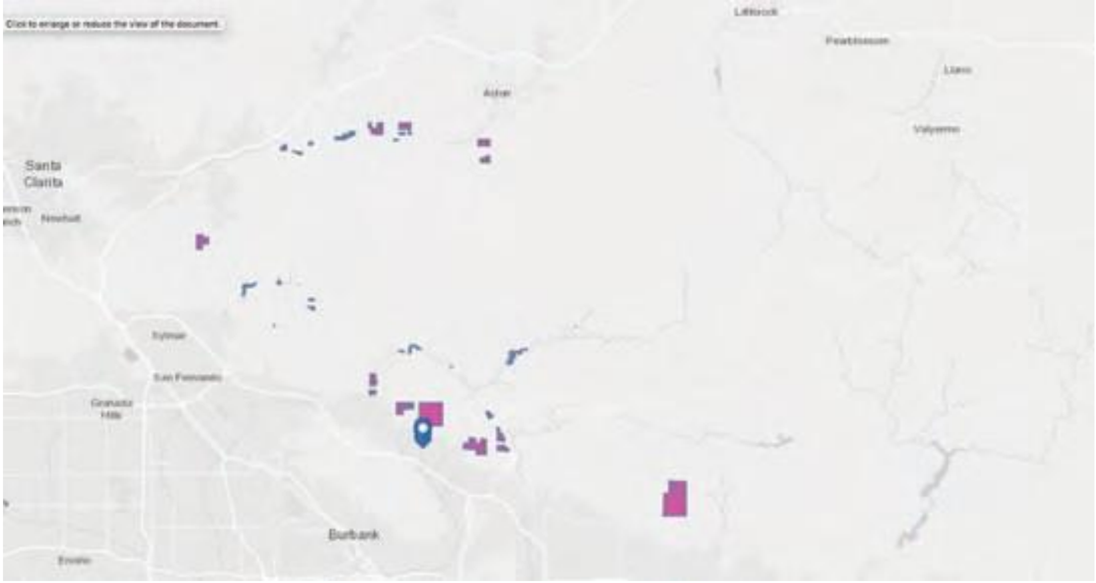

Figure 3: The purple squares are the locations that were pos- sible study areas, as they met our parameters.

With the $5,000 budget, and the study area in mind, our team began to design and build our flight-ready CubeSat. The follow- ing components were used: an aluminum frame that contained the hardware of our CubeSat; an external power bank that supplied our Arduino with power; an 8238 meteorological balloon with an inflated diameter of 9 feet to carry our payload; and an Arduino MLX90640 Lite, which ran our GPS, thermal imaging, and data storage. This Arduino was accompanied by an Arduino MLX90640 thermal camera that captured all of the thermal imaging data used for our results, and by a device running Strava, an app that recorded the elevation of the flight. These two devices were the major components of our subsystems.

Our original subsystems sketch can be seen in *Figure 4*, but it underwent a near-complete overhaul before our flight to match the guidelines of the competition. The structure remained rela- tively similar, but the XinaBox had to be removed for reasons that are expanded upon in the computing section. The solar panel and power bank ended up being a singular item, and our team logo was excluded from the final flight, as mounting it reduced the structural integrity of the payload.

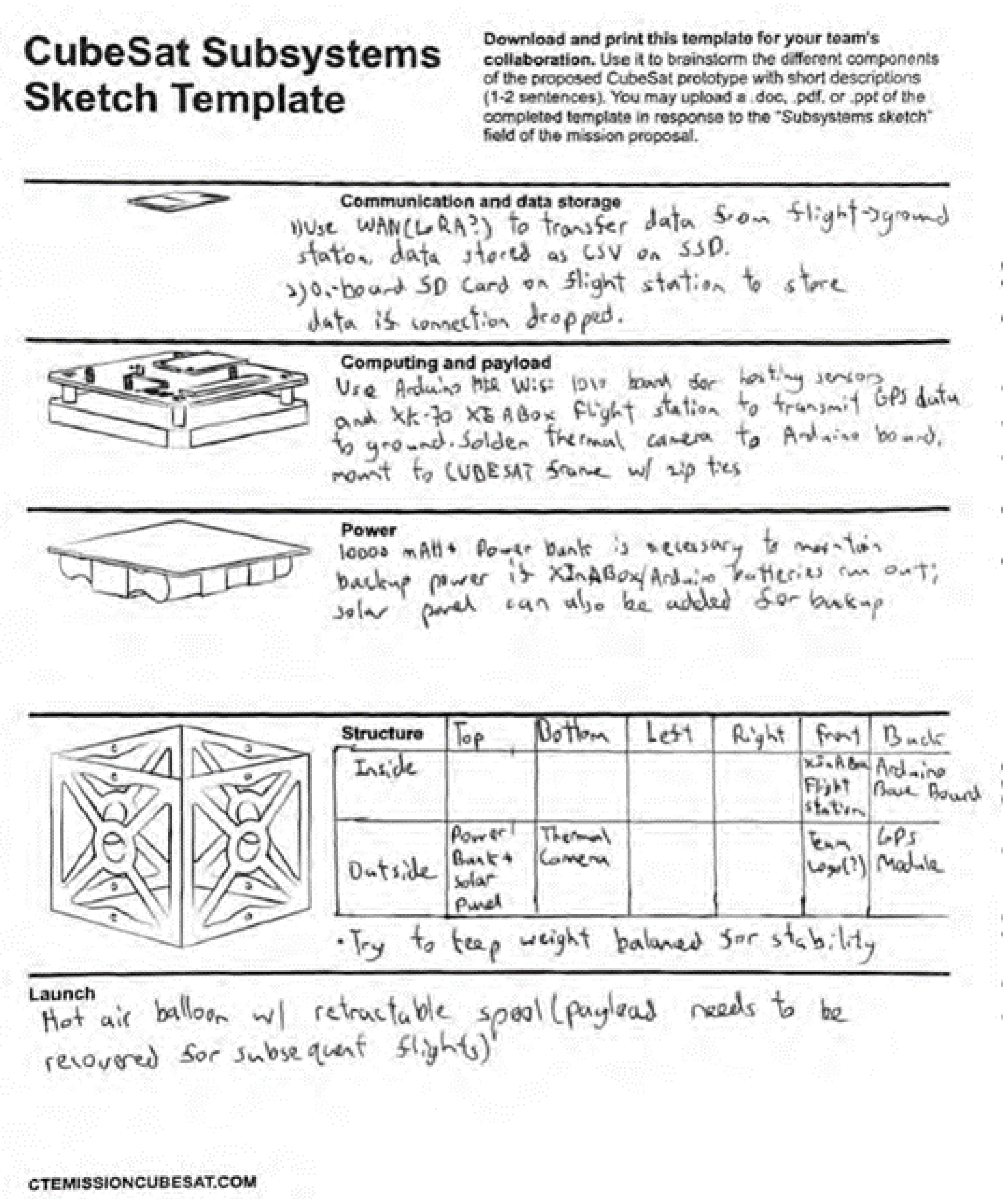

Figure 4: Our subsystems sketch

For power, our team used the onboard battery with the Arduino IoT Carrier Board. However, in case this proved insuf- ficient, we included a redundant system, which was a 30,000 mAh power bank that had a solar panel on the top. The battery was replaced and the power bank fully charged before the flight to ensure that power would not be a concern. Tests with the power bank and battery yielded a minimum of 10 hours of use before depletion, which was far beyond what was necessary for the flight.

To launch our CubeSat, we used a weather balloon filled with just enough helium to carry the payload. The amount of helium needed was calculated by using the lifting capacity of helium, 30.34 g/ft^3, and multiplying that by the weight of our CubeSat, which was 0.88 kilograms. As a result, we needed a minimum of 30 cubic feet of helium to lift it. The CubeSat frame with the components mounted inside was subjected to a heavy shake test before launch to ensure that wind would not dislodge any critical components. Once the frame was mounted to the balloon with zip ties, we attached the balloon to a 120-foot-long nylon line on a cave diving reel and filled it with helium. Since our study area was near three airports, we could not risk losing the balloon, so we put redundant safety protocols in place. We tied our nylon line to the balloon, then folded and secured it with duct tape. Two students held the line during the operation, one held the reel, and one held the line itself a few feet up from the reel. Our weather balloon remained tethered during the entire flight. Our teacher advisor kept a pellet gun on hand to immediately deflate the balloon in case of emergency.

Our project had three main computing components: thermal imaging, GPS, and communication. While we originally planned to use XinaBox for the latter two, a problem with the XinaBox software prevented us from flashing the firmware onto our chips and using them. We thus had to improvise and use the Arduino as an all-in-one solution. Our thermal camera, the MLX90640 (*Figure 5*), took a 24x32 image with a 55° field of view, with each individual pixel reporting a thermal read- ing. The Arduino MKR IoT Carrier also included an ambient temperature sensor. To find where thermal readings were present, we programmed the Arduino MKR WIFI 1010 Board to compare these two readings. If any pixel of the MLX90640's image was more than 15% hotter than the ambient temperature, a thermal reading was reported and the GPS coordinates at the time of the picture being taken were reported. We used BLE (Bluetooth® Low Energy) to communicate with our ground team. We also had to calculate the height we needed to fly our CubeSat using field of view (FOV), which can be seen in *Figure 6*.

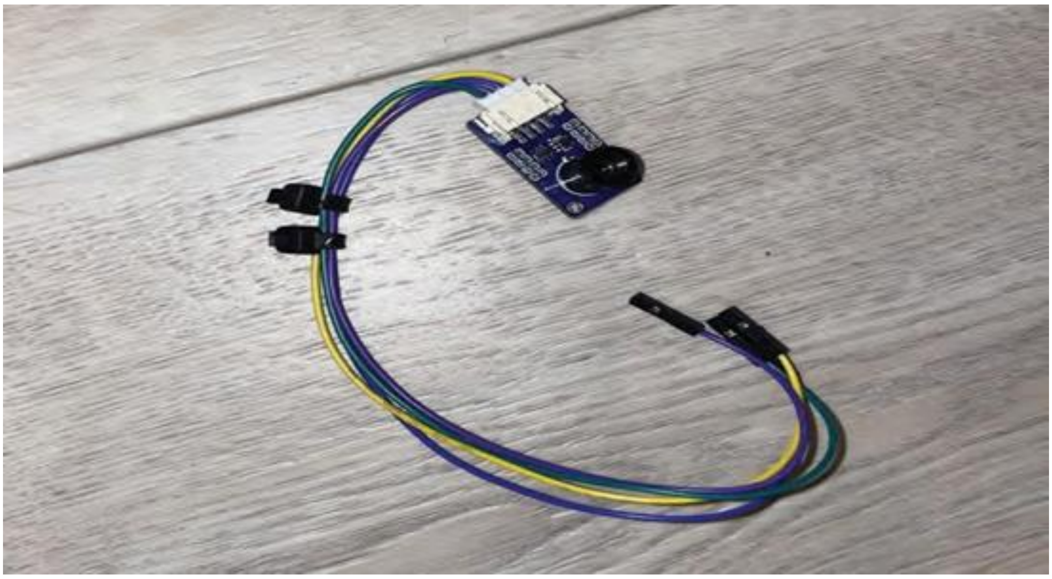

Figure 5: MLX90640 camera

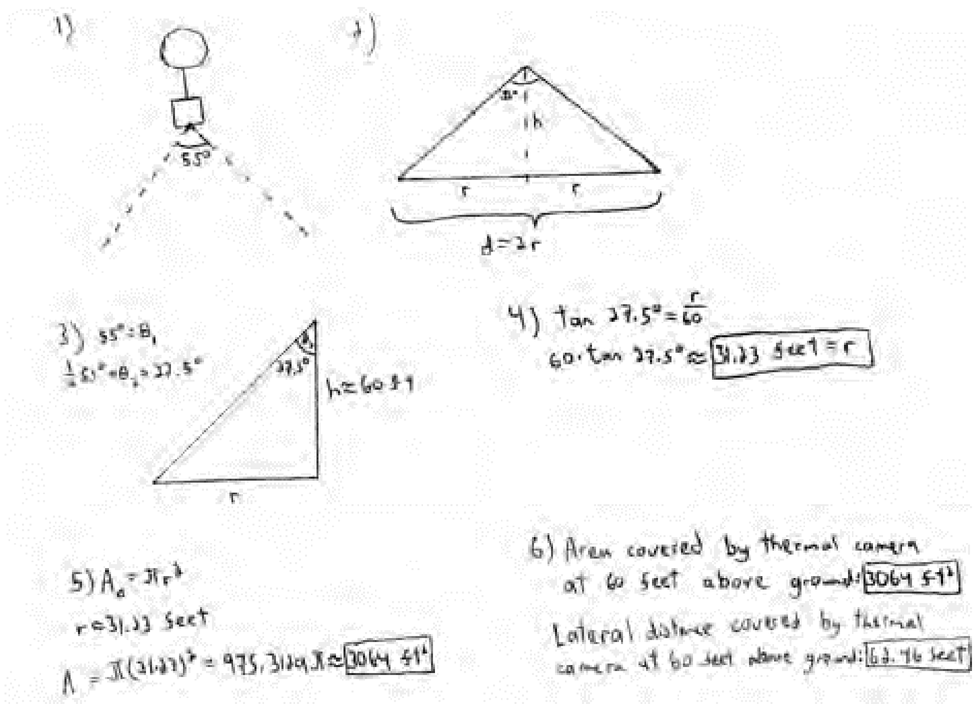

Figure 6: Field of view (FOV) calculations

Figure 7: Thermal readings (https://bit.ly/3umcrvN) from a FLIR sensor are shown in bright yellow. Image taken in Ventura with a Parrot ANAFI Thermal UAV as proof of concept.

To secure our components to our payload, we used a combination of zip ties and VELCRO® tape. VELCRO tape was used to secure our largest component, which was the solar power bank, as the zip ties were unable to support its bulky size. However, we opted for zip ties to secure our Arduino (*Figure 8*), GPS module (*Figure 9*), and thermal camera. By crisscrossing the zip ties, we were able to secure these smaller parts and prevent them from breaking off. The removal of the XinaBox kit resulted in a challenge when it came to balancing the weight of the CubeSat payload; however, doing so was necessary to ensure our thermal camera at the bottom of the payload would get a clean shot of the area below it. We secured the GPS module and Arduino Carrier Board on opposite sides of the CubeSat, and the rest of the components were either secured on the top or bottom as identified in our original subsystem sketch (*Figure 10*). We tested the balance of the payload by holding the balloon attached to it close to the ground, and we found that it was able to stay perpendicular to the ground.

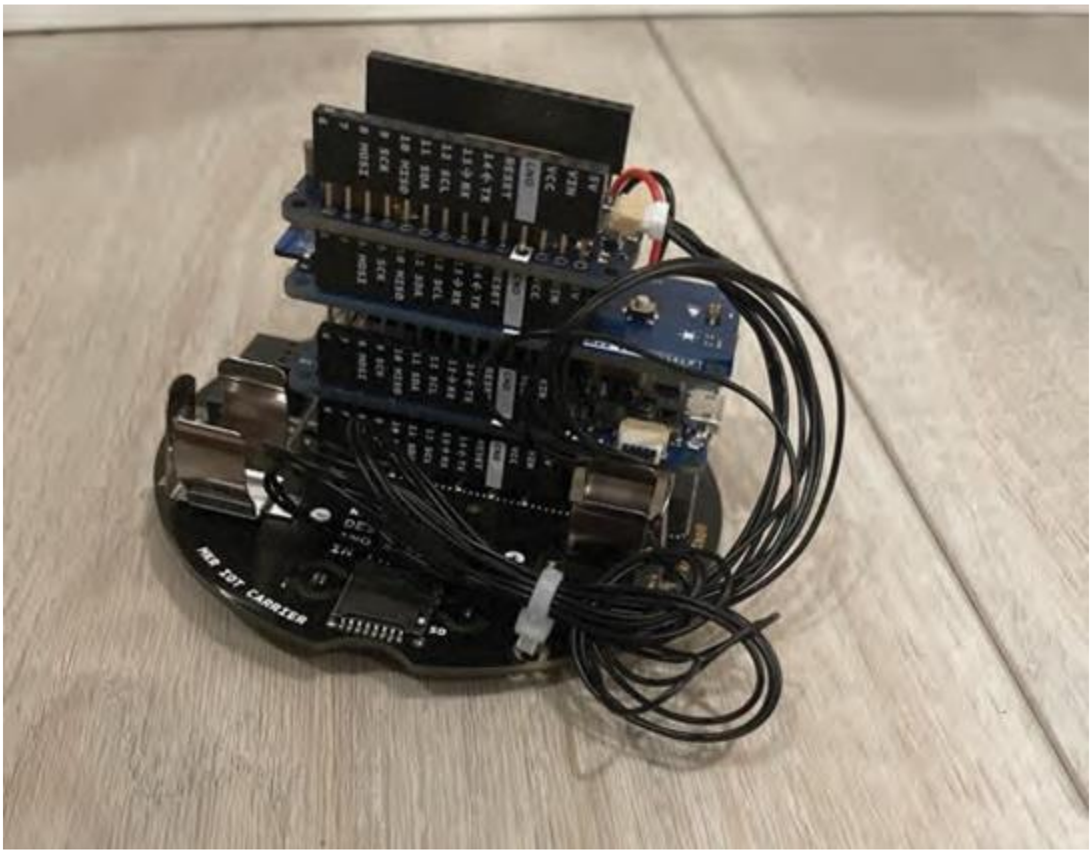

Figure 8: Arduino MKR Board, including an ambient tempera- ture sensor and an MKR WIFI 1010 Board

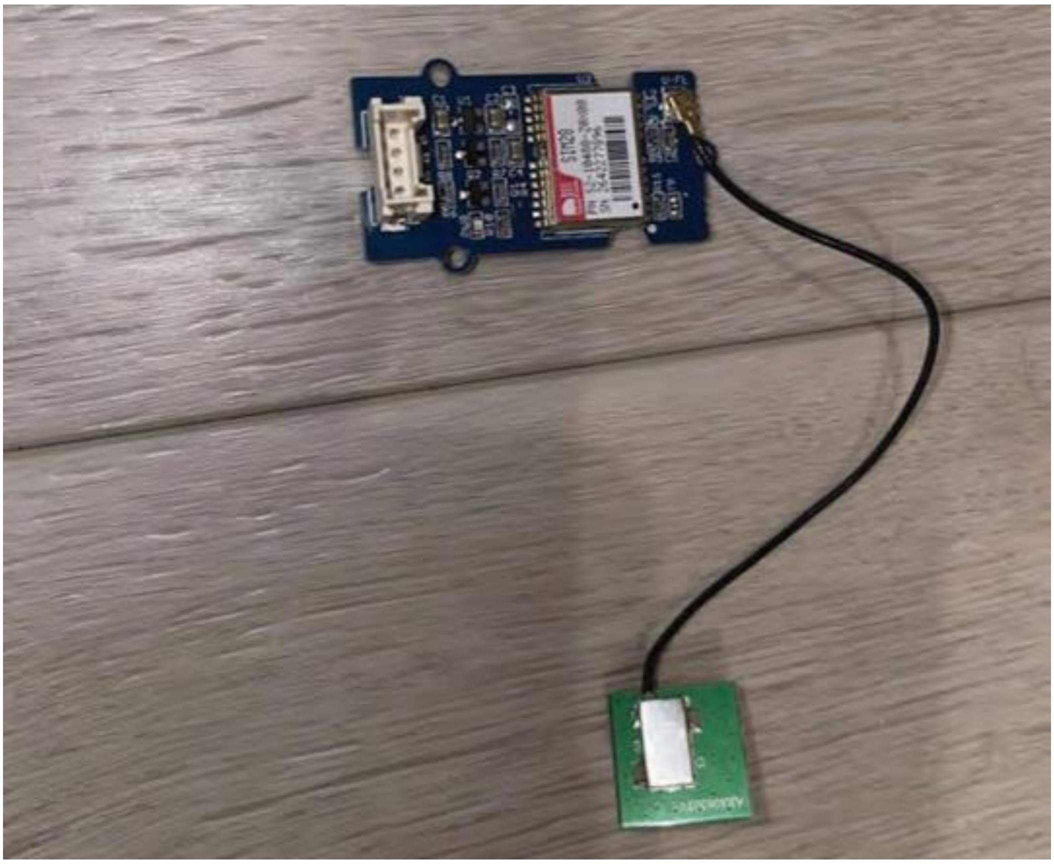

Figure 9: Grove GPS module

Figure 10. Final CubeSat model and mounting system

For communication and data storage, we used a twofold approach in case of equipment failure. Our primary method of communication was BLE, which is a low-energy variation of Bluetooth capable of communication up to 300 feet away with line of sight. However, due to the unreliability of such wireless communication methods, we also included an SD card on an Arduino LAN Board that would store any data recorded before it attempted to communicate with our ground station. Our data was stored in the form of a CSV file to allow the creation of a story map on ArcGIS. The data points were recorded in four columns: latitude, longitude, elevation, and thermal reading. All four of these points were collected by the sensors mentioned above.

For our ground component, we had to find an alternative to the XinaBox ground station to receive data from our satellite. As noted, we opted for BLE as our communication method. To receive this data, we used an application called nRF Connect that is available on Android and iOS devices. This allowed us to connect to the MKR WIFI 1010 Board (*Figure 8*) remotely and provided an output console log that reported the four elements described in the communication and data storage section.

Figure 11: Photo showing a homeless encampment in natural color to prove the accuracy of the IR sensor

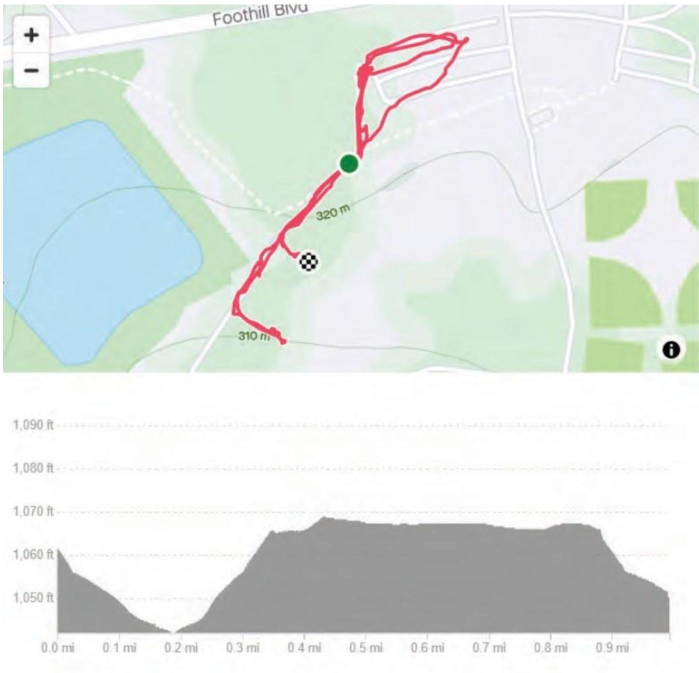

Figure 12: Location and elevation (https://bit.ly/3GsgBF1) of CubeSat Flight 1 from Strava app

Figure 13: Map of Flight Path and Elevation of the CubeSat (https://bit.ly/3nAXqkS) during Flight 2, with the darker the color, the higher the elevation. The elevation changed due to a wildfire and the need to lower the balloon to keep it away from Fire Department helicopters.

Figure 14: Overview (https://bit.ly/3bkRp6h) of second flight over Hansen Dam

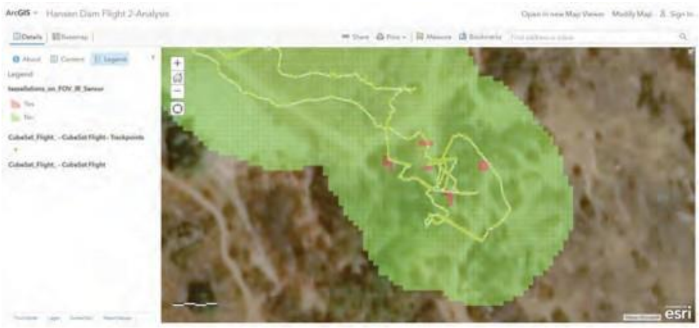

Figure 15: Second flight over Hansen Dam zoomed to the tes- sellations on FOV IR sensor (https://bit.ly/3vYgpJN) positive readings

Figure 16: Our final flight

After obtaining the results from our flights, we utilized ArcGIS Online to analyze our results. We began by adding the GPX file from the Strava app that had the location coordinates and elevation data. We buffered the flight path to 60 feet on either side of the CubeSat and used that as an FOV boundary. Then we created a tessellation analysis of 5x5 bins and set it to the boundary of 60 feet. The visibility range of the map was set to show IR data when zoomed in to the “Buildings” level. The 5x5 bins that were marked red indicated thermal readings that were 15% or higher than the total ambient temperature of the area, and represented possible homeless encampments. The total ambient temperature of the area was determined by our Arduino’s infrared sensor. The elevation data was used to create a 3D ArcScene that displayed the elevation change during the CubeSat’s flight and aided in determining the view distance of the thermal camera.

RESULTS

Our team was able to conduct one flight with a Parrot UAV equipped with a FLIR infrared sensor over a dry riverbed in Ventura. The readings of the FLIR sensor (**https://bit.ly/3BfRJxy**) are shown in bright yellow (*Figure 7*). Our initial exploration proved that an IR sensor was capable of identifying homeless camps in heavy brush. Two subsequent flights with our CubeSat using the Arduino IR sensor were conducted in the Hansen Dam area to identify the locations of homeless encampments. We created an overview (**https://bit.ly/2Y1tvJY**) of the second flight over Hansen Dam where trackpoints are shown in yellow (*Figure 14*). Using an MLX90640 thermal camera, we were able to find the coordinates of homeless encampments in a high-fire-risk area. Pixel readings that were 15% higher than ambient temperatures were recorded and designated as positive for the presence of home- less camps (*Figure 15*). Symbology of the data was classified with ambient readings as light green, and thermal readings over 15% ambient as light red. We identified five camps within a 13,300-square-foot area. We ground-truthed our data with visual confirmation (*Figure 11*). We created a Strava Walk activity map to display the locations and elevations of the CubeSat flights (*Figure 12*). A Map of Flight Path and Elevation (**https://bit.ly/3nE5XU5**) of the CubeSat during the second flight is shown in *Figure 13*, with the darker the color, the higher the elevation. We used an ArcGIS story map (**https://bit.ly/3EzzDc5**) to communicate our results with the City of Los Angeles Fire Department.

DISCUSSION/CONCLUSION

Our CubeSat design process involved a series of failures that culminated in a success; without these roadblocks, we would not have had such a successful flight (*Figure 16*).

Problems first began to rear their head as soon as we attempted to upload firmware to our XinaBox Flight Stations, as neither of our students responsible was able to get the program running. After postponing working on our subsystems for two weeks in hopes of a software update, we ended up opting to move all of the functionality our XinaBox was responsible for to our Arduino. This also signified our first success, as we were able to put together a configuration for our Arduino that included all of the necessary components for a flight station: wireless connectivity and communication, sensors, thermal cameras, power, and onboard storage.

However, as we dipped our feet in the waters of success, a wave of new challenges rose to meet us. We had many problems with developing code on the Arduino. Our first and most persistent issue was our Arduino failing to connect to a COM port on Windows devices. Thankfully, our student software developer was able to borrow a laptop running macOS to be able to upload his code.

Once our code was successfully uploaded to our Arduino board, all that remained was to ensure our hardware was able to function properly. This is where we faced the majority of the roadblocks in our project. Our team attempted to use four different thermal cameras before finding one that gave us readings accurate enough at a long distance, with some being poorly calibrated and others lacking the resolution to take accurate thermal measurements. However, our fifth attempt, with the MLX90640 camera, proved to be successful. Another component that gave us grief was the GPS module. Because we were surveying a heavily wooded area in L.A. County, we had problems getting our original GPS to connect before launching through the trees. We decided to swap out our MKR GPS Shield for a Grove GPS module, which is specifically designed to pick up a weak signal in areas with high-rise buildings that would obstruct it. Although our project was not its intended use case, it ended up working and we got a GPS signal despite the dense vegetation. However, any time a hardware component was changed, it required the software to be changed. This ended up becoming a major time sink, but we managed to get a working final prototype in time for flight week.

Upon our flight, we were faced with both a failure and a success. After allowing our balloon to gain some altitude, we found that our BLE connection was extremely unstable. We were very rarely able to receive any data at our ground station. However, this also proved the success of our onboard storage system. Despite the failure to record data during the flight, after the flight we were able to recover all flight data from our SD card as a CSV file. This proved the success of our redundant data recording system.

Another interesting event during our second flight was the outbreak of a wildfire. Our ArcScene map (*Figure 13*), showing elevation, had a sudden drop in elevation near the homeless camps. The reason was that a fire broke out, and helicopters flew in overhead to reach the scene quickly. The balloon needed to be lowered to avoid interfering with them, despite it restricting our data range.

Our biggest achievement over the course of this project was our adaptability. Our team ran into problems at about every step of the development process, but we were able to overcome them by being flexible and dividing work among team members. While our student software developer worked on rewriting code for a new component, our design team worked on a way to integrate it into our CubeSat frame. By the end of the project, our CubeSat only contained the original Arduino baseboard from the first prototype, and it ended up working better than we had expected from our original subsystems sketch.

Another major success of our project was the implementation of redundant systems. As discussed previously, by using two methods to record data we were able to ensure that we had all of our measurements by the end of the flight. Even though our wireless communication between the flight and ground stations failed, our onboard storage system was a success.

Another example of a successful redundant system was the power. While the onboard battery was sufficient according to the specifications provided by Arduino, after our flight we found that it had been depleted and the board had fallen back to our power bank for energy. Without having this backup battery system, our Arduino would have died halfway through the flight and failed to record or communicate any data.

One thing we would do differently given the chance to do this project again would be not waiting for a XinaBox software update. If we had begun moving our functionality to the Arduino instantly instead of waiting for two weeks, we would have had much more flexibility in our scheduling before flight week. In a best-case scenario, we might have been able to create two prototypes, one with Arduino for subsystems and one with XinaBox. However, this proved not to be a major roadblock, as our Arduino prototype was functional.

Another mistake our team made was testing components one at a time. A more prudent approach would have been to buy a batch of components for each function: multiple thermal cameras, computing boards, GPS modules, and wireless communication modules. This would have eliminated the time we had to wait between trying and returning parts, as this involved a minimum two-day wait from Amazon. This alteration to our procedure would have given us more time to polish our prototype before our first flight.

The biggest success and differentiating factor in our project was the integration of our data into a story map (**https://bit.ly/2XRpGHb**). This representation of our data is much more interactive than a table with coordinates, and it combines our knowledge from activities throughout the year in class with what we learned from completing the project.

The biggest lesson we learned from this experience is the importance of having redundancy in your systems, along with having a backup plan. In both cases where redundancy was implemented in our final CubeSat prototype, it ended up being necessary and saving our flight. We also would not have been able to overcome many of the challenges discussed earlier in this report if we had not prepared alternative approaches for certain components. Conducting this project without these precautions would have resulted in a comprehensive failure.

Our project ended up being a success due to the iterative approach we used, and this method is not something we would change if we were to participate in this competition again. It gave us the chance to refine our subsystems and payload design while also learning more about troubleshooting hardware and software.

We were able to contact Captain Steve Marotta from the City of Los Angeles Fire Department and share our CTE Mission: CubeSat story map with him. He provided us with his thoughts and suggestions regarding the project. Marotta agreed that homeless camps are especially dangerous in the creation and spread of wildfires in the L.A. area. He also agreed that mapping the Hansen Dam Recreation Area was a good idea due to the high amount of vegetation and homeless people who reside there. He added that “this type of intelligence will help us to focus rescue and evacuation of homeless people during vegetation fires. The other benefit is that it will help us to locate patients during EMS incidents.” Marotta suggested that we share our data with the Police Department to help them locate suspects more efficiently.

Our research question was: Can an aerial infrared sensor be used to document homeless encampments in wildfire-prone areas? After analyzing our data we came to the conclusion that it is possible to document homeless camps using an IR sensor. Our hypothesis — an infrared sensor in our CubeSat would be able to identify homeless encampments — was accepted.

ACKNOWLEDGMENTS

First, we would like to thank the U.S. Department of Education for giving us the opportunity to create this project. We also would like to recognize the help from Luminary Labs, which managed the CTE Mission: CubeSat. Thank you to Captain Steve Marotta from the City of Los Angeles Fire Department for taking the time to communicate with us and provide his thoughts on the CubeSat project. Thank you to Kyle and Larry Fuller, who helped with thermal imaging of the Willoughby Preserve in Ventura with their Parrot ANAFI drone and shared their data with us. Special acknowledgements to the parents who helped. Special thanks to Lauris Bye for help with the helium, teacher David Black for equipment, and Dino's Party Supply for not charging us for extra time with the helium cylinder. Thank you to everyone who stood by us while we worked on this tough, yet rewarding project.

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6961 Simple yet important

Is a Seed Floating Test a Good Indication of Seed Viability?

Annabelle Bilbray, Payton Bilbray, Emily Coplan, Naomii Donovan, Landen Gutierrez, Jameson Hernandez, Angelica Pacheco Leora, Dustin Minnicks, Eli Zaccardo, Emma Zaccardo, Shayden Monroe (staff), Sarah Pryor (staff), and T. Miller (teacher, retired)

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The purpose of the experiment was to see if a floating water test is a good way to determine if a seed will germinate. The hypothesis was that the test would be a good one for nastur- tium seed viability. We believed the seeds that sank would be denser, and so more of them would germinate. Nasturtium seeds were dropped into a container with water and soaked for 15 minutes. After this time, the seeds were separated into those that floated and those that sank. Two large plastic con- tainers with holes in the bottom were filled with potting soil. Fifty seeds that floated were planted in one container and 50 seeds that sank were planted in the other container. The seeds were watered every day. At the end of two weeks, 33 seeds (66%) that floated germinated, and 28 seeds (56%) that sank germinated. The hypothesis seemed incorrect because more seeds that floated germinated.

6962

Leachate-Filtering Efficacy of Varied Liners

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To prevent the leaching of contaminated water (leachate) into the surrounding environment, current landfills utilize a system of liners that often contain bentonite powder, a material intended to filter acidic leachate and release clean water. This research aimed to test different powders' neutralizing abilities to find a better alternative to the currently used bentonite. It was hypothesized that if the basic powders kaolin (KL), diatomaceous earth (DE), and activated charcoal (AC) were used to filter acidic leachates, then the most basic powder would shift the pH closer to neutral than bentonite. This was tested through gravitational filtration by placing each clay into holed cups and running them through with lemon juice (pH of 4.8) or vinegar (pH of 4.5). The filtered samples were collected and the average pH changes for each powder were recorded. As shown from the means, DE and AC displayed higher pH increases than bentonite, while KL clay failed to filter any leachate. The data were analyzed by conducting one-tailed (directional) t-tests. The final comparisons of DE (avg. pH=6.57, SD=0.11, n=5, p=0.023) and AC (avg. pH=6.54, SD=0.15, n=5, p=0.068) with bentonite (avg. pH=6.45, SD=0.3, n=5) revealed that DE had the highest pH increase. The t-test results gave sufficient evidence (p=0.023) to conclude that DE powder is a better filtering alternative to bentonite. Future research will investigate other factors that contribute to the finest landfill powder. (Editor's Note: For the work summarized in this abstract, Marta was selected as a finalist in the Earth and Environmental Sciences category at the Virtual Regeneron International Science and Engineering Fair 2021. See more project details at https://bit.ly/3hlA1RB. Congratulations Marta and great work!)

3. Conclusions

This paper presents a look at a Presidential Award at the high school level and college level, with motivation being instrumental in achieving this honor. The high school research is as good or better than some university level work and should be considered as an important contribution to the U.S. research effort. We present a how-to-do-it look at the factors that have resulted in Presidential Awards and feel that many other individuals can benefit from this exploration if they are interested in doing so. Steve's and Dominique's programs are very different, yet similar, as can be seen. Student success in quality research is seen in both. Motivation is a key for success. As John Kennedy once said, we don't do what is easy. We do what is hard. You can do it, if you want to. It can be fun rather than work. That's the attitude of Steve and Dominique and many of the others who mentor student research. Terri Miller, for example, loves it so much that she still mentors student research in retirement at boys and girls clubs.

Acknowledgements

Thanks to Carolyn Oppenheimer for a massive amount of formatting time and CSUN leadership for over 50 years of support.

Notes

Note 1. Evans-Bye, D., Berman, M., Chun H., Lundgren, A., Oppenheimer, S. NSF Presidential Award Webinar, Frontiers in Education Technology, vol 5 #1, 2022.

Note 2. **Oppenheimer, S., Ed., New Journal of Student Research Abstracts, Volumes 1-27. http://scholarworks.csun.edu/handle/10211.3/125029**

This collection contains volumes I - XXVII of *The New Journal of Student Research Abstracts*. 27 volumes (1995-2022). Published in conjunction with CSUN and several publishing partners, and edited by CSUN biology faculty member Steven Oppenheimer, the journal contains abstracts of K-12 student science experiments and some full length papers.

Note 3. Volume I (1995)

Note 4. Volume II (1996)

Note 5. Volume III (1997)

Note 6.Volume IV (1998)

Note 7.Volume V (2000)

Note 8. Volume VI (2001)

Note 9. Volume VII (2002)

Note 10. Volume VIII (2003)

Note 11. Volume IX (2004)

Note 12. Volume X (2005)

Note 13. Volume XI (2006)

Note 14. Volume XII (2007)

Note 15. Volume XIII (2008)

Note 16. Volume XIV (2009)

Note 17. Volume XV (2010)

Note 18. Volume XVI (2011)

Note 19. Volume XVII (2012)

Note 20. Volume XVIII (2013)

Note 21. Volume XIX (2014)

Note 22. Volume XX (2015)

Note 23. Volume XXI (2016)

Note 24. Volume XXII (2017)

Note 25. Volume XXIII (2018)

Note 26. Volume XXIV (2019)

Note 27. Volume XXV (2020)

Note 28.Volume XXVI (2021)

Note 29. Volume XXVII (2022)

Note 30. Oppenheimer, S.B., Motivating College Students: Evidence from 20 Years of Anonymous Student Evaluations, Higher Education Research 4 (#2), pp. 42-45 (2019).