



THE
**NEW JOURNAL OF
STUDENT RESEARCH
ABSTRACTS**

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CSUN

CALIFORNIA
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NORTHRIDGE



Marking 25 Years of Student Science Research!

The New Journal of Student Research Abstracts **2020 / Volume XXV**
An Annual Journal for Young Investigators and Their Teachers

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ON THE COVER

Top and center photos: **Dominique Evans-Bye** (far right in White House group photo), a CSUN alumna and teacher of outstanding journal student authors, has received the prestigious Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring — the highest U.S. government honor for mentors who work to expand science, technology, engineering, and mathematics (STEM) talent. *White House Photo Credit: Andrés Harris*

Bottom photo: CSUN alumna **Mina Alikani** has provided a significant donation for this journal that leaves no child behind. She is a renowned clinical embryologist, an in vitro fertilization laboratory director, and a mentee of Dr. Oppenheimer's master's degree programs.

Staff

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Director, Center for Cancer and Developmental Biology and
Trustees Outstanding Professor, the CSU System,
California State University, Northridge

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Recognition of Some of the Scientist Mentors

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We are pleased to welcome you to the 2020 edition of the *Journal of Student Research Abstracts*. First produced and edited in 1995 by Dr. Steven Oppenheimer, Professor of Biology at California State University, Northridge, this edition marks the 25th anniversary of the *Journal*, which showcases the work of young scientists in grades K-12 who have conducted their research under the guidance and support of their teachers.

This journal and the associated poster symposium recognize the research and scholarly work of the participating students and their teachers. Everyone wins when the pursuit of knowledge is undertaken with the spirit of discovery. The excitement of conducting hands-on research and publishing their findings in the *Journal* provides students with the kind of experience, confidence, and pride that are essential to encouraging them to pursue a career in science and research. Such pre-college experiences encourage students to pursue the sciences in college, creating a pipeline for future innovative scientists.

The importance of such experiences is underscored by several noteworthy milestones we celebrate on this 25th anniversary. This past spring, the university received a generous gift to support the continued publication of the *Journal* from Mina Alikani '83, M.Sc. '85 (Biology), a clinical embryologist, laboratory director and consultant. A CSUN alumna, Ms. Alikani bestowed the gift in appreciation of the teaching and mentorship Dr. Oppenheimer provided to her as a student.

We also congratulate Clark Magnet High School teacher Dominique Evans-Bye, another CSUN alumna, for being honored in 2019 with a Presidential Award for Excellence in Science, Mathematics and Engineering. Many of her students' research are featured in this issue, reflecting the strong mentorship and encouragement she gives to students in pursuing the sciences, which earned her this high recognition, one of the few high school teachers to have been so honored. She, too, credits the opportunities provided by CSUN and her teachers for giving her the confidence and drive to pursue knowledge, discovery and teaching.

In addition, recognizing the important work of this program in encouraging young people to pursue careers in the sciences, the National Science Teaching Association featured the journal in its October 2019 issue of *NSTA Reports*.

We are proud to support the work of Dr. Oppenheimer, the teachers and students whose outstanding work is included in the journal.



Dianne F. Harrison
Dianne F. Harrison, Ph.D.
President

Mary Beth Walker
Mary Beth Walker, Ph.D.
Provost and Vice President
for Academic Affairs

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Jerry Stinner, Ph.D.
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California State University, Northridge

Honoring a Great Mentor and Donor

JULIE GORCHYNSKI, M.D.
Professor

IN HER WORDS

As Professor and Research Director in emergency medicine, my interest in research and education began during my graduate studies at California State University, Northridge (CSUN), in biology as a master's student under the supervision of Steven B. Oppenheimer, Ph.D.

I received two bachelor's degrees at CSUN, in public health and biology. During the master's program I taught CSUN biology laboratory courses to undergraduate students. My mentoring of students began during this time and continued through my medical training. After obtaining a master's degree in 1987, I went to medical school at Creighton University School of Medicine in Omaha, Nebraska. I returned to California in 1991, where I completed my specialty residency training in emergency medicine at Loma Linda University Medical Center in 1994.

As an academic faculty for the past 20+ years, I have mentored hundreds of high school, undergraduate premedical, and preprofessional health students, medical students, and residents. Since 2011, selected graduate students in the master's program in the Center for Cancer and Developmental Biology at CSUN receive a Julie Gorchynski, M.D., MSc Research Scholarship Award for research supplies to advance graduate student research. Most recipients are now in post-graduate Ph.D., M.D., dental, and law programs.



I also have been involved in clinical emergency medicine, research, and education since 1991 in California at Loma Linda University Medical Center and at the University of California, Irvine, Medical Center, as well as in Texas at Texas A&M and the San Antonio UT Health Science Centers. I have been an invited speaker for local, state, national, and international emergency medicine conferences, where I had also been selected to present my research. I have numerous publications in medical journals for my clinical research in emergency medicine. One of my numerous awards in research includes a Certificate of Recognition from the National Science Foundation and Research Director Program awarded to me by Dr. Oppenheimer, NSF/U.S. Presidential Award recipient, Director for Cancer and Developmental Biology. This certificate was signed by Dr. Oppenheimer and by the late Francis H.C. Crick, Nobel Laureate, Honorary Project Chair.

Many of the students I have mentored in the past 20 years have entered into professional postgraduate training in medical, dental, veterinary, pharmacy, nursing, physical therapy, law, and Ph.D. programs.

It has been said that "as a teacher, it isn't someone who teaches something, but someone who inspires the student to give of their best in order to discover what they already know."

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ABOUT THE EDITOR

Steven B. Oppenheimer, Professor Emeritus of Biology, received his Ph.D. degree from Johns Hopkins University and is currently Director of the Center for Cancer and Developmental Biology at California State University, Northridge. He is author or co-author, mostly with his Cal State students, of more than 300 published papers, abstracts, letters, books, and national presentations; was awarded over \$7 million in research and science education grants serving as Principal Investigator; and served on National Institutes of Health and National Science Foundation grant review panels.

In addition, he serves on the editorial board and is editor for the United States, Canada, and South America of the more than 60-year-old international journal *ACTA Histochemica*, published by Elsevier. He is recipient of 26 distinguished teaching awards, distinguished research awards, outstanding professor awards, and other honors from local, statewide, and national organizations. In 1984, he was named statewide Trustees Outstanding Professor of the California State University system (the system's highest honor), and in 1992 he was elected Fellow of the American Association for the Advancement of Science (AAAS). The AAAS defines a Fellow as "a member whose efforts on behalf of the advancement of science or its applications are scientifically or socially distinguished." He is a recipient of a U.S. Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring.



Dr. Oppenheimer thanks the following organizations for funding his student-involved research programs: National Institutes of Health, National Institute of General Medical Sciences SCORE, RISE, and MARC programs, the Joseph Drown Foundation, the Sidney Stern Memorial Trust, the National Science Foundation, and California Science Project.

The editor also wishes to thank Van Nuys Airport for its past support of the journal, helping give wings to students' educational dreams!

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Editor's program websites:

www.csun.edu/biology/faculty/oppenheimer.htm

www.youtube.com/watch?v=JQCd5NIFVoQ

www.youtube.com/watch?v=KmlN6DHW3nQ

ABOUT THE ASSOCIATE EDITORS

Helen H. Chun received her Ph.D. and was a postdoctoral researcher at the University of California, Los Angeles. She currently is an Associate Professor in the Biology Department at California State University, Dominguez Hills. Her research interest is in the cellular response to radiation exposure, particularly in the stimulation of DNA repair and cell death. In addition to her work with Dr. Oppenheimer and *The New Journal of Student Research Abstracts*, Dr. Chun also is involved in various collaborations with the College of Education (CSU Dominguez Hills) to enhance STEM instruction in K-12 and undergraduate education.

Mindy Berman, owner of Mindy F. Berman Communications, has more than 30 years of experience in public relations and marketing communications. She has coordinated numerous successful communications and educational programs, and — bringing organizations the "write stuff" — also has written and edited all types of materials. This work includes authoring a book titled *Celebrate Pasadena's Vision: 100 Years of Community-Owned Power*, and editing *The New Journal of Student Research Abstracts* since 2006. She earned her bachelor's degree in journalism from CSUN and her MBA from Pepperdine University, and previously taught public relations and writing courses at UCLA Extension, CSUN, and Woodbury University. www.mfbcommunications.com

ABOUT THE DESIGNER

Alvalyn Lundgren has designed and art directed *The New Journal of Student Research Abstracts* since 2006. As the founder of Alvalyn Creative, a strategic design and branding consultancy, she assists businesses and organizations in building their influence platforms through brand strategy. Among her design awards are two for *The New Journal of Student Research Abstracts*. She was an undergrad at CSUN and completed her degree at Art Center College of Design in Pasadena, CA. In addition to her design practice, she teaches at Art Center College of Design, Otis College of Art and Design, and UCLA Extension. www.alvalyncreative.com

ABOUT THE ACQUISITIONS EDITOR

The journal's Acquisitions Editor, **Terri Miller**, retired in 2016 after teaching middle school in the Los Angeles Unified School District for nearly three decades. She consistently involved her students in hands-on research that was published in this journal and presented at poster symposia, and now is very pleased to continue promoting science education by recruiting additional teachers to contribute student abstracts. Among her many accomplishments over the years, Terri received the Julie Gorchynski, M.D., Center for Cancer and Developmental Biology K-12 Teacher Research Award for the journal for 2014-15. In addition, several of her students earned first place in the 2013 U.S.-China Space Science Education Project, a pioneering international program.

ABOUT THE SPONSOR

California State University, Northridge, has been ranked by the National Science Foundation in the Top 15 (sometimes No. 1) of over 500 similar universities in numbers of its science and social science graduates who go on to achieve doctoral degrees.

CSUN Science was ranked No. 1 in North America in the largest percentage increase in publications in high-impact journals 2012-2015 by Nature Index:
www.csun.edu/science-mathematics

ABOUT THE JOURNAL AND ABSTRACTS

The New Journal of Student Research Abstracts is published yearly in the fall. Continued publication is always dependent on funding. The journal is intended to serve as:

- 1] a vehicle to honor young investigators and their teachers by showcasing their work, motivating them to continue their involvement in research science;
- 2] a sourcebook for both students and teachers who are looking for ideas for research projects; and
- 3] a volume to disseminate student research discoveries.

Many abstracts included in the journal demonstrate good science, i.e., clear introductions describing a hypothesis to be tested, appropriate methods and data analysis, results and conclusion statements, and – most important – sufficient numbers of appropriate control and experimental samples and repetitions of experiments. Some are idea abstracts, and some are abstracts of library or Internet research projects.

Abstracts are reviewed by the teachers and the journal editors, and may be edited for clarification or grammar corrections. Although the journal editors delete very poor abstracts from the publication, some abstracts herein are quite flawed, and some lack at least one component of a good science experiment. Including some of these abstracts helps make this journal very useful for classes to learn what makes for a good experiment and a good abstract versus a not-so-good experiment and a not-so-good abstract.

Some of the abstracts are experimental plans instead of completed projects. This is especially true in the case of long-term, sophisticated research programs that require extensive setup and planning. The journal encourages abstracts on the planning and progress of such projects.

The journal editor continues to reserve the right not to publish those abstracts that are seriously flawed. The journal does not notify authors if their abstracts have been deleted. **Please note that any abstract that involves harming vertebrate animals (including humans) will not be published in this journal. In addition, students and teachers must ensure that experiments are conducted using necessary safety measures as appropriate.**

Any opinions, findings, and conclusions or recommendations are those of the individual authors of the abstracts presented in the journal, and do not necessarily reflect the views of California State University, Northridge, other contributing organizations and individuals, or the journal staff.

SUBMISSION OF ABSTRACTS

Any science teacher may submit student abstracts following the format used with the abstracts in this volume. After the title, followed by student-author name(s) and teacher name (teacher), school and school street address, city, state, and ZIP Code, abstracts should begin with the purpose of the study, followed by how it was done, and then the results and conclusions.

All abstracts should be typed in **11-point Arial font**, error-free. Messy abstracts and those not following proper format may be discarded. The journal is not responsible for any abstracts received or for publication errors. The journal does not acknowledge receipt of abstracts and there is no guarantee that they will be published or that the journal will be published in any given year.

Only teachers may submit their students' abstracts to the journal. Teachers must submit each abstract as a **Word document to steven.oppenheimer@csun.edu**. Abstracts not submitted electronically or not following the other guidelines provided herein may be discarded without notice.

The deadline for receipt of abstracts for each annual volume is June 1, but an issue may be closed at an earlier date. Publication is scheduled for each fall. Submitted abstracts are not returned to authors, so students and teachers are advised to keep a copy of all submitted materials. The only confirmation that abstracts will be published is if they appear in print.



FROM THE EDITOR

A Golden Opportunity for Underrepresented Science Students Interested in Careers in Biomedical Research

To those underrepresented science students who select California State University, Northridge (CSUN), for your college experience: We have a golden opportunity for you. If you are a U.S. citizen or permanent resident and if you are possibly interested in a Ph.D. degree in biomedical science, you can apply for distinguished programs funded by the National Institutes of Health (Maria Elena Zavala, Director). These programs will open many doors and will pay you thousands of dollars to do research while a student at CSUN. We thank the National Institutes of Health, National Institute of General Medical Sciences MORE program for distinguished support for these student opportunities. *(Note that programs are dependent on yearly funding.)*

For more information, contact Steven Oppenheimer at steven.oppenheimer@csun.edu.

CONGRATULATIONS TO A PRESIDENTIAL AWARD WINNER!

In 2019, CSUN alumna Dominique Evans-Bye, whose students regularly submit outstanding abstracts to The New Journal of Student Research Abstracts, received the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM) – the highest U.S. government honor for mentors who work to expand science, technology, engineering, and mathematics (STEM) talent.

The National Science Foundation (which administers the Excellence Awards in Science and Engineering, including PAESMEM) selected Dominique from among thousands of Presidential Award recipients to share insights into supporting student research as part of an August webinar for program alumni. Dominique chose Dr. Steven Oppenheimer, CSUN Professor Emeritus of Biology and journal Editor-in-Chief, as a co-presenter based on his contributions to her success.

Dominique currently teaches “Byeology,” AP Environmental Science, and Geographic Information Science classes at Anderson W. Clark Magnet High School (in the Glendale Unified School District). Her innovation and dedication continue to empower and enrich her students.

We congratulate Dominique on the prestigious Presidential Award honor, and thank her for her unwavering commitment to science education!

IN HER WORDS

I consider myself a decent teacher most days, but I’m at my best when mentoring my students. Rather than using teacher-directed learning, I integrate as much project-based learning as possible into my classes. The most enjoyable and rewarding part of teaching for me is to facilitate student research projects. I teach students the foundations of science, basic project management, and collaboration and networking skills, and then turn them loose to be creative in their own investigations. I guide students, but allow them to make mistakes. When students can identify their shortcomings and implement their own solutions to the problem, the real learning takes place. I like to feel confident that my students can take charge of their own learning outside of my class – something that goes beyond Google and Wikipedia.

Credit to CSUN

In 2019 I was awarded the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM). Achieving an honor of that level was quite a journey. I credit my time at CSUN, both as an undergrad biology major and during my graduate degree studies in geography, for preparing me to meet the challenges I have faced throughout my career. I created my research class by age appropriately modeling Dr. Larry Allen’s graduate program. As a new teacher, I benefited greatly from Dr. Oppenheimer’s Research Director Fellow Program. Through Dr. Oppenheimer’s grant, I was able to charter the research vessel *Yellowfin* for my own class research projects.

When I discovered Geographic Information Science (GIS), my world was opened to the *science of where*. I soon followed in the footsteps of my CSUN mentors and wrote my own grants to fund the equipment, field trips, and professional development



that make my program so unique. I started with a Toyota TAPESTRY large grant for \$10,000, and then received \$30,000 through UCLA’s Teacher-Initiated Inquiry Projects (TIIP).

As I implemented my proposed programs, our success grew exponentially and made more funding available. As part of its philanthropy initiatives, Lexus donated \$20,000 to my program and UCLA gave me another \$30,000 through TIIP. The Society for Science & the Public (SSP) accepted me as a Fellow, and trained me in project management and how to facilitate student research. SSP funded my research program with \$8,000 each year for four years. Since grant writing was such a great experience and a valuable skill set, I decided to involve my students in the process. Target offers field trip grants of up to \$700. Each

year, my students design and fund their own field trips. One year I collaborated with a student to write a State Farm Youth Advisory Board grant for \$100,000.

With more than \$200,000 in funding over an eight-year period, I was able to create a three-course Career Technical Education GIS Pathway that was accepted as meeting University of California "A-G" requirements. I bought specialized equipment that would have been out of my reach without grant funding, and attended professional development workshops of my choice that were extremely useful.

I also attended industry conferences as a speaker, presenting papers, and as a participant, furthering my knowledge in GIS. I learned to bring biotechnology and bioinformatics into the classroom with the DNA barcoding program from the Coastal Marine Biolabs and the Amgen® Biotech Experience. I participated in three summer internships at Caltech, one in theoretical chemistry, one in protein engineering, and one in atmospheric chemistry. In our research projects, I worked side by side with students, collaborating and learning together instead of teaching and directing activities.

Student Successes

I was able to apply all of these project-based learning programs into my teaching, which offered students opportunities and experiences they would otherwise have to wait until graduate school to obtain. Some of my students were finalists in the International Science and Engineering Fair, and many were student speakers at industry and academic conferences.

Years of student success catapulted me into the district limelight, gaining awards and recognition. When I was nominated as Teacher of the Year, I went to the interview at the Los Angeles County Office of Education carrying three editions of *The New Journal of Student Research Abstracts* featuring my students' work, which totally impressed the judges. The journal, along with a scrapbook of our field work, clinched the award and propelled me to a California State Finalist.

Earlier, I had received the Presidential Innovation Award for Environmental Educators and have a letter signed by President Barack Obama. My students have certificates signed by President Obama. They also have the added benefit of translating their unique experiences to college and internship applications. I get the pleasure of writing interesting recommendation letters that help set my students apart when applying to top-tier universities. I have found that students appreciate the opportunities my program offers. They reciprocated the favor by writing letters to nominate me for the PAEMEM program.

I very much appreciate the opportunities provided by Dr. Oppenheimer, CSUN, and our many project partners that have enriched my program and empowered my students and me in our journey to become better researchers. *The New Journal of Student Research Abstracts* has been a great resource that has benefited both my career and my students' science education.

Read on for more information about Dominique in the following story from *CSUN Today*.

TWICE PRESIDENTIAL-HONORED TEACHER AND CSUN ALUMNA FINDS SUCCESS IN BEING DIFFERENT

From *CSUN Today*
April 29, 2020
By Cary Osborne

A reporter doing a story on Clark Magnet High School teacher and CSUN alumna Dominique Evans-Bye asked one of her students to describe her.

The student's reply: "She's ... different."

"It's true," said Evans-Bye '95 (Environmental Biology), M.S. '12 (Geographic Information Systems). "I do things my own way. I make a mess, my equipment is everywhere. I'm in the way, but this is because I put my students first. I don't have a lot of storage room at school. I'm bouncing between three different rooms, teaching four different subjects, so I have to improvise."

Different has worked for the biology and geography teacher, so much so that in the Fall of 2019 she was selected as a recipient of the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring. The honor is one of many in the career of a teacher whose enthusiasm for her work and creative application of knowledge, technology and tools has made her a standout figure in Los Angeles County's educational system.

Evans-Bye didn't initially want to be a teacher. Instead, she said, teaching chose her. And CSUN teachers helped in that choice.

"I give a lot of credit to the opportunities CSUN provided," Evans-Bye said. "I took full advantage of CSUN's programs."

Evans-Bye participated in the California State University International Student Exchange Program at the University of Queensland in Australia and the National Student Exchange Program, where she attended Moss Landings Marine Labs through CSU San Francisco.

Evans-Bye said because she is the curious type she took more classes at CSUN than were required for her to earn her bachelor's degree.

But one class, in particular, she said, was the door-opener to so many things in her life.

"What really changed my life at CSUN was the scuba diving class," she said. "I loved marine biology. I loved the ocean and wanted to scuba dive, but my mom was overprotective and wouldn't allow it. Once I saw the class at CSUN, there was no stopping me. I signed up, made a lot of dive buddies through CSUN, and we dove every chance we got."

The CSUN scuba instructor used past students as TAs for the course. Evans-Bye was recruited to be a TA, but she realized that she needed more training to handle the responsibility. She got all the class TAs together and convinced an associate CSUN scuba instructor to start a rescue/divemaster scuba class for the group. Later, she followed in the footsteps of her mentors and took the LA County Underwater Instructors Certification Course to

become a scuba instructor herself. This led to her also becoming a volunteer public safety diver for the Ventura County Sheriff's Department.



Dominique visits the E/V Nautilus' ROV/Sonar control room, where the first underwater sonar images of the Titanic were identified and seen.

Shortly after earning her bachelor's degree, she began teaching scuba at a sporting goods store and one of her co-workers, who was also the principal in charge of opening the new science and technology magnet high school, encouraged her to make use of her biology degree and teach children. Evans-Bye started by teaching at Roosevelt Middle School in Glendale. She laughs recalling her early days in the profession.

"I was thinking going into it, 'I'm so passionate about biology and about science that these kids have to be interested. With my enthusiasm, they'll love it.' And I was just amazed they could care less what I had to say," she said.

After two years, she moved over to Clark Magnet High School in La Crescenta in 2000 and began to blossom.

What makes Evans-Bye's teaching different, said her new Principal and fellow CSUN alumna Lena Kortoshian, is, she has always been ahead of the time.

In 2013, the state Board of Education adopted Next Generation Science Standards for California public schools, thus giving educators more flexibility to design classroom learning experiences. It also introduced more inquiry-based learning environments where students became more active participants, rather than just textbook learning.

"Dominique has been doing that from day one since she's been a teacher," said Kortoshian '88 (Math – Secondary Teaching), '91 (Credential), M.A. '98 (Educational Administration). "Students learn. They do the inquiry on their own. And then she is a role model for them. They look at Dominique like a mentor."

Evans-Bye developed a three-course GIS program at Clark Magnet, writing curriculum for classes: Geology of Disasters, Honors GIS & Remote Sensing, and Honors Environmental GIS. She introduced project-based learning, allowing her students to choose an environmental issue to investigate and then design a project around. Many of the projects have been entered into and won competitions.

Over the last 13 years, Evans-Bye's teams have earned about \$500,000 in prize money from the Lexus Eco Challenge – a national STEM contest for grades 6-12. Students receive 70 percent of the money, 20 goes to the school and Evans-Bye gets the

remaining 10. She also wrote a grant with a student that earned her school \$100,000.

For her innovative work, passion for her job and ultimately the influence she has had on her students, she has been honored with numerous awards.

Evans-Bye received the California Geographical Society's Distinguished Teaching Award in 2014 and was named Los Angeles County Office of Education Teacher of the Year in 2017. She has also won two extraordinary national honors.

In 2013, she was recognized with the Presidential Innovation Award for Environmental Educators and this past fall she was a recipient of the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring, earning her a trip to The White House.

"She looks for opportunities all the time to make students work hard and harder and prepares them for college and careers, and even life," Kortoshian said. "We're very proud of her."

Recently, her students were given a project based on one of Evans-Bye's real-life experiences.



In her full dive gear, Dominique enters the water from the Ocean Defenders Alliance ship the LegaSea to clear tangled ropes from a sediment sampler.

Last September, the Ventura County Sheriff's Department called on her to help in rescue and recovery efforts after the dive boat Conception burned and sank off the coast of Santa Cruz Island, a tragedy that resulted in 34 deaths. Evans-Bye, who has continued to volunteer for the department since her days at CSUN and has served as its research-and-development officer for nearly a decade, operated a remotely operated vehicle (ROV) aboard a rescue and recovery ship on the day after the tragedy.

Evans-Bye, preparing her students for the potentially critical work that they might have to do in a career, later brought some of the mapping data into the classroom at Clark Magnet. Using a GIS analysis application, the students turned the data into a story map.

The CSUN alumna who didn't want to be a teacher has consistently brought new ideas into the classroom to satisfy her own curiosities, inspire kids and elevate them. She takes a lot of pride in doing things out of the norm. But she takes pride in something greater.

"I do it my own way," she said. "And I'm successful, but more importantly my students are successful."

Thank You to a Distinguished Donor!

BIOLOGY ALUMNA'S GIFT SUPPORTS JOURNAL OF K-12 STUDENT STEM RESEARCH

From *CSUN Today*
 April 28, 2020
 By Perla Colin

Alumna Mina Alikani '83 (Biology), M.Sc. '85 (Biology) has given a \$17,000 donation to help support the publication of CSUN biology professor Steven Oppenheimer's New Journal of Student Research Abstracts, an annual and beloved project in the College of Science and Mathematics.

The publication is celebrating its 25th edition and showcases science, technology, engineering and mathematics (STEM) research discoveries made by local K-12 students, motivating them to continue their involvement in research science.

For over a decade, Los Angeles Unified School District (LAUSD) science teacher Terri Miller assisted her students in publishing their research work in the journal, from 2000–16, earning her recognition as a top contributor.

"The world has been highly involved in trying to rid itself from an insidious, deadly virus," Miller said this month. "We so need our future research scientists and medical professionals. Dr. Oppenheimer has always had the foresight and determination to continue the incorporation of research for students of all ages."

Now retired, Miller continues to help students with their research and even serves as the journal's acquisitions editor, where she advocates for teachers to get involved and recruit their students to participate.

"The United States needs now more than ever for our young people to choose careers in science," Miller said. "Having their science experiments published in the New Journal of Student Research Abstracts and attending a Science Poster Symposium at CSUN encourages students to accomplish this highly important task."

Alikani, a clinical embryologist, laboratory director and consultant in New York, benefited from Oppenheimer's mentorship as a graduate student and while working in his laboratory as a research assistant in developmental biology. It was through her experience in the lab that Alikani forged valuable connections, volunteer opportunities and ultimately a rewarding career in her field of interest – Assisted Reproductive Technology (ART), which includes treatments such as in vitro fertilization (IVF).

"To eventually end up on that path and in the ART field was really quite amazing," Alikani said. "It still is amazing to me when I think back to how I found my way into this field and, of course, being at CSUN and in Dr. Oppenheimer's laboratory in particular, was clearly instrumental."



Oppenheimer's journal and the people who help bring it to life every year, such as faculty and staff in CSUN's Department of Biology and LAUSD teachers, are dedicated to the education of young students and the promotion of STEM fields.

"Mina was one of my great mentees," Oppenheimer said. "I hope that other CSUN mentees will step up to the plate and donate for this journal — a program that rewards all participating students, not just high achievers. This is so important for the security of the United States in helping to inspire new generations of scientists."

Her desire to support the continued success of the journal motivated Alikani to provide funding for a project she considers meaningful and impactful.

"Science teaches us to think critically, to reason and learn through experimentation," Alikani said. "It is important, now more than ever, to have the next generation interested in and committed to science, committed to fact, truth, the scientific process and critical thinking. This is how we ensure our collective future."

A Message From the Editor:**IN A YEAR LIKE NO OTHER, THE FUTURE REMAINS BRIGHT**

During these unprecedented times – with the worst public health crisis in a century and the darkest economic period since the Great Depression – it strikes me that the students published in *The New Journal of Student Research Abstracts* represent the future leaders who will need to address evolving challenges in our increasingly interconnected world.

But, in reading the abstracts, I have no doubt that some of these students will pursue careers in scientific fields, discovering life-changing technologies, curing diseases, and achieving breakthroughs to better our planet and our lives.

As we navigate life during the COVID-19 pandemic, with daily news about work on treatments and a vaccine, we hope

students will see the real-life applications of scientific pursuits, and the opportunities to pursue careers in a variety of research applications.

We thank the teachers who continued to support their students' science work in 2020 in a changing learning landscape, and the young investigators who shared their research projects. We look forward to seeing what your futures bring, and we're excited to read new student abstracts in 2021.

Thank you again. Stay safe and be well.

Steven B. Oppenheimer, Ph.D., Professor Emeritus of Biology
California State University, Northridge

**CSUN STUDENT RESEARCH JOURNAL CELEBRATES 25TH YEAR OF CHANGING YOUNG LIVES**

For a quarter century, *The New Journal of Student Research Abstracts* has been sparking the scientific imagination of K–12 students for the present and future. The students' work wouldn't happen without the commitment of outstanding educators like the following:

Stacy Tanaka, a long-time contributor of her students' abstracts to the journal, now serves as Magnet Coordinator for Northridge Middle School's Medical and Health Careers Magnet, established in 2018. This center received the New & Emerging Magnet School of Distinction Award from Magnet Schools of America, and the Maggie Award for Innovative Partnerships from Los Angeles Unified School District's Integration Services. Stacy was a research student in Dr. Steven Oppenheimer's lab decades ago, and in 2017-18 was honored with the Dr. Julie Gorchynski K–12 Teacher Research Award for her work with students and the journal.

Greg Zem's Ernest Lawrence Gifted/Highly Gifted Magnet received a School of Distinction Award from Magnet Schools of America (MSA) – the third national MSA award for this campus. Greg was one of the first teachers to prominently participate in CSUN's K-12 programs decades ago, including submitting abstracts to the journal, and to this day continues working with CSUN to present nationally reviewed student posters. He is also a recipient of the Dr. Julie Gorchynski K–12 Teacher Research Award.

Watch our video and read more about the excitement the journal generates at <http://bit.ly/1MaPsGF>.

We look forward to the next 25 years and beyond of showcasing the science work of K–12 students and honoring these young investigators and their teachers!

COMMENTARY: Steve Oppenheimer

The Value of Recognizing the Efforts of All Science Students

By Steve Oppenheimer



Steve Oppenheimer

Current education research has shown that precollege science experiences substantially increase the number of students choosing a science major in college. However, science fairs usually select a relatively small number of winners from hundreds of participants, leaving most with little to show for their efforts, which can diminish those students' future interest.

About 35 years ago, I established a research training program for K–12 teachers. After training many teachers in our labs, I developed the *Journal of Student Research Abstracts (JSRA)* to showcase and reward participating students with published abstracts in a free online journal. All students, not just the high achievers, should be

encouraged to do precollege science research, as by the time they reach college, they often have decided on careers. The United States needs more research scientists, so we should encourage many more students, not just high achievers, to fall in love with science.

Teachers across Los Angeles and around the world submit abstracts on behalf of their middle and high school students to *JSRA*. Journal editors and teachers rigorously review abstracts, and students have the opportunity to correct any problems. Although this research is conducted by students, scientific rigor is expected. Abstracts document the use of appropriate controls, sufficient replications, and adequate numbers of samples.

Accepted abstracts are published in the journal, and student authors receive a print copy of the journal containing their published research. (*JSRA* is available online at <http://bit.ly/2kkE0Et>.) One teacher said their students dance with joy upon seeing their work in print.

Working with teachers like Greg Zem, Terri Miller, Stacy Tanaka, and

Aphrodite Antoniou, my colleagues and I also created The Center for Cancer and Developmental Biology Pre-College Research Poster Symposium, which also recognizes hundreds of middle and high school student scientists each year. The posters often are based on the reviewed project abstracts submitted to *JSRA*, and a cadre of advanced senior-level university students trained in research science evaluate them. Students conduct their research at their schools and homes, and present their reviewed research in poster form at the symposium, held at California State University, Northridge (CSUN), where they receive medals and certificates recognizing their efforts. This really inspires them to continue in science.

Former students who contributed to the journal and participated in the symposium have reported that their siblings "fight" to become involved. Students have been admitted to a spectrum of higher learning institutions, including the California State University system, University of California system, Drexel University, Oxford, Pepperdine, Stanford, Harvard, Penn State, and the University of Tokyo.

Thousands of good precollege science experiences exist that can motivate students to choose science careers. Just having a great science teacher can spark students' interest. Our journal and poster symposium recognize thousands of kids for their research work. A reward like a published abstract or a medal and certificate may be the first and often only recognition from a university many of these students receive. Following the most recent symposium, CSUN Vice Provost Matt Cahn noted, "This is one of those transformative

opportunities that we hope all students have."

How often do hundreds of students receive university and parental recognition for science research work? The pride that families take in their children's science work provides an extra push for them to choose a science career.

These programs are replicable by teachers, schools, and school districts if they wish to encourage many more students to contemplate future science careers. I also suggest that science educators consider urging their middle and high school students to submit research abstracts to *JSRA*. ●

Author's note

I would like to thank Andrew Weiss, Elizabeth Altman, Mindy Berman, Alvalyn Lundgren, and Helen Chun for their work on *JSRA*. I have been fortunate to have support from CSUN leadership and staff in launching and running the symposium and the journal. ●

Steve Oppenheimer, professor emeritus, CSUN, has received several awards, including the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring and a CSU System Trustees Outstanding Professor award. He is an American Association for the Advancement of Science Fellow and serves as director of CSUN's Center for Cancer and Developmental Biology. He is editor of *Elsevier's* international journal *Acta Histochemica*, affiliated with the International Federation of Societies for Histochemistry and Cytochemistry. He has taught, conducted research, and worked with middle and high school students and teachers at CSUN for 48 years.

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Are you interested in submitting a Commentary for consideration for *NSTA Reports*? E-mail Lynn Petrinjak at lpetrinjak@nsta.org for more information.

ABSTRACTS

6778

Will a Population of Collembolans Increase If Dawn® Dishwashing Foam Soap Is Placed in Their Environment?

Nathaniel Cruz, Gavin Decker, Justin Decker, Angela Sorensen, and T. Miller (retired teacher)

Laughlin Library

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The purpose of this experiment was to determine if Dawn Dishwashing Foam Soap will harm a population of Collembolans (*Onychiuridae encarpatus*). The hypothesis was that a population of Collembolans would decrease if Dawn Dishwashing Foam Soap was added to their environment. Collembolans are tiny insect-like animals that have a springtail for jumping and feed on mold. For the procedure, one part charcoal was measured and placed in a container. Nine parts plaster of Paris also were measured and placed into the container, and the lid was tightly closed. It was shaken until the ingredients were completely mixed. The mixture was placed in a different plastic container and water was added while the mixture was stirred to make it the consistency of yogurt. The liquid was poured into eight Petri dishes and tapped on the table until it was spread out evenly in each Petri dish. It was allowed to dry for a few days. Half of the Petri dishes were labeled control and half labeled experiment. Water drops were added to make a moist environment. Equal numbers of Collembolans were added to the eight control and experiment Petri dishes. Dawn Dishwashing Foam Soap was added to the four experiment Petri dishes. Yeast was added to all of the Petri dishes for the Collembolans to eat, and drops of water were added daily. The Collembolans and their eggs were counted and graphed. After 35 days, a total of 1,208 Collembolans were counted: 39% in the experiment and 61% in the control. A total of 623 Collembolan eggs were counted on Day 35: 105 (17%) in the experiment and 518 (83%) in the control. The hypothesis was correct. Dawn Dishwashing Foam Soap decreased a population of Collembolans.

6779

Does the Fat Content in Milk Affect Curdling?

Lucia Lin and G. Zem (teacher)

Ernest Lawrence Gifted/ Highly Gifted Magnet

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This science experiment showed how the fat content in milk affects how well it curdles. I used four different types of milk: whole milk (3.5% fat), reduced fat (2% fat), low fat (1% fat), and fat free (no fat). I curdled each type of milk by heating them and adding a teaspoon of lemon juice. I then let them rest for 7 minutes before straining them. I observed the color, texture, and weight of the curds. My hypothesis was wrong, and I found out that the less fat there is in the milk, the better the milk curdles. So if you are looking to make something with curdled milk, like cheese, you should use milk with a lower fat content for better results.

6780

The Effectiveness of Different Protectants When Blocking Out Harmful UV Rays

Annette Park and G. Zem (teacher)

Ernest Lawrence Gifted/Highly Gifted Magnet

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The science experiment I did showed the levels of effectiveness of common ultraviolet (UV) protectants, such as sunscreens with different SPF levels and different fabrics, in blocking out harmful UV rays. This knowledge can help people limit their exposure to UV rays when going outside. To show how much UV rays affect objects based on what they are covered by, I covered different groups of UV-sensitive beads (which turn a more intense color when exposed to more sunlight) with different sunscreens ranging from an SPF level of 30 to an SPF level of 100. Furthermore, two additional groups of beads were covered, one with dark fabric and one with light fabric. After recording and analyzing how much the colors changed with each protectant, I concluded that higher levels of SPF have similar sun protection values in comparison to lower levels of SPF. The beads had very little difference in terms of color. After SPF 50, everything was relatively the same, so people should consistently just stick with using medium levels of sunscreen and reapply it frequently. Finally, I found out that darker fabrics block out more sunlight as well due to the higher concentration of dye.

6781

How Does Time Affect the Freezing of Different Liquids in Cold Temperatures?

Angela Wong and G. Zem (teacher)

Ernest Lawrence Gifted/Highly Gifted Magnet

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My project was about how time affects the temperature of different liquids put in a freezer (0°F). Knowing about this can help with studying the temperatures and states of different and possibly unknown liquids in the freezer. The liquids I used in my experiment were tap water, vegetable oil, cold milk, and water with a few drops of oil. I also used a three-by-seven section ice cube tray, a thermometer, a timer, and a freezer. I filled each ice cube tray section with a different liquid, with some sections full of liquid and some sections half full. To avoid contamination, I spaced out the liquids. I took data on the temperatures and states of the liquids at the start, and then I placed the tray in the freezer and set the timer at intervals of 10 minutes, 30 minutes, 1 hour, 2 hours, and 3 hours. I recorded the data and compared the temperature, state, and any prominent details of the different liquids. My results were that all of the liquids I experimented with got colder the longer they stayed in the freezer, but the different liquids' temperatures dropped differently. The water, oily water, and milk all froze completely solid after 3 hours, and the vegetable oil turned into a soft jelly surrounded by a layer of liquid oil. The regular water and the oily water were clear with small bubbles inside. The frozen milk appeared cloudy, different than the milk's plain white color. In

conclusion, the longer the different liquids stayed at 0°F, the more their temperatures dropped and became closer to their freezing points. The different liquids seemed to have different temperatures when compared at the same time intervals, and there were differences between the appearances and behavior of the liquids and their frozen states.

6782

What Effect Does Microwave Radiation Have on Different Organisms?

Audrey Sieng and G. Zem (teacher)

Ernest Lawrence Gifted/Highly Gifted Magnet
10100 Variel Ave., Chatsworth, CA 91311

My experiment showed how microwave radiation affects fungi and plant life. For the plants, I used sweet alyssum flower seeds and cherry tomato seeds. To test the effects of microwave radiation, I microwaved the seeds of both and planted them. After they sprouted, I compared them to the control group to gather data. I also microwaved baker's yeast and compared it to a control group after adding warm water to both, recording the rising time and making observations. In the end, I found a general similarity between the plants in each of the two groups per plant type. I concluded that the microwaving caused the plants to germinate more slowly and mature more weakly. The yeast samples ended up rising to the same height, but the microwaving made the process much slower. Analyzing these results, I found out that microwaves affect different organisms negatively, lowering their success rate at healthy development, although they still grow.

6783

Effect of Temperature on Hockey Puck Slide Distance

Brendan Hillig and G. Zem (teacher)

Ernest Lawrence Gifted/Highly Gifted Magnet
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In this experiment I wanted to see what, if any, effect the temperature of a hockey puck has on the distance it can slide on the ice. My experience playing hockey made this an interesting area to explore. I designed and helped build a puck launching ramp that would create the same amount of inertia for each puck. I prepared four groups of three pucks at different temperatures: 1) super cold, packed in dry ice; 2) cold, immersed in ice water; 3) room temperature, the control; and 4) warm/hot, boiled and kept warm. Using a laser thermometer and laser tape measure, I collected data on a regulation ice hockey rink in Simi Valley, CA. The ice had been prepared the night before and was in optimal condition. The data showed that there was a direct link between a lower temperature and a farther glide distance. This benefit was not unlimited, however, as I found that the effect diminished at a certain point as the pucks got colder. I also found that the hot/warm pucks were slowed mostly by the melt water that built up in front of their travel. If I were to do this experiment again, I would drop a much larger number of pucks because there were a few outlier puck drops where the release

was not optimal and fouled the data. I also would drop each of the pucks at each of the temperature levels to help remove the puck differences from the data.

6784

How Do Different Video Game Genres Affect a Heart Rate?

Casey Pope and G. Zem (teacher)

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This project showed the change in heart rate when playing different genres of video games, as well as the difference in heart rate when playing a slow-paced versus a fast-paced game. I played two different games for each genre, one slow-paced and one fast-paced, and calculated my heart rate after each one. I then put the heart rates into a chart and saw the differences in the data. Horror games had, by far, the highest heart rates, with battle royale and shooter games having the second-highest heart rates. Sports games had the next-highest heart rates, and simulation games had the lowest ones.

6785

Does Age Affect Your Reaction Time?

Eric M. Hoang and G. Zem (teacher)

Ernest Lawrence Gifted/Highly Gifted Magnet
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The purpose of my science project was to figure out if age really does affect a person's reaction time, and by how much. I also wanted to find out what this would look like on a graph. My hypothesis was that age severely affects reaction time. My experiment required me to take the reaction times of people of various ages. After plotting everyone's average I found out that age did affect reaction times, so I was right about that; however, how much wasn't so clear. Individuals' reaction times varied. There was no exact pattern of how much someone was affected. I concluded that people's reaction times depend on their brains and how they process information. Since all of our brains are different, our reaction times and the amount of reaction decay are also different. Reaction times will get worse with age. As the age of the people in the experiment increased, so did their reaction times. However, the times people got were different. The times collected were either close together or far apart. There was no consistency. I learned that the way people react to things varies by who they are and their brains. Age will definitely get to you, but that doesn't mean you'll become slower than the rest.

6786

Smart Circuit*Tanvi Sure and G. Zem (teacher)*Ernest Lawrence Gifted/Highly Gifted Magnet
10100 Variel Ave., Chatsworth, CA 91311

For my project I created a computer-controlled electrical circuit using Python™ that also worked as a traffic light with motion sensors attached. I thought of this project to solve one of the small problems I noticed in California. At night, when there are no cars passing on the other side of an intersection, you still have to wait for the light to turn green as you would when there are cars on all sides of the intersection. This results in a waste of fuel and time. I hypothesized that there could be an easy fix, and I was delighted to find out there was. With basic Python skills, I figured out a way to put them to use and program this circuit. Using a Raspberry Pi, breadboards, LED lights, Dupont wires, resistors, motion sensors, and the programming language of Python, I was able to create circuits that worked as traffic lights at an intersection with motion sensors attached. Version by version, my idea came to life and I think it would be great to implement into today's traffic lights. The circuit I created is a prototype and there are many more things you can add to this design, but this is the first step toward creating optimal traffic lights.

6787

The Effects of Different Liquids on Seashells*Mitch De Guzman and G. Zem (teacher)*Ernest Lawrence Gifted/Highly Gifted Magnet
10100 Variel Ave., Chatsworth, CA 91311

My project tested the effects that different liquids have on the physical properties of seashells, such as rigidity, weight, and color. I chose this topic out of curiosity after seeing someone drop a seashell inside their soda cup at my cousin's birthday party. I selected multiple seashells of the same type and performed this project twice with seashells that weighed the same. I left my seashells to marinate in their liquids for two days, after which some had experienced drastic changes. After the two days I let the shells dry out, and then I weighed them. The results of my experiment showed that Coca-Cola® stained the seashells brown. Vinegar drastically softened the seashells to the point that their arch shape was deflating due to poor structural integrity, with cracks in the arches, and also their weight decreased by 50%. Finally, milk had several effects. It gave the shells a spoiled milk smell and somehow the shells gained mass, with one gaining 2 g and the other 1 g. Meanwhile, the control and water seashells were exactly the same as before they were placed into their cups. These were the effects that different liquids had on seashells.

6788

Can You Develop a Dependency on Chocolate?*Madison Bausley and G. Zem (teacher)*Ernest Lawrence Gifted/Highly Gifted Magnet
10100 Variel Ave., Chatsworth, CA 91311

The question I focused my experiment on was, "Can you develop a dependency on chocolate?" This inquiry took a surprisingly simple experiment to answer. At the beginning of the week, I gave two pieces of chocolate for the volunteers to resist. I recorded how long it took each volunteer to give in. Next, I gave them one piece every day during the second week after they had previously tried to resist the two pieces. Finally, I repeated my first step and compared the first week and third week. The experiment was very straightforward. The workplace of the volunteers mainly consisted of women so there was no difference in gender, and they wouldn't mingle or talk about their progress because most didn't see each other during those weeks, which could have influenced the results. My conclusion was that you can, in fact, grow a dependency on chocolate depending on your lifestyle. The volunteers who were living sugar-free lives were far less attached to chocolate than the volunteers who ate what they wanted however they wanted. On top of that, the volunteers who said they ate chocolate before the study found it harder to resist the temptation of chocolate during the study.

6789

Does Color Affect Your Memory?*Mayukha Talinki and G. Zem (teacher)*Ernest Lawrence Gifted/Highly Gifted Magnet
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Many people tend to write and highlight notes because they say it helps them study and remember things better. This led to my curiosity about whether reading words in different colors or plain black affects your memory. I predicted that reading words in different colors would help people remember them better because color catches people's attention more than black. My experiment included a control test and an experimental test. I started off by giving 15 people of various ages a stack of 15 white flash cards with one random word written in black on each card. I gave them 10 seconds to look at each flash card, and after going through the whole stack they were given as much time as needed to write down all of the words they remembered. A few days later, the same people were given a stack of 15 flash cards, but the words were written in red, blue, and green instead of black. Once again, I gave them 10 seconds to look at each flash card, and after that I gave them as much time as they needed to write down the words they remembered. After looking at my data, I learned that the results proved my hypothesis wrong. Sixty (60) percent of the people remembered more words when they read them in black, two remembered the same number of words in both color and black, and 27% remembered more words in color. In the end

I realized that it doesn't matter if people write words in color, and that people actually remember more words when they are written in black.

6790

Which Candle Burns the Most Quickly?

Caressa Pinto and G. Zem (teacher)

Ernest Lawrence Gifted/Highly Gifted Magnet
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Purpose: The purpose of my science project was to find out which type of candle would burn down the most quickly in a given amount of time. **Hypothesis:** I thought that Candle A (uncolored, unscented) would burn significantly faster, because this candle didn't contain as many chemicals in it. **Procedure:** The steps I took to arrive at my conclusion were as follows. I lit four candles: uncolored and unscented (Candle A), colored and unscented (Candle B), uncolored and scented (Candle C), and finally colored and scented (Candle D). I lit them for a total of 60 minutes, split into two equal segments of time (30 minutes and 30 minutes). After each segment I recorded the results to see the progress. As I researched more information on the chemicals in candles, I found out that most are made of a substance called paraffin wax. Although candles that are made in the USA are supposed to have wicks made of cotton or paper, there are many that still have lead-core wicks. Whichever candle in the experiment burned down the most quickly in the given amount of time would reveal to me why. **Results:** My hypothesis was slightly right but also slightly wrong. Candle A did burn the most quickly, so it was first. But I thought it would burn down significantly faster. It didn't. Candle B burned down just 5 minutes after Candle A. So the amount of chemicals doesn't necessarily affect a candle's burn time.

6791

The Effects of Temperature on Rock Porosity

Ayle Guevarra and G. Zem (teacher)

Ernest Lawrence Gifted/Highly Gifted Magnet
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My science experiment showed how different temperature settings affect the porosity of different types of rocks. Porosity is a physical property of rocks, which, in simpler terms, is the capacity of rocks to absorb water. This is important for builders and engineers because, to ensure safety and structural integrity, they need to find out which materials they can use that can withstand extreme temperature changes. For this experiment, I chose rocks that represented the different rock types: granite (an igneous rock), slate (a metamorphic rock), sandstone (a sedimentary rock), and limestone (another sedimentary rock). Other materials I used included four clear plastic cups (each the same size and capacity), a graduated cylinder, water, a timer, and a notebook and pencil. I also had access to a refrigerator and oven toaster. I predicted that the hot temperature setting would increase porosity the most, followed by room temperature and the cold temperature, respectively. I also predicted

that among the four rocks used, sandstone would have the highest porosity in all three temperature settings. First I let the four rocks sit for 1 hour so they would reach room temperature. I placed each rock in a separate cup (one rock per cup) and poured 150 ml of water in each one. I left them undisturbed for 30 minutes before draining the water not absorbed by the rocks. The volume of drained water was measured, and this amount was subtracted from the initial 150 ml to determine the rocks' porosities, with the lower the difference, the higher the porosity. I repeated all of these steps two more times for a total of three trials and used the values obtained to calculate the averages. I also repeated the entire series of steps under the cold and hot temperature settings, with the difference being that instead of leaving the rocks out, I put them in the refrigerator for 1 hour for the cold setting and heated them in the oven toaster for 15 minutes for the hot setting. After performing this experiment, my hypothesis was shown to be correct. The hot temperature setting increased porosity the most as proven by thermal expansion, followed by the room and cold temperatures, with the rocks in the cold temperature setting absorbing the least since exposure to the cold may have limited the pore spaces within the rocks. I also found out that sandstone had the highest porosity among the four rocks in all of the temperature settings due to its loose and granular composition, followed by limestone, granite, and slate, whose compositions were tighter and compact.

6792

Do Different Decibel Levels of White Noise Affect Sunflower Growth?

Anna Jin Lee and G. Zem (teacher)

Ernest Lawrence Gifted/Highly Gifted Magnet
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The purpose of my science experiment was to study the effects of white noise on plants, specifically sunflowers, to explain if sound waves in their environment stunt or promote plant growth. (White noise is made of sound waves.) I placed 15 terra cotta in rows of three and columns of five. Every two to three days I watered the sunflowers, and about every month I recorded their progress. I provided the plant groups with an hour of white noise at different volumes measured in decibels (dB), and collected data from four separate days in the span of October to February. I compiled the data in a table showing the day it was taken, which row and column each plant was in, the height of the maturing plants, any visual observations of the plants, and the number of leaves that the plants were growing. The results showed that the growth of the sunflowers was not affected by the different sounds in the environment because of human error, planting out of season, and possible seed infertility.

6793

What Material Best Filters Water?*Yasmine Gomez and G. Zem (teacher)*Ernest Lawrence Gifted/Highly Gifted Magnet
10100 Variel Ave., Chatsworth, CA 91311

For my project, I tested several different materials to figure out which one best filters water. I used a tissue, a coffee filter, a cloth, a cotton ball, a paper towel, and tissue paper (the kind that is used in gifts). I made a mixture of rocks, soil, small pieces of leaves, and tap water. In the first test I used a tissue to filter the water. This was not a good option because the tissue absorbed the water instead of filtering it. In the second test I used cotton balls. This material filtered the water for the most part, but the water still looked a little muddy. In the third test I used cloth from new socks to filter the water. This material did not really filter at all, as the water was still very muddy. In Test 4 I used a coffee filter. There were still small particles, including dirt, in the water. For Test 5 I used a paper towel, and this filtered the water perfectly. It absorbed the muddy water, was strong enough to hold all of the thick rocks, and had holes small enough to filter the small particles. In Test 6 I used the tissue paper. After being filtered, the water still had small pieces of leaves, and the paper did not filter all of the materials from the dirt. In the end the paper towel (Test 5) filtered the water the best, and this was the outcome of my experiment.

6794

Which Drink Does Ice Melt in the Most Quickly?*Demiana Abdel Malek and G. Zem (teacher)*Ernest Lawrence Gifted/Highly Gifted Magnet
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For my experiment, I chose to find out which drink causes ice cubes to melt the most quickly. I got cups and labeled them with the different drinks I used – sparkling water, apple juice, cranberry juice, apple cider, and regular water. Then I got the drinks, poured them into their designated cups, and put two ice cubes in each one. I started a stopwatch right when I put the ice in the drinks. Then I waited to see when the ice cubes melted in each drink. The results were not what I thought they would be. My hypothesis was that the ice would melt the most quickly in the sparkling water, and would melt the slowest in the regular water. But a second hypothesis was that the ice might also melt at around the same time in all of the drinks because I made sure that all of them were the same temperature, and I put the same number of ice cubes in all of them. The results were sparkling water, regular water, apple cider, apple juice, and lastly cranberry juice. I enjoyed doing this experiment because it was interesting to see how ice reacts differently in different drinks, but it did take a while to get the results of the experiment. So I probably wouldn't want to do this experiment again because of the amount of time it took.

6795

Do Different Water Solutions Given to Plants Affect Growth?*Andre Lokusza and G. Zem (teacher)*Ernest Lawrence Gifted/Highly Gifted Magnet
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This project showed how three different water solutions – vinegar/water, salt/water, and tap water – can influence the growth and development of plants. I decided to study this topic because the effects of water solutions on plants can be related to the effects of foods that we eat and what they do to our bodies. I put five beans in each of three cups, with one for each solution. Every other day, I watered the beans with 4 tbs. of the designated solution. The vinegar mixture was 2 tbs. of water with 2 tbs. of vinegar; the salt mixture was 4 tbs. of water with 1 tsp. of salt (supersaturated); and the last solution was 4 tbs. of tap water. I recorded the results every other day over the course of two weeks to see how the plants developed over time. In the end, the beans in the cups watered with the salt and vinegar solutions showed drastically minimal development compared to the beans in the cup watered with only tap water. The vinegar cup's plants had barely sprouted, and the topsoil was layered with fungi. The salt cup's plants hadn't sprouted at all, and the topsoil was layered with salt crystals. All of the tap water cup's plants had grown healthily, and had just began to grow buds. The sprouting of seeds depends heavily on the condition of the soil, which is why the beans in two of the three cups performed poorly. The lack of hydration in the salt and vinegar cups prevented the beans from sprouting properly.

6796

How Does Talking to Plants Affect Their Height and Root Count in 15 Days?*Anisah Khan and G. Zem (teacher)*Ernest Lawrence Gifted/Highly Gifted Magnet
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For my project, I demonstrated the effects of talking daily to a group of nine pole beans in comparison to a group of nine pole beans that received no vocal stimulation. Each group had three cups, with three pole beans per cup. I watered both groups daily and they were treated the same, with equal amounts of water and sunlight. I measured them every other day. I spoke to the "Talking Condition" group for 30 minutes a day, spending 10 minutes talking and 20 minutes reading. At the end of the project the average height of the Talking Condition plants was 17.6 centimeters, while the average height of the control plants was 1 centimeter. Meanwhile, the average root count for the Talking Condition plants was 17 roots, while the average root count for the control group plants was four roots. Sound vibrations enhance photosynthesis, carbon dioxide preservation, enzyme activation, and hormonal changes in seed germination. Due to my project's surprising results, I have concluded that talking to plants directly enhances their growth.

6797

Potential Danger to Earth From Asteroids

Nikhil Yetukuri and G. Zem (teacher)

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Project Subtitle: *Using the scientific method, how can I analyze asteroids and come to conclusions regarding the dangers they may pose to Earth and the correlations between their different designations?* This project compared different designations of asteroids with each other to determine their size; (inclination of) orbits; perihelion and aphelion (closest and farthest points to and from the sun, respectively); and chance of colliding with Earth. This project was also for the purpose of making more people interested in and concerned with space. I chose this topic because I want to become an astrophysicist, which is almost entirely related to space. I thought that this might be a good project to share my knowledge with the world while gaining some knowledge too. I did some research and found a publicly accessible database filled with several designations of 6000-plus asteroids. Based on this, I created a graph with the x-axis labeled “Semi-Major Axis” (half of the widest point in elliptical orbit) and the y-axis labeled “Orbital Period” (the time it takes for an asteroid to circle the sun once).

6798

How Much Fat Is in Your Food?

Mahek Kapadia and G. Zem (teacher)

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This science experiment used the solvent extraction technique to show how much fat is in foods that we eat nonstop. Although we can read the fat contents of a food on its label, all of those numbers can become extremely confusing to the point where we do not know what they are even for. For my solvent, I used acetone, which once it evaporates leaves behind extracted fats. As for food, I chose almonds, potato chips, and chocolate. I crushed 10 g of each and mixed it with 20 g of acetone. Next, I ran each mixture through a strainer, separated the solid and liquid, and repeated the fat extraction with the same solid once more. After doing this with all three of the foods, I let the containers sit out until the acetone completely evaporated (this took 28 hours). Then I weighed the containers to see how much fat was left and observed the consistency of it. The mass of the container with crushed potato chips was 24 g and the mass after extraction was 20 g, leaving 4 g of fat. The chocolate had 2 g of fat and the almonds also had 4 g. This was the same information as on the nutrition labels, but somehow seeing that fat physically there really made me realize that having chocolate so often is not such a good idea. As for the consistency of the fat: The potato chip (reduced fat) was a liquid, oily, with a tint of yellow; the chocolate (SNICKERS® bar) was solid, thick, and had a brown layer with a white layer on top; and the almond fat was a waxy consistency with a yellow and brown tint.

6799

How Do Water, Pounds Per Square Inch, and Payload Affect the Peak Altitude of a 1-Liter Bottle Rocket?

Elizabeth Teeter and G. Zem (teacher)

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The purpose of this project was to determine how the volume ratio of air and water, the launch pressure, and payload weight affect the peak altitude of a 1-liter plastic bottle air-water rocket. For my experiment I created a bottle rocket and ran 45 tests to see how the peak altitude varied when I changed the amount of water, pressure, and payload in the bottle rocket. I averaged and graphed all of my data to compare my results. The results showed that the highest rocket altitude corresponded to the ratio of one-half water and one-half air. Adding on, the higher the pressure, the higher the rocket altitude, which meant that the rocket reached its peak altitude at 45 pounds per square inch (psi) and its lowest altitude at 25 psi. The peak altitude of the rocket decreased as the payload weight increased, proportionally to the following equation: percent altitude decrease = empty rocket weight/empty rocket weight + payload weight.

6800

How Does Temperature Affect the Height of a Tennis Ball Bounce?

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The purpose of my project was to discover how the temperature of a tennis ball affects the height it can bounce. A tennis ball consists of a hollow, rubber-like core filled with gas. After throwing a tennis ball, it lands on the floor and gains kinetic energy. The force exerted on the ball from the ground causes the molecules to expand and contract, producing more energy. Therefore, the ball can bounce off the ground. For my experiment I used nine tennis balls. I heated three in a heating pad, froze another three, and left three at room temperature. After dropping each tennis ball from 5 feet — at different times — I found the average bounce height for each ball by rounding the results to the nearest hundredth. The average bounce height for the heated tennis balls was 40.25 inches, the average bounce height for the room temperature tennis balls was 32.88 inches, and the average bounce height for the frozen tennis balls was 23.25 inches. The data collected showed that a hotter tennis ball bounces the highest compared to a cold tennis ball and a room temperature ball. This is because an increased temperature causes the gas molecules inside the ball to expand. Consequently, the energy increases and the molecules bounce faster inside the ball. The increased energy and movement of the molecules result in a higher bounce. In contrast, a lower temperature leads to the gas molecules contracting and producing a lower bounce.

6801

Which Type of Cup Keeps a Hot Drink Warmer For a Longer Period of Time?

Clare Lee and G. Zem (teacher)

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My project examined which type of cup keeps a hot drink warmer for a longer period of time. My hypothesis was that if I poured water in paper, plastic, glass, and Styrofoam cups, the water would stay warmer in the Styrofoam cup because I think Styrofoam is a good insulator of heat. I heated the water to a specific temperature and poured it in all four cups at the same time. After a specific amount of time, I used a thermometer to check the temperature of the water in each cup and wrote down my results. After recording my data from the trials, I found out which type of cup maintained warmth the longest. I saw that the Styrofoam cup's hot drink stayed the warmest for the longest amount of time, so the winner was the Styrofoam. My hypothesis was correct. Styrofoam is a good insulator of water.

6802

How to Use Red Cabbage to Find Out If a Solution Is Acidic or Basic

Sriya Datla and G. Zem (teacher)

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This science experiment showed that red cabbage can be used as a pH indicator to differentiate bases and acids by influencing the color change of a solution type. It was very interesting to find out how red cabbage acts as a pH indicator, which results in a chemical change to determine if a solution is acidic or basic. First, a few leaves were separated from the red cabbage and added into boiled water, which was then placed into a grinder. A strainer was placed over an empty bowl and the mixture was poured through the strainer to remove the cabbage pulp. After the mixture was strained it was a purple liquid. The household solutions that were added to the first four glasses were detergent, brown sugar mixed in water, vinegar, and lemon juice. The solutions that were used for the next four glasses were water, baking powder mixed in water, Alka-Seltzer® dissolved in water, and dish soap liquid mixed in water. After adding a few drops of the red cabbage pH indicator into each solution, the following color changes occurred in this order: blue to a purple shade, light blue to a darker shade of blue, light yellow to a bright red, white to a pink color substance, clear to a light shade of blue, white to a dark shade of blue, white to a light shade of purple, and white powder to a dark shade of blue. Lastly, the solutions were rearranged from most basic to most acidic in the following order: baking powder, dish soap, sugar solution, water, Alka-Seltzer, detergent, vinegar, and lemon juice. The results of the experiment showed that the more purple or blue a solution was, the

more basic it was, and the brighter the color was, the more acidic the solution was. In conclusion, the red cabbage acted as a pH indicator, which helped to place each household solution onto the pH scale.

6803

Which Solution Is Better For Electrolysis?

Vincent Cheung and G. Zem (teacher)

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This project showed that the type of electrolyte used in the process of electrolysis affects how much oxygen is produced over a certain amount of time. I chose this topic to find out which solution is best for electrolysis. I used three different solutions: one was a 4% weight by volume (w/v) salt solution, another was a 4% w/v baking soda solution, and the final one was just distilled water. The liquid solvent used in the w/v solutions was distilled water. I set up an apparatus similar to a Brownlee Electrolysis Apparatus, with alligator cables connecting the anode and cathode of the apparatus to a 9-volt battery. I then tested the effectiveness of each solution by placing a test tube filled with the solution over the cathode and recording the time it took for the hydrogen produced by electrolysis to displace the solution below a line on the test tube. My hypothesis was that with the 4% w/v salt solution, the hydrogen produced would displace the solution in the test tube below the set line the most quickly. However, it turned out that the hydrogen produced displaced the 4% w/v baking soda solution below the set line the most quickly, proving my hypothesis wrong.

6804

Study Zones

Bhagya Yaggahahewage and G. Zem (teacher)

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For my project I compared three frequent study locations – the bed, a table, and outside on a bench – to see which one provided the best score on a test. I studied three different topics for 45 minutes each in these locations, then took three tests (five-question quizzes written by my sister) for each topic at each location with the same difficulty level to see which one gave me the best results. I thought that the outside location would give me the highest score, and I was correct. I got 60% for the quiz I studied for on my bed, then 80% for the table study quiz, and lastly 90% for the outside study quiz. This is because studying in nature tends to be more relaxing and calming. Green is proven to be calming, which adds to why studying outside helps you, because you are studying freely with no distractions, you are more relaxed than ever, and your posture is also better. This in a way motivates you to do better. In conclusion, throughout this experiment I learned that studying outside will give you the best results on a test.

6805**Which Music Improves Your Productivity?***Andrea Reji and G. Zem (teacher)*Ernest Lawrence Gifted/Highly Gifted Magnet
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This project showed which type of music can help improve productivity. I chose this topic because I have always wondered about this. Some students hypothesize that classical music improves productivity, so they listen to that type of music while doing homework. I made a 25-problem multiplication-timed test for my testers to take. Because I had to experiment with two types of music, I took the first test and reversed all of the problems. Before I began the experiment, I had each tester say which music they liked better: classical or pop. I had 25 testers, and they took the test one week apart. The results of the experiment showed that the testers had better accuracy and a quicker time when they took the test with their favorite type of music. The people who liked classical music did better with classical than pop, and the people who liked pop music did better with pop than classical. This was due to everyone's preference and style. Everyone works better with their favorite type of music.

6806**What Surface Has the Most Bacteria?***Claire Mussell and G. Zem (teacher)*Ernest Lawrence Gifted/Highly Gifted Magnet
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For my science fair project, I wanted to find out how much bacteria my hands had on them after school and after I washed my hands. I swabbed my hands right after school for three days. Then I swabbed my hands after I washed them. The first day, I washed my hands for 5 seconds, the second day I washed them for 10 seconds, and the third day I washed them for 20 seconds. After I swabbed my hands, I rubbed the swab on a layer of agar in a Petri dish. I counted how many bacterial colonies the agar plate grew for five days after I swabbed my hands. My experiment provided me with some interesting results. The Petri dishes after I washed my hands for 10 and 20 seconds had a lot of colonies, but all of them (except for maybe one or two) were very small. This was most likely because the soap broke down the colonies, so they were much smaller. Also, because soap can cover the surface of my hands, it left less room for the bacteria to grow and it only could grow in the spaces that were available. In addition, since you wash your hands multiple times a day, I should have really been focused on my Day 1 data. The only time there were zero bacterial colonies on Day 1 was when I washed my hands for 20 seconds. My data agreed with the Centers for Disease Control and Prevention (CDC) that you should wash your hands for 20 seconds.

6807**What Is the Effect of Various Surfaces on the Speed of a Soccer Ball?***Pranav Kulkarni and G. Zem (teacher)*Ernest Lawrence Gifted/Highly Gifted Magnet
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This project showed the effect that surfaces have on the speed of a soccer ball. These included artificial grass, thin grass, thick grass, asphalt, and concrete – five of the most common surfaces that soccer is played on. I chose this topic to figure out the optimal surface to play soccer on by determining the surface that had median results. I did the test by kicking the ball at the same distance from my foot and at the same power for every surface, doing the test five times per surface, and calculating the averages for more accuracy. In addition, I made sure that the surfaces were flat and that there were no external forces (wind, etc.). The results of the experiment showed that the ball traveled the least distance on thick grass and the farthest on concrete. The final results showed that thin grass was the median surface in terms of distance traveled. I found out that on thick grass, you should dribble with more power because the ball travels less on this surface than it does on the other grasses. In addition, on thin grass and artificial grass, you should dribble and kick the ball at normal power and shouldn't apply too much or too little force. On the contrary, the results from asphalt and concrete showed that if you play soccer on these surfaces, don't kick the ball too hard because even with a small kick, the ball will move far due to the high coefficient of friction.

6808**Does Unpurified DNA From Humans and Bananas Look the Same?***Arnav Dangre and G. Zem (teacher)*Ernest Lawrence Gifted/Highly Gifted Magnet
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This project showed the difference between unpurified DNA from bananas and humans. I chose this topic to find out the difference in appearance between DNA from bananas and humans. First I extracted DNA from a banana and recorded how it looked. Then I extracted DNA from a human (myself) and recorded how it looked. I put the DNA on two of the same types of toothpicks to observe the samples better. The toothpicks wouldn't make a big change to the samples because the same type of toothpick was used for both. If a change happened to one sample, it would most likely happen to the other. I compared the two samples and got my results. I learned that the two samples appeared to be the same, but the DNA from the banana had a very subtle and hard-to-notice yellow tinge. Both of the DNA samples were wet, stringy, and slimy. This was because most living things have the same basic DNA structure. After all, all living things have the same basic needs.

6809

Which Fertilizers Promote Microalgae Growth?

Taylor Lee and G. Zem (teacher)

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In this research, *Chlorella vulgaris* was grown with several different types of test substances, each mixed in water. The underlying question that I sought to answer was, "Which fertilizers promote microalgae growth?" This experiment was conducted in the hopes of finding a faster way to grow microalgae. Currently, several studies around the globe are utilizing the natural oils that come out of these microalgae. Algae can survive and thrive in many environments. Based on these characteristics, we have a vision of a future where fossil fuels are replaced with biofuels, or fuels made from plants. For the experiment, four bowls were set up with equal parts of *Chlorella vulgaris* starter in all of them. The first bowl just had the *Chlorella vulgaris*, the second one had green tea powder, the third one had yeast and sugar, and the last one had coffee grounds. They grew in the containers for two weeks, with observations recorded daily. I discovered two key points. First, the common belief that algae can technically grow with nothing is true to a point. They can survive for a few days without nutrients, but end up dying. Like all plants, they need nutrients. Second, nitrogen has considerable effects on the growth of algae. Unlike all of the other test groups, the coffee grounds showed the most promising results. The algae grew, which further backed up the discovery that algae blooms occur in nitrogen-rich waters. These two discoveries showed me the requirements of algae growth and their limits.

6810

What Color Absorbs the Most Heat?

Suvan Kapoor and G. Zem (teacher)

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My project showed how differences in color help to absorb more heat. I chose this project to find out if using different colors to manufacture different products would be practical and beneficial. I set out four pieces of paper: white, yellow, blue, and black. I placed one cup of water on each piece of paper. Every 15 minutes I measured the temperature of the water in each cup. To make sure my results were accurate, I did my experiment twice. I recorded my results and found out that my hypothesis was correct. The darker the color, the more light that was absorbed. This is because the closer to dark a shading is, the more heat it absorbs from light sources. The key is that colors don't retain various measures of heat, just different amounts of heat from light. Since lighter colors reflect more light when outside, the heat from the sun is reflected too. Because darker colors reflect minimal sun-based light, they reflect minimal sun-oriented heat and are therefore hotter.

6811

Frizzy Hair, Don't Care

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The goal of this project was to figure out what effects humidity and temperature have on static electricity. My hypothesis was that an environment with low humidity and high temperatures would create the most static electricity because I think that dry and hot air can produce a more conductive and electric atmosphere for static electricity to be generated. For my experiment, I used a balloon, my brother's hair, a heat dish, a humidifier, and a cold source. I first rubbed the balloon in room temperature (68°F) and at a humidity level of 36%, and a good amount of his hair stuck to the balloon. On a scale of 1-10, I assigned it a 6. I conducted the same experiment in a cold temperature (32°F) and at a humidity level of 60%, and some hairs stood up, but not as many as before. On a scale of 1-10, this was a 4. Next, I conducted the experiment in a hot temperature (97°F) and at a humidity level of 25%, and all of the hairs stood up and got stuck to the balloon. There were even a few shocks and sparks. On a scale of 1-10, this was a 9. I decided to conduct this experiment one last time, but this time in a humid environment, where the humidity level was 100% and the temperature was 70°F. No hairs stood up this time, because the humidity created steam and water, preventing any conductivity from occurring in the air. I found out that my hypothesis was correct: When there are high temperatures and low humidity levels, there will be the most static electricity. If the humidity levels are high, it establishes a barrier for electrical charges to create an imbalance between the objects. This is the result of what effects temperature and humidity have on static electricity.

6812

What Can Slow Down the Melting of Ice?

Claudia Shin and G. Zem (teacher)

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This project showed how different materials affect the melting time of a piece of ice. I chose this topic to figure out how to keep ice from melting. I used several different pieces of ice of about the same size and put each one in a different environment. My control was a piece of ice put in a bowl at room temperature. The other pieces were put inside a ball of tape, a Ziploc® bag, my hand, room temperature water, and coated with nail polish. After recording the melting time for each piece of ice and putting the data in a table, my conclusion was that the ice wrapped in a ball of tape took the longest to melt. The ice that melted the most quickly was the piece in room temperature water. The rest of the pieces melted in the following order of speed: the ice in my hand, the ice in the Ziploc bag, and the ice coated in nail polish. My conclusion from this experiment was that when ice has insulation like tape or nail polish, it takes longer to melt.

6813

Do Gender and Age Impact Memory?

Eliana Jablon and G. Zem (teacher)

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This experiment tested which age group and gender have a better memory when it comes to following directions. I chose this topic because I wanted to see who has a better memory, and included 35 people who were divided into four groups based on age and gender. For the experiment, I created a list of 20 simple tasks to be completed in a specific order. I read the tasks to individuals in a private area where there would be little to no influence from others. I told an individual the first task and they attempted it, then I told them two tasks and they attempted them, and this process continued with me adding more tasks. The test ended if an individual forgot a task or did the tasks in the wrong order. I recorded my data on a chart. I noticed that many participants turned the test into a competition with their friends and family, which motivated them to do better. At the end of my experiment, I concluded that females under the age of 18 have a better memory compared to the other groups I tested.

6814

Hydrogen Fuel Cells: Which Material For an Electrode Increases Electricity Production During Electrolysis of H₂O?

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I chose this topic because I wanted to find out which electrode material is most efficient for electricity production. At the beginning, it was predicted that the most efficient would be copper. I started out by building my own fuel cell because then I would be able to change the electrodes effortlessly. Two other containers were placed in a big container, one for hydrogen and one for oxygen. The electrodes were connected to wires, which were connected to batteries. Later, when the electrodes were fixed, I slowly let them down into a container full of water. In a controlled environment, I tested copper, aluminum, steel, and graphite. I charged the electrode types, which were submerged in water, for 5 minutes each with a 9-volt battery, and then recorded the volts using a voltmeter right when the battery was unplugged. I wrote down the length of time each type of electrode released energy and the volts it discharged when I unplugged the battery. According to my graph, graphite produced 2.38 volts and discharged energy for approximately 36 minutes. It produced the most energy for the longest period of time. It turned out that copper is a highly reactive metal, and it slowly loses electrons and loses mass at its cathode (where hydrogen forms). Evidently, since there is no cathode left, it doesn't produce much electricity. According to the results of this project, graphite is the best electrode. Graphite turned out to be a cost-effective and convenient option.

6815

What Is the Best Recipe For Making the Largest Bubbles?

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This project showed that the consistency of and ingredients in a bubble mixture, and the time it takes for each mixture's bubble to evaporate, change the size of a bubble. Ultimately, I chose this topic for my science fair project in order to find the best recipe for producing the largest bubbles. I created three different bubble mixtures in which the ingredients and the bubble base's ratio varied. On three separate white pieces of printer paper, I blew five bubbles for each mixture. To ensure I obtained results as close to accurate as possible, the bubbles were blown in a controlled environment with a controlled strength of air. Afterward I found the circumference of each bubble using the water stain left behind when the bubble popped on the paper. I then used this information to find the average size of the bubbles for each mixture. After recording all of my measurements on a table, I found that the recipe with cornstarch, baking powder, dish soap, water, and corn syrup resulted in an average of larger bubbles. The results aligned with my research and prediction that when a mixture has more ingredients, it is thicker and the liquid evaporates more slowly, resulting in a stronger bubble that is durable enough to stretch into a large bubble. At the same time, the mixture with the smallest average bubble size was the one with the fewest ingredients (only distilled water, dish soap, and glycerin). This recipe resulted in a quicker evaporating time and a thinner film of soap, which allowed a very minimal amount of air inside of the soapy film. This is the result of Marangoni convection and surface tension causing the surface portion of liquid to be attracted to another surface.

6816

How Do Different Glycerol Proportions Affect Biodegradable Plastic?

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This project showed how different proportions of the ingredient glycerol affect the physical structure of biodegradable plastic. I chose to create a project based on this topic in order to determine which type of biodegradable plastic is the most durable. I made five different batches of biodegradable plastic, with all of the ingredients besides the glycerol remaining the same. Glycerol acts as a natural plasticizer by bonding the hydrogen atoms in the plastic together. By changing the proportions of glycerol, the elasticity and durability of the plastic should be directly affected. I used different quantities of glycerol ranging from 0.5 tsp. – 2.0 tsp. The results of the experiment revealed that the more glycerol that was added to the plastic, the more elasticity the finished plastic possessed. This result was caused by glycerol's natural chemistry. Glycerol

is a natural sugar substance that is an extremely dense liquid at room temperature. The more glycerol I added to the plastic, the more the plastic acted like glycerol at room temperature. Therefore, increasing the proportion of glycerol in biodegradable plastic will cause the plastic to become less durable and more flexible.

6817

What Liquids Melt Ice the Most Quickly?

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This project showed which liquids can melt ice the most quickly. To perform my project, I gathered six ice blocks and six liquids. For the first trial, I made sure that the liquids were all the same temperature to ensure accurate results. After checking the liquids, I poured one on each ice block and timed them. After the first ice block melted, I checked the temperature of the water and recorded it soon after, and put all of my data in tables. I found out that the liquid that melted the ice the quickest was water, and the liquid that melted the ice the slowest was saltwater.

6818

Are Batteries Affected By Temperature?

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The project I did showed that batteries are affected by temperature, even if just a little. I chose it because I was using a device with batteries, and was curious to see if temperature would have an effect on it. To perform the project, I made sure that I had free time within three days, because each part took one day. I needed to have a room at a certain temperature and then I put a battery in a battery-powered device. In this case, it was a fan. I recorded the time it took for the fan to power off for three different battery types. For the next two days, I repeated the process, but with different room temperatures. There was an increase in battery life as the temperature got lower. This project showed that temperature does have an effect on the longevity of a battery. The colder the temperature, the slower the current inside the battery, which leads to less chemical usage and the battery lasting longer compared to in higher temperatures.

6819

Do Plants Grow Better When Watered With Different Liquids?

Ezra Hong and G. Zem (teacher)

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This project showed how different liquids can make plants grow more quickly or more slowly. I had a box of beans that all went through the same germination process together, and I put them in my garage, where they received an equal amount of sunlight. I divided the 12 beans I had into four rows of three cups filled with the same amount of soil. I then marked each row of cups with the names of four different liquids I decided on earlier: water (my control), soda (Dr Pepper®), saltwater (with 1 teaspoon of salt in it), and orange juice (Kirkland brand from Costco®). Then every three days I watered the plants with a quarter cup of the designated liquid. I recorded the data and created a bar chart to see how much the plants with the various liquids differed in growth. Not surprisingly, the plants watered with water did the best. The orange juice plants did the second best, then the soda plants, and then the saltwater ones, with the salt killing the plants.

6820

Does Recycling Actually Help? Plus Its Impact on the Earth, Especially the Ocean

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This project examined if recycling really benefits us and how it impacts the Earth, especially the ocean. Endless numbers of reports have been published about how animals die by consuming plastic bottles, particularly the caps. I decided to recycle some of the cans and bottles I had in my house as one of my experiments. To back up my hypothesis I also gathered a few surveys from my family members and some of my peers. In conclusion, I think that recycling really helps reduce human pollution in many different ways, starting from preventing sea creatures from dying by accidentally consuming plastic, to bringing cans and bottles to nearby recycling centers (and making money from this). This research also alerted me that global warming and human pollution are impacting the world severely. The Earth is dying. Millions of animals are dying because of all of the fires, more earthquakes are happening because of bigger fault lines, and more tsunamis are occurring because of more earthquakes. The biggest lesson from this research is that I encourage everyone to recycle or reduce trash and reuse things if possible. Recycling will benefit us by enabling us to earn money, and it will benefit the Earth by preserving nature with less trash that harms animals. For example, instead of using paper plates, you can use glass plates when your guardian makes you dinner. Small things like this really can change the future of the Earth.

6821 Which Batteries Last the Longest in Different Temperatures?

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This project was based on figuring out if batteries that had been in three different temperature environments would work differently (more quickly or more slowly; lasting a longer or shorter time), and if this could provide information to people who want their batteries to last longer. The temperatures included an icy cold environment with a temperature of 35°F (or 1.7°C), an average room temperature of 64°F (or 17.8°C), and an average hot day. I took six of the same brand of batteries (Duracell®) and used them for my controller for the PS4™. I left six batteries, with two in each of the three different environments. After a day, I took all of the batteries out of the environments and tested them on the controller. When I used each battery, none of them worked differently. They all worked the same and didn't charge the game more quickly or help it work more quickly; overall they just kept the game at a steady pace. In order to use the information from this experiment correctly, I had to calculate the correct amount of time for the batteries to stay in. Since the time in for both the batteries outside and the batteries in the refrigerator (meaning the cold environment) didn't matter much, it seemed that the room-temperature batteries should go first with the controller. After that, I put each battery in the controller and used it for a maximum amount of time. In conclusion, my hypothesis was proven incorrect. All six batteries either showed no signs of change among them or any signs of working more quickly within the 2 hours of using the controller. The batteries that were in the hot and cold environments could have then, after being put in a room temperature object, soon gone to room temperature.

6822 How Much Salt Is Needed to Float?

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This project demonstrated how much salt you need in a body of water in order to float. I chose this topic because I became curious about salt and buoyancy once I read about the Dead Sea. For my experiment I used four different cups, each with 1 cup of water in it. Then, using measuring cups, I began to add different amounts of salt, starting with ½ cup. I dropped an egg in to serve as a model of the human body. As I slowly decreased the amount of salt I was putting into the cups, I recorded the results on a chart for each amount. After much trial and error, I discovered that an egg floated with ⅓ cup and 1 teaspoon of salt. This means that the human body can float in water that is at least 35.4% salt.

6823 Do Different-Colored Lights Produce Different Amounts of Electricity?

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I chose this topic to find the color (wavelength) that would produce the most electricity. The materials used were four solar panels, a LEGO® base, hot glue, and light-emitting diode (LED) lights (blue, UV, green, pink, white, orange, orange-yellow, and red). First I built two types of circuits, a parallel circuit and a series circuit. The series circuit would produce a higher amount of electricity. Then I hooked up each circuit to an oscilloscope. I held the lights 5 inches away from each solar panel. I did this three other times and found the average of the numbers. Surprisingly, blue produced the most electricity, generating 1.28 volts in the parallel circuit and 3.60 volts in the series circuit. Red produced the least, with 0.54 volts in the parallel circuit and 2.44 volts in the series circuit. I made two data charts to show how many volts each color produced in the two different circuits. The highest producing (blue) was at the top, while the lowest producing (red) was at the bottom. The two charts were almost identical, except that the colors pink and white switched orders. In the end, I noticed that colder colors (blue, purple, etc.) produced the most electricity, while warmer colors (red, orange, etc.) produced the least amount.

6824 Which Is Cleaner? Rainwater or Tap Water?

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This experiment showed whether rainwater or tap water is cleaner. I conducted this experiment because if tap water is dirtier than rainwater, that would indicate we need to either get better (lead-free) pipes, or a better water source. Because the tap water was a bit cleaner than the rainwater, it IS safer to drink, but who knows what bacteria or chemicals may potentially be lurking in it that a microscope can't see. I also conducted this experiment for the health of everyone in California, because there might be a chance that we've been drinking hazardous water without anyone realizing it. I've read about certain states not having clean tap water, leading to autism/birth defects. This made me think that the same thing may be happening in California. I conducted the experiment by collecting rainwater in a small container, freezing it, letting it melt, putting it under my microscope, boiling it, and then putting it under my microscope again. I did the same with the tap water but didn't freeze it. At first, in their natural states, both water samples had many odd particles in them, but the rainwater had more that looked like germs based on what I've researched. When I boiled both of the liquids, there was barely anything left besides a few air bubbles, but the rainwater still had small, oddly shaped particles. To conclude, tap water, boiled or not, will always be cleaner than rainwater.

6825

Dropping Eggs in Oobleck

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My science project showed the strength and thickness of oobleck (a mixture that pours like liquid but is solid under pressure), along with the fragileness of an egg. For the project, I dropped an egg into an oobleck-filled container from certain heights, and used a stopwatch to time how long it took the egg to sink to the bottom. I used a clear see-through container, oobleck (in this case, 18 cups of cornstarch and 9 cups of water), a stopwatch, a piece of paper, a pencil, and measuring tape. I used all white-shelled eggs as well. The clear container had a width of 7 inches, a length of 10 inches, and a height of 2.5 inches. I filled it with oobleck to a height of 2 inches. For the first trial, I dropped an egg 5 inches from the oobleck. For the second trial, I dropped an egg 8 inches from the oobleck. For the third trial, I dropped an egg 12 inches from the oobleck. For the fourth trial, I dropped an egg 16 inches from the oobleck. Lastly, I dropped an egg 44 inches from the oobleck. When timing the drops, I started the stopwatch as soon as each egg hit the oobleck. The first trial resulted in the egg not cracking, and it sunk to the bottom of the oobleck-filled container 2 seconds after landing on the oobleck. In the second trial, the egg did not crack, and it sank to the bottom of the container 9 seconds after hitting the oobleck. The results of the third trial were the egg not cracking, and sinking to the bottom of the container after 12 seconds. In the fourth trial, the egg did not crack, and sunk to the bottom of the container after 13 seconds. Lastly, in the fifth trial, the egg also did not crack, and it sunk to the bottom of the container after 15 seconds. The results of my experiment showed me that eggs do not crack when being dropped in oobleck, no matter how high they are dropped from (based on the maximum height I tested). This demonstrated the impact gravity has on an egg when being dropped from certain heights onto oobleck. I also learned and became aware of the similar results of using oobleck to test with eggs when they have comparable forces being exerted onto this substance. I saw that an egg will sink in oobleck more quickly if it does not apply a strong and heavy force that keeps it sitting on the oobleck for a few seconds. This is due to oobleck's liquid-like characteristics when encountering non-harsh forces.

6826

Desalination Salvation

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My science experiment mimicked recycled thermal seawater desalination. I wanted to find out if different colors affect the amount of freshwater collected from seawater. I used three clear, high-walled plastic containers, each with different-colored bottoms: one white, one black, and one covered in foil. Each contained 250 ml of imitation seawater, and a straw with

a funnel at the drinking end. The other end of the straw went through a hole in the container and through a hole in a plastic cup, with both holes sealed with modeling clay. Each container also was covered with plastic cling wrap, taped to the edges, with a nickel above where the funnel was located. Using a heat lamp for a light source, the imitation seawater evaporated and condensed onto the cling wrap. Due to the nickel sitting on top of the funnel, the condensation ran above the funnel and dripped into it. Then the water went through the straw and into the cup. In a span of eight days during which I recorded data, with two restarts due to leakage in one container, I found that the container with the black bottom produced the most freshwater. Because a dark pigment absorbs light, it heats up, which in this case caused the water to evaporate more quickly. The foil-lined container produced the least amount of freshwater. Because foil reflects significantly more light than it absorbs, the water evaporated more slowly.

6827

How Much Weight Can the Surface Tension of Water Hold?

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This project showed how much weight water can hold due to surface tension. I chose this topic to see which objects would float on the surface or sink. I first found three objects, which were a paper clip, piece of paper, and a fork, and then filled a cup of water and a small bowl. I put each object on the water to see what would happen. As soon as the objects either sunk or stayed afloat, I wrote it down on a spreadsheet. I did not use different types of water, as that would not have affected the surface tension. The results of my experiment showed that the paper clip and piece of paper were able to stay afloat on the water's surface, but the fork's weight was too much to handle for the surface tension of the water.

6828

Do Plants Transpire At the Same Rate Under Different Sources of Light?

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This science experiment showed the different rates at which plants transpire under different sources of light. When looking for materials, I wasn't able to find all of the plants I wanted for the project. I originally planned to use different types of plants, but in the end I only used radishes. The materials I used consisted of three 2-liter plastic soda bottles, potting soil, scissors (or cutting tool), three young specimens of radishes, $\frac{3}{4}$ cup of water, a fluorescent lamp, a household lamp, sunlight, a spatula, and a graduated measuring cup. I placed one radish in each of the removable bottoms of the three plastic soda bottles. I cut the tops of the soda bottles to fit within the soda bottle

bottoms to imitate a terrarium. Each one was placed under a different light source for a period of 6 hours. I then compared and recorded the amount of transpiration. I used a spatula to scrape off the water from the inside of the soda bottles. Plant 1 (which was under sunlight) transpired the most out of the three. In total, it transpired about 2 teaspoons of water in the 6-hour period. Plant 2 was under a fluorescent light, and it transpired about 1 teaspoon of water. Plant 3 (which was under household light) transpired about ¾ teaspoon of water, the least out of the three. In conclusion, this experiment was very informative. I didn't know that plants transpired. I also had to grow the plants myself in a pot beforehand, so I learned how to care for a plant. The outcome was not what I expected. I expected the plants to transpire a lot more, but I knew the one under sunlight was likely to transpire the most, which is what ended up happening.

6829
Personality and Memory

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The purpose of my experiment was to determine whether our social orientation in terms of the eight psychological traits (Extraversion, Introversion, Sensing, Intuition, Thinking, Feeling, Judging, and Perceiving) has anything to do with our short-term memory. To do this, I gathered 24 volunteers and gave them each a personality test and a memory test. The personality test I used was an online survey based on Carl Jung's and Isabel Briggs Myers' typological approach to personalities. Once you complete the test, you will, like the website states, "obtain a 4-letter type formula" of your personality type. The 16 different formulas or the "4-letter type formulas" the site categorizes you by are:

- ENFJ -INFJ
- ENFP -INFP
- ENTJ -INTJ
- ENTP -INTP
- ESFJ -ISFJ
- ESFP -ISFP
- ESTJ -ISTJ
- ESTP -ISTP

To determine your formula based on the eight psychological traits, the test indicates which one fits you using this categorization:

- Extraverted (E) versus Introverted (I)
- Sensing (S) versus Intuition (N)
- Thinking (T) versus Feeling (F)
- Judging (J) versus Perceiving (P)

For the memory test, I used one I originally found online and printed 24 copies of it. This test included a total of six trials. It started off easy with only a couple of letters to memorize (in a random order), and progressively got more and more difficult. The participants were given 6 seconds to memorize the series of letters for each trial. The goal was for each volunteer to write down as many letters as they could remember. For accuracy, they were given the instruction to list the exact number of letters needed per trial whether they remembered them all or not. Past studies such as ones by Marti Olsen Laney already have proven that extroverts have better short-term memories than introverts due to the discovery of greater activity in certain neural pathways of extroverts. However, Carl Jung claimed that people can be characterized by their preference in general attitude, so what role and impact do the other six traits bring in addition to extroversion and introversion? After having all 24 volunteers perform these two tests, I created several documents. In one, I grouped together the volunteers who shared the same 4-letter type formula. Categorizing them this way made it simpler for me to organize them based on their individual 4-letter types. By doing so, I was able to easily find the average scores for each of the eight psychological traits (Extraversion, Introversion, Sensing, Intuition, Thinking, Feeling, Judging, and Perceiving). My results showed that people who are extroverts on average got 90.05% of the memory test correct, and introverts averaged 88.26%. Those with the sensing trait averaged 89.6%, those with the intuition trait averaged 90.8%, those with the feeling trait averaged 89.2%, those with the thinking trait averaged 91.56%, those with the judging trait averaged 90.0015%, and, lastly, those with the perceiving trait averaged 90.08%. This meant the following:

- Extraverted (E) > Introverted (I)
- Sensing (S) < Intuition (N)
- Thinking (T) > Feeling (F)
- Judging (J) < Perceiving (P)

This also meant that the best 4-letter type formula in terms of short-term memory was an ENTP. I went back and looked at my data. The only person to score 100% on the memory test was R**** (the name is not shown for privacy reasons). Not only that, but he was an ENTP. Because extroverts have a shorter dopamine pathway, they have good short-term memory, which allows quick thinking. In addition, the activation of the sympathetic nervous system means that extroverts act quickly under stress. Take a second to reread that statement. Do you notice any of the other traits listed for an ENTP in there? To act quickly means to act on your instinct or intuition, and because the shorter dopamine pathway is found in an extrovert (another trait there), they have good short-term memories because of their quick thinking. Not only that, but in order to recall something, you have to be able to recognize it, which is exactly what it means to be perceiving. In conclusion, the perfect 4-letter type formula is an ENTP, and people with those individual psychological traits may have better short-term memories.

6830

Does Playing Meditation Music Help Soothe the Nerves of Stressed and/or Excited Dogs?

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This project demonstrated what happens when you play meditation music to dogs when they are barking or showing characteristics that could be described as excited or stressed. I chose this project to see if playing this music would calm the dogs down/soothe their nerves. I experimented with four dogs using the following procedure: First, I recorded the number of breaths taken by each subject per minute using a stopwatch. Next I activated their stimuli. For example, I threw a dog biscuit twice for each subject to chase after and get excited about. After this, if it was possible, I counted the number of breaths per minute once the subject was visibly excited. I then used the stopwatch to record the amount of time it took for the subject to become visibly calm (lying down, slower breathing, etc.). Once the dog was visibly calm, I counted its number of breaths per 30 seconds, 60 seconds, and 120 seconds. Then I started the process over by activating the dog's stimuli again, but this time once the dog became visibly excited, I started to play meditation music instead of waiting for the subject to calm down on its own. I learned that the meditation music seemed to relax the dogs who were stressed/excited more quickly than letting them calm down on their own. Their breathing was slower and they stayed still longer when the meditation music was playing, but when they were left alone these results took more time to take effect. It is worth mentioning that because I was testing dogs, there were some variables that I couldn't control. For example, when there was a loud noise that interrupted the experiment, they got distracted. But for the most part, this was the result of observing dogs calming down on their own versus calming down while listening to slow meditation music.

6831

How Do Four Drinks Change After Three Days?

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The purpose of this science project was to leave out four drinks – Brisk® lemon iced tea, milk, French vanilla latte (coffee), and melon agua fresca – for three days and see the differences over time from Day 0 to Day 3. I was curious about what would happen to some drinks after leaving them out for a few days and decided it would be an interesting experiment. Would the drinks change color, state, or smell? Either way, it would be very fascinating to see the results. My overall findings were that, on Day 3, the milk was very chunky and there was still liquid in it. It almost looked like cottage cheese. Before mixing it, the milk was still, and there wasn't any movement in it. Through the glass, the chunks and cracks were visible. Once it was mixed, the chunks became more clearly noticeable. It also

started to have a bit of a foul scent to it. For the Brisk lemon iced tea, nothing really happened to the liquid over the three days. However, the white outline around the drink from Day 0 was gone. It looked the same before and after mixing. With the French vanilla latte (coffee), not much happened apart from the fact that some of the French vanilla creamer appeared at the top and it was also evaporating. On the last day, at the top you could see the cream formed. There also were bubbles/bumps that formed at the top. The scent was constant, which was the smell of coffee beans. When the coffee was mixed, nothing really changed from how it looked before it was mixed, except the bubbles went away. Lastly, the melon agua fresca had already changed from Day 0 to Day 1. The melon separated from the rest of the water and liquid. It had an awful smell that I believe was because the melon had rotted. It also was really foamy at the top and there were many bubbles. The melon not only separated, but it also split into small pieces at the top. When the drink was mixed, the substance was slimy and it seemed almost to have consistency like that of applesauce. In conclusion, I learned more about what happens when leaving drinks out and how they change over time. This experiment was really intriguing and fun to do. I might just do it again with other drinks next time.

6832

What Type of Water Makes Plants Grow More Quickly?

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My science fair project determined what type of water makes plants grow the most quickly. My hypothesis was that if three plants get three different types of water (salt, purified, and tap), then the purified water plant will grow more because it will not have to filter out impurities from the water. The purpose of this experiment was to help people so they use the right kind of water when they water their plants. For this experiment I first got three clear plastic cups with dirt in them. Then I got the seeds to plant and put them in each corner to see their growth. After that I watered the plants every two days and recorded their heights by taking pictures and making a table for a graph. My results were that the plants that received the purified water did better since they didn't have to filter out things. The tap water plants did better than the saltwater plants, but worse than the purified water ones. Lastly, the saltwater plants didn't grow. In conclusion, this experiment showed that purified water is better for plants than the other two types of water tested, but if you want to save money then tap water is good. However, saltwater is not good for your plants.

6833

A Demonstration of Osmosis Using Gummy Bears

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This project showed how osmosis works in different solutions. I chose this topic to see how different solutions affect gummy bears. I used saltwater, baking soda water, sugar water, vinegar, and regular water, placed one gummy bear in each of the solutions, and let them sit for 12 hours. After this time, I carefully removed each of the gummy bears from the solutions and carefully observed them. Each of the solutions had a different result. In osmosis, the water inside the solutions travels from the side of the membrane with the lower amount of pressure to the higher amount, wanting to equalize the concentration of the solutes. As a result, the gummy bears not only grow, but their texture becomes softer than that of the original gummy bears.

6834

Density to Filterability Ratio

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In my experiment, I wanted to find a ratio between the time it takes for a liquid to pass through a coffee filter and the density of the liquid. I used six different liquids – cherry syrup, orange juice, pomegranate juice, sparkling water, milk, and regular water. I consistently used 250 ml of each liquid and weighed them in a measuring cup. The measuring cup weighed 379 g. I subtracted that from the weight of the liquids. The liquids I used had a variety of densities, ranging from cherry syrup at 1.248 g/ml to water at 1 g/ml. I poured each liquid through a Melitta® brand coffee filter and recorded the times. All of the liquids except orange juice passed through. It did not because of the pulp in it, which clogged up the filter. The liquid that took the longest amount of time was cherry syrup, at 1 hour and 29 minutes, and the liquid that took the least amount of time was water, at 1 minute and 10 seconds. I also made a ratio for each liquid. The ratio was between the density and the time it took for the liquid to pass through the coffee filter. My hypothesis was that the ratios between the weights and the densities of the liquids would be proportional to each other. However, after finishing my project, I realized that my hypothesis was wrong, and creating ratios for each individual liquid is possible, but they will be far from proportional. My initial thinking was that the heavier a liquid is, the higher the ratio will be. This was mostly correct; however, the ratios I made still were not proportional. This was due to the fact that because I used the same amount of each liquid, the weight was the only thing that changed in the density equations. And the weight of each liquid didn't always match how quickly it went through the coffee filter. Orange juice had a density of 1.24 g/ml and milk had a density of 1.132 g/ml. Milk passed through the filter

in 3 minutes and 47 seconds, but the orange juice didn't pass through. This was because of another factor: the pulp. The pulp didn't weigh much; however, it greatly affected its ability to pass through. The same thing happened with the cherry syrup. It had a density of just 0.868 g/ml more than the milk, yet it took 1 hour and 26 minutes more. This was due to the sugar in the syrup, which made it thick. Thus it was harder for it to pass through the coffee filter. In conclusion, I learned that creating proportional ratios for all liquids between their density and their "filterability" is simply impossible. This is due to all of the tiny differences between the liquids that don't show up in the density.

6835

Which of the Following Has the Most Vitamin C: Orange Juice, Carrots, Lemonade, or a Lemon?

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The purpose of this project was to show which of four items – orange juice, carrots, lemonade, and a lemon – contains the most Vitamin C. I first made a cornstarch-iodine solution. I mixed 2 tbsp. of cornstarch in 500 ml of water, and filtered the starch solution through two to four of thicker-brand paper until there was a clear liquid. I added tincture of iodine by drops with constant stirring until the solution turned a deep, dark blue. I then used the chemical procedure of titration. I dissolved a 500 mg Vitamin C tablet in 500 ml of water to make the standard solution, and I poured 10 ml of the blue indicator solution into a clear glass cup. Using a pipette, I put a drop at a time of the standard solution into the indicator solution. I recorded how many milliliters of the standard solution were added to the indicator solution until it began losing its blue color. The amount that was used was for titrating 10 ml of blue indicator. For this experiment I had to filter out the juice inside the items. Then I poured 10 ml into a clear container. Using the pipette, I dropped juice one drop at a time into the indicator solution. I calculated the amount of Vitamin C per milliliter of juice by dividing x by y . The results showed that orange juice had the most Vitamin C because it took less amount of titration to become clear when titration was performed.

6836

Do the Different Foods/Drinks We Consume Affect Our Heart Rates?

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My project explained how the different foods and drinks we consume affect our heart rates. I wanted to find out how different items change our heart rates, meaning whether they lower, raise, or keep our heart rates the same. I used different foods

and drinks and placed them under several categories: sweet, oily, healthy, etc. I recorded how different people's heart rates changed from before to after the foods/drinks were consumed, and documented the results. My hypothesis was mostly correct: All of the foods/drinks changed the heart rates in some way. No heart rate was the same before and after food/drink consumption. The biggest change came with the Starbucks Frappuccino®. This was pretty obvious because Frappuccinos have a significant amount of caffeine and are pretty sugary; for the people I tested, the heart rates increased on average by six beats per minute (BPM). The second-highest change in BPM came with the spicy chicken sandwich. It raised the heart rates by an average of five BPM, probably because it was very oily and was spicy. All of the changes were due to the amount of vitamins, fat, and sugar in a food item or drink. Cholesterol, dietary fiber, protein, and carbohydrates also can affect your heart rate.

6837

What Do Plants Grow Better With?

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This project was about which type of water is best for watering plants. I used three aloe vera plants to test the water samples on each one, using microwaved water, boiled water, and tap water. I let the water cool so the plants wouldn't die afterward. After it cooled, I watered the plants, and did this once a week for eight weeks total. The microwaved water plant was pretty decent, but it started to dry out toward the tips of the plant. The tap water plant also dried up at the tips. It was the control, but it did not do well. The boiled watered plant grew the best, and out of all of the plants, it was the only one that didn't dry up. So the next time you water your plants, use boiled water, let it sit for a while, and then water them.

6838

Does Peppermint Improve Reaction Times?

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My science project showed how eating peppermint affects reaction times. I gathered 10 participants who were willing to take an online reaction time test before bedtime for two nights. On the first night, they took the test without peppermint. On the second night, they took the test while eating peppermint. The online test recorded the time it took them to see and identify the color of a stoplight, and then click a button. After five tries, each volunteer's average score was shown. Each person recorded their average times on both nights and sent the information to me. The results were that nine out of the 10 participants had a quicker reaction time when they took

the test while eating peppermint. By conducting a paired t-test on the data, I found that the two data sets were significantly different, which meant that peppermint improved reaction times.

6839

Which Common Household Object Generates the Most Electricity?

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My science research project examined how I can use household objects to generate electricity. I chose this topic because I wanted to find more natural, alternative, and cost-effective resources for electricity generation to reduce the amount of fossil fuels (gas, coal, and oil) that are burned. As of 2019, fossil fuels still generated 62.7% of the electricity in the United States (U.S. Energy Information Administration). Using a voltmeter, I experimented with different household objects that could possibly generate electricity. I started by gluing a magnet to the bottom of a plastic cup. Next I filled the cup with tap water and then added shakes of salt slowly into the water. Using a voltmeter, I measured the voltage, which turned out to be 116 millivolts at its highest. I then measured the voltage of a potato, apple, lime, and orange. The apple measured 16 millivolts, the lime measured 30 millivolts, the potato measured 20 millivolts, and the orange measured 35 millivolts. Given these results, I realized that a plastic cup with a magnet at the bottom and filled with salt and tap water generated the most electricity out of all the common household objects I tested.

6840

Which Material Can Boil an Egg More Quickly?

Sehivon Valacheril and G. Zem (teacher)

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My experiment was based on a question that I've had in my mind for a while, which is the conductivity of heat of different metal cookware with different shapes and sizes. I used two pots I had at home, and my goal was to understand which one I could boil an egg in more quickly. First I learned that one pot was aluminum and one was steel. I noticed that aluminum was lighter and not as strong as steel. The aluminum pot's tip was more closed (it had a narrower top opening) and the base was smaller, while the steel pot's tip was larger and the base was also bigger. I started the experiment using a stopwatch to count the minutes an egg took to boil in each pot. Each pot had three cups of water in it and the heat set to 6, which is a medium to high temperature heating level. I watched the experiment the entire time to make sure there were no interferences that might affect my purpose. After waiting for around 11 minutes, I was shocked to see that the aluminum

pot's egg cooked more quickly than the steel pot's egg. I thought that the steel pot would boil the egg more quickly based on the many benefits I stated above, but aluminum was the winner.

6841 Is Homemade Ferrofluid As Good As Store-Bought Ferrofluid?

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My project determined whether or not homemade ferrofluid (a fluid with very small magnetic particles) is as good as store-bought ferrofluid. For my experiment, I made two different ferrofluids using various supplies and compared them to the store-bought ferrofluid. To make the first ferrofluid, I broke apart cassette tapes, put them into a bucket, and filled the bucket with acetone. After that, I covered the acetone-filled bucket with various materials I found around the house. After a few hours passed, I covered a magnet with plastic wrap to collect the ferric oxide that came from the tapes. Afterward, I put the ferric oxide into a container, poured in some vegetable oil, and mixed my concoction to make the first ferrofluid. To make the second ferrofluid, I added toner powder into a bowl, poured in a few tablespoons of vegetable oil, and mixed well. If the mixture was not thick enough, I added more vegetable oil until I got my desired result. Then I poured the original ferrofluid into a bowl and started to compare the color, smell, reactivity, and other factors. In the end, I found out that homemade ferrofluid was not at all as good as the store-bought product. Everything, from the color to the texture of the fluids, was not similar to each other at all.

6842 Does the Fold of a Paper Airplane Affect How It Flies?

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This project showed whether the number of folds of a paper plane affects how it flies. I chose this topic because I love to fly planes and I wanted to see how I could replicate throws. All five throws of each model were made under the exact same conditions, with no wind. The paper used was the same type, and every plane also had a small piece of tape on the nose to stop it from bending upon impact. After every throw, the distance was tracked on a chart. In the beginning, I thought that the most modified plane (with the most folds) would travel the farthest. As it turned out, the plane with the fewest number of folds traveled significantly farther. The next-best plane traveled an average of exactly 8 feet less. The top plane exceeded my expectations, as it had a maximum of 33 feet 6 inches in distance traveled, with an average of more than 26 feet. This experiment was very fun to test because I was able to throw

airplanes. Although my prediction was incorrect, I considered this experiment a success because I found a simple and perfect paper airplane.

6843 The Role of Vision in Maintaining Human Balance

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Along with proprioception and vestibular cues (both related to perception of body position and movement), vision is used to help an individual balance. When one of these inputs is taken away, the remaining inputs are reweighted to have a greater impact on an individual's balance. When two or more of these inputs contradict each other, an individual must rely more heavily on one of the contradicting inputs than the other(s). In order to investigate the impact of different visual stimuli on a person's ability to walk in a straight line, participants in this study were asked to walk along a line under three different visual conditions, with each condition attempting to assess proprioception and vestibular cues. Participants appeared to have more difficulty maintaining their balance both when they received no visual information and when they received contradictory visual information. In addition, participants seemed to have the most difficulty orienting themselves when faced with the contradictory visual information. Although the results of the study were not statistically significant, they did suggest that further studies should be done on the impact of false visual information on balance.

6844 The Link Between Females of Different Ethnic Groups and Their Susceptibility to Cognitive Impairment

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A preliminary study was conducted to establish a possible connection between access to basic food needs and cognitive function among Mexican American, non-Hispanic white, and non-Hispanic Black women. In this study, data was retrieved from the National Health and Nutrition Examination Survey (NHANES) 2011-2012 database. Specific questions on food security, balanced meals, and animal naming were asked and the results were analyzed. Respondents from the non-Hispanic Black community reported "often true" the most among the ethnic groups to the question "couldn't afford a balanced meal"; responded "never true" the most among the ethnic groups to the question of having "adult food security"; and they had the lowest animal naming test scores among the ethnic groups. This indicated that they have high cognitive impairment. Mexican American women had the fewest number of participants in the NHANES database, suggesting there is a greater need for additional studies within this particular group. This preliminary study had interesting results and highlighted

the need for more work in this area to further explore connections between ethnic groups and their likelihood of cognitive impairment related to food insecurity.

6845

Measuring the Relationship Between Digital Stimuli and Heart Rate

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As technology becomes a more prominent component of daily life, it grows in influence on human health and behavior. This study aimed to explore the interaction between technology and human emotion. Selected participants viewed a series of videos and images determined to elicit an emotion of happy, scared, or sad. The heart rates of the participants were measured before and during the viewings as a way to determine emotional effect. In addition, the participants self-reported their emotions using a Discrete Emotions Questionnaire. The subjects reported a happiness response 56% and 63% of the time when watching the happy video and happy image, respectively. For the scary video and image, the participants reported a 33% anxiety response and 44% disgust response. The sad video and image resulted in 63% and 42% in sadness responses, respectively. The results from the statistical comparison between heart rates and video or image type revealed no statistical difference. Continued work in this topic area should address participant sample size and experimental design improvements before making final conclusions on links between emotions and heart rate.

6846

An Examination of Tillage and Cover Crops on Soil pH and CO₂ Respiration

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Tillage and cover-crop applications are two soil management strategies that have possible effects on soil pH and carbon dioxide (CO₂) respiration. This study was conducted to determine if these soil management strategies affected soil pH and CO₂ respiration levels at Little Portion Farm in Ellicott City, MD. Additives for tilled and non-tilled soil (cover crop applied one year ago, compost application, and vegetable plants planted in those plots), as well as decaying bamboo-like material coverage found in the non-cover-crop-treated plot, were applied prior to the tests performed in this study. A chemical pH test and a biological CO₂ respiration test were then performed and the findings compared between soil samples from the tilled and non-tilled plots, as well as from the cover-crop-treated and non-cover-crop-treated plots. The test results indicated no significant statistical differences in pH values or CO₂ respiration levels between the tilled plot and the non-tilled plot, nor

the cover-crop-treated plot and the non-cover-crop-treated plot. Additional studies and experimental design are proposed, and should be conducted, to further explore the effect of tillage and cover-crop application applied on agriculture plots before final conclusions can be made.

6847

A Study on Ground-Level Ozone in Baltimore, MD

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Air pollution has negatively affected multiple cities, including Baltimore, MD. According to the American Lung Association, from 1990 until 2017, Baltimore's ground-level ozone levels exceeded the federal limit. Baltimore's number of high-ozone days can be attributed to multiple factors, such as building placement, humidity, population, wind direction and speed, and temperature. In this project, wind direction and speed, along with temperature, humidity, and building direction, were analyzed to assess ground-level ozone propensity in Baltimore. A focus on residential areas indicated that wind flow and building direction may not be able to circulate smog. In addition, due to population growth, there has been an increase in TRAP (traffic-related air pollution). Proposed solutions to combat these high levels of ozone include implementing green spaces near parking lots and regulating industries that produce smog.

6848

The Effects of Pseudoephedrine on *Caenorhabditis elegans* Activity

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In recent years, there has been an increase in drug-facilitated sexual assaults in the United States using over-the-counter drugs such as Sudafed® (reference unknown), which contains the active ingredient pseudoephedrine HCl (PSE HCl). Studies have shown that the model organism *Caenorhabditis elegans* (*C. elegans*) experiences sensitivity to human toxins and drugs, and has many of the same receptors and signaling pathways that are found in mammals. Therefore, *C. elegans* is an adequate organism to study the effects of pseudoephedrine. This experiment tested the hypothesis that the introduction of pseudoephedrine to *C. elegans* will increase its activity, measured in the number of thrashes per minute. The activity of *C. elegans*, in the number of thrashes, was recorded as the organisms were exposed to four different concentrations: a sterile nutrient broth, 0.5x PSE HCl, 1x PSE HCl, and 10x PSE HCl. The 1x concentration of pseudoephedrine had the largest effect on *C. elegans* and increased the number of thrashes per minute of the organisms, supporting the hypothesis. This research may lead to the investigation of pseudoephedrine reversal drugs,

and positive findings in this area could drastically affect many areas in pharmacology studies and revolutionize treatment. This could also contribute to the actions of those trying to prevent crime, especially drug-facilitated sexual assault using over-the-counter drugs.

6849 Impact of Acne Solutions on Bacterial Growth

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This study focused on how different types of acne solutions affect the amount of facial bacterial growth. In the study, we used agar and acne solution products to grow facial bacteria from problematic acne areas, and then recorded how the growth of bacteria varied per solution. The three products we used were benzoyl peroxide-based, salicylic acid-based, and tea tree oil-based. Samples of acne-prone skin were swabbed and placed in a Petri dish with agar. Then each acne solution product was placed as a second layer on top of the agar, while for the control a separate Petri dish was used with no solution to measure the growth of the bacteria alone. We found that the product that most efficiently stunted the facial bacterial growth was the benzoyl peroxide-based one, while the next best was the tea tree oil-based product. The salicylic acid-based product was the least efficient in preventing the growth of facial bacteria, seeing that there was more growth there than on the control. From this data, we inferred that if this person were to choose a product to clear the bacteria from their face, using a benzoyl peroxide-based or tea tree oil-based product would help decrease facial bacteria and possibly efficiently clear up their skin.

6850 Cleaning Product Effect on Bacterial Growth From Household Items

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Our experiment observed bacterial growth on household objects with the use of three different cleaning products: Seventh Generation® (advertised as eco-friendly), Clorox® (chemical-based), and vinegar (used for homemade cleaning solutions). The overall purpose was to see if these cleaning products are actually effective in impacting the amount of bacteria, including if they change the form of or damage bacteria in any way, and if the way they are advertised is accurate or faulty at all. The bacteria were taken from household objects and grown in an incubator, after which colonies were selected and transferred to Petri plates containing the cleaning products to see if there would be a reaction or change. Trends seen were that the bacteria were mostly killed by the eco-friendly cleaning solution, while some still grew in the Clorox as well as in the vinegar. Our results showed that the eco-friendly cleaning

product was the most accurate in killing the bacteria, while the other cleaning products were less effective. This indicated that eco-friendly cleaning products should be used due to their capability and because they are safe for our environment.

6851 Effects of Colored Water on Algae Growth

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While it may sound trivial, trying to determine the effects of colored water on algae growth is very important regarding the use of photosynthesis in algae or even aquatic plants. The goal of this project was to find out if certain colored water potentially affects this process in different ways. Colored water has been used to slow algae growth before, but does color have a significant effect, and can certain colors potentially be more effective for different reasons? The study was conducted by testing cups of algae with different colorations under similar growing conditions, with the use of scales to measure the mass of the cups and evaporation taken into account with a cup of plain water. The results showed that the algae in the colored water developed slightly differently than the algae in the clear water, demonstrating the concept of how pigments of the color dyes used in the water caused photosynthesis to slow down, and thus the growth of the algae cells. Based on observation alone, it cannot be said if the water coloration affected the algae growth in each cup. The findings of the study led to a conclusion that the colored water's effects were fairly minimal in slowing down growth, but that the colored water still had an effect compared to clear water, with yellow water having almost no additional impact on slowing down algae growth.

6852 Hamster Activity Levels By Gender

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In nature, the behavior of many animals depends on whether they are male or female. Sometimes the male does more work than the female, or maybe the female is quicker than the male. For this experiment, we compared female and male hamsters based on how active they were. The overall purpose of the experiment was to find out if the sex of a Roborovski Dwarf Hamster determined if they are more active. The question we wanted to answer was: "Does the gender of a hamster determine their activity level?" We designed this experiment in a way that we would be able to tell when each of the six hamsters (three male and three female) was active. Each hamster had a cage and a wheel, and of course also had water and food. The three female hamsters usually started exercising on their wheel at around 10 p.m., whereas the males didn't start until around 12 a.m. or 1 a.m. Every time a hamster became active, the time they started was written down, and the time they stopped also

was recorded. This way we could tell which hamsters were active the longest. A trend we noticed was that the females were almost always more active than the males. From what we studied and observed, we came to the conclusion that in this group of six Roborovski hamsters, the females were the most active. The female hamsters started exercising earlier than the males, and always finished later. For this reason we believe that the female hamster is more active than the male hamster.

6853

Light Color Impact on Yeast Growth

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Yeast are made of single-celled fungi and are a major component in the lifting of bread. Bread is able to lift due to yeast respiration that occurs in the dark. A major characteristic of yeast is sensitivity to light. This study investigated how the direct intensity of colored and white light affected the anaerobic respiration of yeast. In the experiment, dry yeast were placed under red, blue, green, and white light for 24 hours before yeast respiration occurred. The average difference for yeast under colored light ranged from 0.2 mm to 0.4 mm. For each trial, the difference of end and initial height ranged from 0.2 mm to 0.3 mm. Only one trial conducted in this study had a difference of 0.5 mm. Overall, very little yeast respiration was observed. We believe this was because the wavelengths of light damaged the yeast, making them unable to respire at a normal rate.

6854

The Impact of Light on Ant Colonies

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In our paper we presented and analyzed whether ant colonies are affected by the amount and type of light they receive. We conducted an experiment where we placed three separate ant colonies in three different light sources and observed their tunnel building. Fifty ants were placed inside each ant farm with the same amount of tunneling sand. One ant farm was placed in normal daylight, one in complete darkness, and one under green light. Over the course of the experiment, it was noted that the ants in the farm placed in complete darkness showed the most progress in terms of tunnel construction. The ants in the daylight farm finished second, and the ants in the green light farm made the least progress. Prior to the experiment, we expected the best results from the ants in the natural daylight because that is the condition they normally experience in nature. Based on our data, we concluded that the ants in the farm in complete darkness created the largest collective tunnel length.

6855

The Effects of Native and Non-Native Plants on Pollinators

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This study was conducted to see the effects that California native and non-native plants have on pollinators in an ecosystem. The basic study design involved creating and placing a pollinator box surrounded with four different plants of different species. For an hour on every Friday, Saturday, and Sunday, we observed the pollinator box and counted the inhabitants in it, which signified if the plants were attracting any pollinators. This procedure was repeated three separate times, each for a different scenario: a pollinator box with native plants, with non-native plants, and with a combination of both. From our analysis, there seemed to be a trend of more pollinators visiting the box of non-native plants. However, upon doing a chi-square test, it was proven that the trend seen was not significant. At the end of the study, we concluded that the local pollinators of California do not have a preference between the state's native and non-native plants.

6856

Basil Herb Growth Rate Analysis

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The purpose of this experiment was to calculate and analyze the growth rate of basil herbs over a certain amount of time when exposed to different substances. We wanted to test these plants with different substances and see how each affected their growth. The experiment also was used to evaluate the process of photosynthesis over time. It enabled us to analyze the different pH of soil and how the texture of soil affected the growth rates of the plants. Some issues we faced in our research included: How many basil seeds should we plant in each container? How quickly do basil herbs grow? What do basil herbs need in order to stay healthy? For the process, we gathered basil herb seeds and four plastic containers, and planted seeds in each container. We squeezed lime juice into one container and added a spoonful of apple cider vinegar to another container. Lime juice is supposed to increase the pH of the soil, making it less acidic, and apple cider vinegar lowers the pH of the soil, making it more acidic. We also had two other containers: one that was exposed to nothing except sunlight, and one that stayed inside (with no sunlight), and wasn't exposed to anything else. Our results showed that the plant with nothing but sunlight grew the most quickly. According to our analysis, sunlight is the main factor for plant growth, and the ideal pH of the soil matters. Our conclusion from this experiment was that the plant with only sunlight grew the most quickly compared to the other plants, which had a slower growth rate.

6857 How Does Acid Rain Affect Plant Growth?

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In our study we asked, “How does acid rain affect plant growth?” To find the answer, we watered two groups of the same plant with water with different pH levels. One group received water with the same pH level as acid rain. The second group received water with a neutral pH level, and acted as our control group. Our findings showed that acid rain does affect plant growth. We had predicted that the acid rain plant group would have a lower growth rate. However, this was proven incorrect by our data, which showed that the acid rain group had a greater growth rate than the control group.

6858 Decay of Fast Food Hamburgers Versus Homemade Hamburgers

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The objective of this study was to test the decay time of a McDonald’s hamburger versus a homemade, preservative-filled burger. We researched the purpose of preservatives in food, and the effects of preservatives on food and the human body. For the experiment, we bought a burger from McDonald’s and made a burger ourselves, put them in separate containers, and kept them next to each other to observe for the next 40 days. During the first 10 days, the McDonald’s burger began to grow mold, unlike the homemade burger, which still showed no signs of mold. Throughout the experiment, the McDonald’s burger always had more mold than the homemade burger, and it grew mold more quickly. We concluded that the McDonald’s burger contains very few preservatives after analyzing the data, which consisted of the decay rate of both burgers. The data proved that the McDonald’s burger decayed more quickly than the homemade burger made with store-bought ingredients and preservatives.

6859 Exercise and Blood Pressure

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Throughout life, people look for ways to reduce their blood pressure to prevent getting chronic diseases. People think that doing strenuous exercises or going on extreme diets will help lower their normal blood pressure. The purpose of this research was to prove that doing simple exercises can decrease a person’s normal heart rate over time, and that the amount of time is equal to the time in which a person doing strenuous exercises lowers their blood pressure. This study was conducted over

a seven-week time frame and tracked the blood pressures of six participants. Three of them followed a strenuous routine consisting of three forms of exercises, while the other three only had a simple exercise routine consisting of one exercise a week. From the information our group analyzed, there is a slight possibility that doing simple exercises can decrease a person’s normal heart rate, and in the same amount of time it takes a person doing strenuous exercises to decrease said heart rate. The key is for people to find a way to include some form of exercise in their daily routine without doing the typical activities people think of when they hear the word “exercise.”

6860 The Influence of Classical Music and Coloring on Stress Reduction in High School Students

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Stress is recognized as the physical reaction to feeling threatened or overwhelmed, which can manifest itself in various ways in an organism’s body. This study was designed to measure the influence of classical music and coloring on the reduction of stress in high school students. Using a population of 16 participants ages 14 to 17, each enrolled in high-performing magnet programs, a baseline measurement of the participants’ stress was taken at the study’s onset via blood pressure recordings across a two-week period of time. The first unit of exposure was classical music, which was prescribed to be listened to daily for several hours over a two-week period. Following exposure to the music treatment, a new baseline measurement was taken across two weeks, prior to exposure to the second experimental measure of coloring. All participants were given coloring sheets and requested to color once daily for a period of two weeks. Per participants’ reports, coloring was found to be significantly more beneficial in stress reduction.

6861 Effectiveness of 2% Salicylic Acid Soap on Reducing Acne

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Acne is a wide-reaching skin affliction that affects many adolescents, with most of the treatments being over-the-counter products. The goal of this study was to test the effectiveness of Neutrogena® Deep Clean® Facial Cleanser soap and, by extension, 2% salicylic acid soaps on acne. The study also was performed to determine the accuracy of the advertised information. The experiment was conducted by analyzing changes in acne presence over a six-week time span when the Neutrogena cleanser soap was used, with environmental factors accounted for. Our testing found that the Neutrogena product led to an

erratic distribution of results, with only one-third of the participants obtaining the results promised by the advertising. This implied that 2% salicylic acid soap is not an effective method to reduce acne. However, it is possible that unaccounted environmental factors skewed the results. More studies need to occur to obtain a definitive answer on whether 2% salicylic acid soap is an effective means for acne treatment.

6862

Impact of Temperature on Plant Growth and Health

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This study focused on changes to plants when they are in an environment with higher temperatures than they usually experience. Observing these possible changes hopefully can show the major issues in placing plants in high temperatures. This should be helpful in making sure to follow the growing requirements already set for the plants so there is a higher likelihood of longer and successful growth. The overall purpose of this project was to demonstrate the importance of following specific instructions given on plant needs. For the experiment, four sets of two pots were used. The sets included one pot with an already grown basil plant and another starting from seeds in a container inside the pot. Each set had its own heat lamp to provide a certain temperature, with one set acting as a control. The control plants were placed in a regular indoor temperature, so a heat lamp wasn't needed for this specific group. The temperatures were set using the distance of the heat lamps, with closer providing a higher temperature and farther being cooler. Plant heights and soil pH were recorded throughout the experiment. The grown plants were measured in inches and the seeds in the germinating pot were measured in centimeters. Using a soil meter, the pH levels were recorded for every set. According to the experiment results, temperature did have an effect on the growth and survival of the basil plants. In an area with a higher temperature, the grown basil plants wilted more quickly than the plants that were exposed to a lower temperature. As for the germinating pots (starting with seeds), the seeds grew at individual rates with different survival spans. The pH soil levels decreased in certain areas of the experiment. The control had a slight neutralizing pH in the pot with basil plants. At a temperature slightly higher than normal, there was a pH change in the pot with basil seeds. Higher temperatures were shown to have a certain amount of negative effects on the plants used in the experiment. Though the plants in the higher temperature were able to survive to an extent, their life span was very short compared to what a planter normally wants.

6863

Preferences For Radishes Grown Using Different Methods

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The way in which food is grown or made can have a large impact on consumers. Fruit and vegetable growth factors are an important example of this. People have preferences on how they want their produce to be grown. Some prefer organic, others prefer pesticides, and there are those who don't care as long as it's good. For our experiment, we wanted to test people's response to radishes grown using different methods. Some were treated with pesticides to ward off any pathogens, some were watered with polluted water, and others were grown normally without any additions. We found six participants who were willing to eat radishes, and separated them into two groups of three. One group would be told about how the radishes were grown to see if it would affect how they would perceive their taste. The other group would be given the radishes without any information on growth methods to see if they would find a difference among them. By doing this, we wanted to determine if the information provided or not provided would affect how the participants perceived how the radishes tasted. Unfortunately, our radishes died before we were able to conduct our study. Some stray cats came into the backyard and knocked our plants over at various times. It got to the point where we couldn't find a suitable spot for our radishes to grow without any problems. In addition, because of the COVID-19 outbreak, our ability to communicate with our test subjects and our group members was limited. And, because of the lockdown that was enforced, we were unable to follow through with our behavioral study. One positive aspect of this experiment was that we were able to record the growth of our radishes for about three weeks. A specific trend we found was that the radishes grown naturally had a higher growth rate than the others.

6864

The Impact of Exercise on Mental Health

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The purpose of our study was to see how much impact exercise can have on one's mental health. To conduct our research with as little error as possible, we gave our participants a weekly exercise routine with a varying first workout, but the remaining two workouts stayed the same throughout the study time frame. Our participants logged how they felt every day after they finished their workouts. They used a scale we put in place for them, 1-10, with 10 being the absolute best they could feel, and 1 being the worst they could possibly feel. We also included a segment where they could indicate whether there were external factors altering the way they felt. They could, if they

chose to, elaborate on what was going on in their lives. While not fully revealing this information, we did determine that the exercise had relatively positive effects on those who participated. We also made very interesting observations regarding specific exercises and their correlation with mental health in contrast to other workouts, since we alternated every day. One major source of error that arose during our experiment was the emergence of COVID-19. The virus made it difficult for participants to accurately log their results, as many had issues with their Internet connection, etc. – not to mention the fact that it seriously affected the mental health of many to the point where the exercise wasn't having the same effect as before.

6865

Does Working Out For a Short Time Help Improve Test Scores?

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In this study, we examined whether working out (physical exercise) for a short period of time helps improve test scores. Ten participants took part over a three-week period. On Mondays, the participants did not perform any physical exercise, and were given a 10-question math test that was timed for 20 minutes. The participants were asked to work out on Tuesdays and Thursdays with a pre-planned workout routine provided to them. The same test from Monday was given on Friday with all of the questions randomized. The results showed that the participants had better scores on the test given after the workouts than on the test after they did not work out. It seems that physical exercise helps processes in the brain use and retain knowledge for skills utilized on a test.

6866

Which Gum Flavor Helps Students Focus More While Studying?

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The overall purpose of this study and the research problem we investigated focused on determining which gum flavor helps students focus more during their study time. Unfortunately, because of the COVID-19 outbreak, our communication was lacking due to the fact that students were out of school. It pushed our study back because we could not meet each study participant and give them gum. As a result, all of the gum flavors we wanted to use were not tested. Our last test, before the pandemic, was during the week of March 9–March 13. We made sure to choose volunteers who had a hard time studying, those who were great at keeping focus while studying, and even those right in the middle so we could get accurate results. We had a total of 24 participants, including ourselves. We selected five different flavors of gum by the brand Extra®

for the study. We planned to give two strips of gum flavors to each of the participants at the beginning of each week for about 2 ½ months. Also, we planned to conduct a survey at the end of each week on the effectiveness of every flavor, leading to the final input in a scenario where all of the data were collected, no flaws were found, and the gum was distributed as planned. However, because of the pandemic, we were only able to give the participants the gum at the beginning of that one week in March, use three weeks, and experiment with three gum flavors (mint, cinnamon, and bubble gum). We tested everyone from home and got 10/24 people to get the gum flavors and try the experiment again because we realized that a simple vote or personal thoughts weren't very accurate for our results and analysis. We were able to record the effectiveness of each flavor through small quizzes (IQ quizzes). We gave the participants each quiz before starting a new flavor and while they were chewing that flavor. We made sure to also take into account their personal thoughts on each flavor and how effective they found it during their studies. The trend that we took significant notice of was that the mint-flavored chewing gum was the most effective in helping our peers focus. According to the mini-quiz results, on the other side of the flavor spectrum, the cinnamon flavor was the least helpful. Another trend we thought was interesting was that not only were the results for the bubble gum flavor all over the place, but several of the participants found that it made their heads hurt, causing them to focus on that rather than on their studies and the quizzes we gave them. Including the personal thoughts that we asked them to share with us, they basically said that the bubble gum was their least favorite for the reason listed above. A third trend we took note of was that most of the participants didn't enjoy the flavoring of the cinnamon; however, it helped them stay focused the second most after the mint-flavored gum. We concluded that the mint-flavored gum was the most helpful and the favorite out of the three gum flavors.

6867

Behavioral Reactions of Betta Fish to Different Music Genres

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The predominant purpose of this study was to compare the behavioral reactions of betta fish to different genres of music. We studied how different sounds and song types affected behavior, coloration, and aggressiveness. Because fish encounter music infrequently, most people are unaware if they prefer certain types of genres. Although it may be hard to observe their feelings, we can observe their emotions by how they react. Moreover, fish hear and feel vibrations, which cause sudden beats that frighten them. Since betta fish are very sensitive, you cannot play anything too loud because it will stress the fish out, resulting in high blood pressure and possibly death. However, all betta fish react differently, although they share a similar dislike for sudden beats. For example, many betta fish may flare

up, become more active swimmers, and can be very aggressive. Although many betta fish will profoundly show their reactions, some may be very calm and show very little reaction. We began the experiment by observing the behavior of the betta fish prior to playing music, thus determining their characteristics to easily capture their different reactions after playing the music. We played significantly different genres of music including classical and rock every week, and allowed a one-week break between them to prevent the fish from stressing. Our observations indicated that the betta fish were calmly active throughout the time classical music was played, and scared/stressed with the rock music.

6868

Can Plants Survive With a Liquid Besides Water?

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There have been many experiments where people test how long a certain plant can survive without water. This made us wonder if plants can actually survive with a liquid other than water. After doing some research, we read that milk can serve as a fertilizer to help plants. This gave us hope that at least one plant (other than the one that received water) would survive, so we decided to put it to the test. We took four plants and watered each one with a different liquid: soda, orange juice, 2% milk, and, of course, water. We made sure that the soil of the four plants was always moist for a period of five weeks. To determine the effects that the liquids had on the plants, we measured the leaves and observed the overall changes in the plants. After the five weeks, we saw expected and unexpected results. We found that plants can grow with limited success in solutions other than water, but that water is an important factor for plant growth.

6869

Does Working Out Reduce Stress?

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The world we live in offers so many opportunities for us to be whoever we want to be, but with this great luxury comes a lot of stress. Some may take supplements to get their mind off of problems, while others may say that isn't their thing. After a lot of research I came to the conclusion that working out may be a lifesaver for those who need to clear their mind. This was not a difficult study, nor did it take much effort. All the participants needed to do was log their feelings before working out, and after working out for two weeks (only five out of the seven days per week were used to work out). Stress levels then were compared to see if working out reduced feelings of anxiety/stress. Although limited data were collected, they indicated that working out reduced stress among the participants.

6870

The Effects of Water on Heart Rates

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In this study we tested the effects water has on our heart rates (measured in beats per minute, or BPM). The purpose was to find out if drinking a gallon of water a day for two weeks would affect both our resting and active BPM counts. We recorded our active BPMs and our resting BPMs two weeks before and two weeks after the experiment. As a result, we observed that our resting and active BPMs decreased after the two weeks.

6871

Behavior in Red-Eared Sliders in Response to a Stimulus

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Animal behavior includes all of the ways animals interact with other organisms and the physical environment. Behavior also can be defined as a change in the activity of an organism in response to a stimulus. Some organisms have innate behaviors in which they change their movement in response to a stimulus, such as a tasty food source. Taxis is a type of movement behavior that involves movement toward or away from a stimulus. In this study, the behavior of red-eared sliders (a type of turtle) was examined in response to a stimulus. The experiment was designed to have two separate groups (with three turtles in each group) go through a maze, with one group given a stimulus (lettuce was used as a treat and put at the end of the maze), and the other group given no stimulus. This was created to test the positive taxis in response to the incentive provided. The research group hypothesized that the red-eared sliders would react positively to the stimulus, meaning that group would complete the maze more quickly. Using the stimulus to test what we believed to be a positive taxis, we demonstrated that the red-eared sliders given the stimulus had a quicker maze completion time than that of the group given no stimulus. Our study suggested that red-eared sliders react positively when presented with a stimulus. They reacted to the stimulus by changing their behavior, moving toward the lettuce.

6872

Impact of Temperature on Butterfly Metamorphosis

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Thermodynamics is the branch of physical science that deals with the relations between heat and other forms of energy, or relationships between all forms of energy. One law of thermodynamics is the quantities of temperature, and that was the main focus of this experiment. We are familiar with the process of a butterfly. It begins with a caterpillar, which within about two weeks transitions itself into a cocoon. A week or so after that, the adult butterfly emerges. Have you ever thought about what would happen if temperature or thermodynamics affected this process? In this project, 10 painted lady caterpillars (*Vanessa cardui*) were split into two different areas: cooler (68°F) and warmer (75°F), with five placed in each area. Every day the temperature and movement were checked so the results would be more accurate. After about 30 days the butterflies finally began hatching. They were kept in one area that ranged more in the warmer temperature than the cooler one. Based on the findings, there was not a significant difference in the growth rate of the caterpillars or the rate of metamorphosis in the temperatures tested.

6873

The Effects of Music Genres on Hamsters' Eating Habits

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This experiment analyzed the effects of music genres on hamsters' eating habits. Different genres, including alternative, classical, country, electronic, jazz, metal rock, pop, rap, and R&B, were played daily throughout three 30-minute intervals. Observations were made before, during, and after the hamsters received 20 grams of food when each music genre was played, with a two-week control prior to the start of the experiment. Six female hamsters were kept in a cage (sized 16" L x 10.5" W x 10" H) in a quiet place with water, two hamster wheels, and food from 7 a.m. to 3 p.m. Using a different music genre each week, at 8 p.m. every night a JBL FLIP 5 speaker was placed exactly a foot (12") away from the cage, with music played at 51 decibels (dB) for 30 minutes. The hamsters were given 20 grams of food at 8:30 p.m. with the music continuing, and they were closely observed. At 9 p.m., the food was removed from the cage while the music kept playing for an additional 30 minutes. The music was stopped at 9:30 p.m., the food was weighed, and any additional observations were noted. Based on averages of data, the hamsters consumed the most food while listening to the classical genre, and the least amount of food while listening to the metal rock genre. In concluding this experiment, we found that the musical effects on hamsters' eating habits result from how the music changes their moods. From this finding, we interpreted that hamsters felt calm and/or safe to eat with

genres such as alternative, classical, electronic, jazz, pop, and R&B, and felt anxious and/or nervous to eat with the genres country, metal rock, and rap.

6874

Do pH Levels Affect the Strength and Durability of Insect Exoskeletons?

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The overall purpose of this study was to examine and determine if pH levels affect the strength and durability of insect exoskeletons. The main research problem we investigated was whether the exoskeletons are affected more by acidic pH levels or alkaline pH levels. We conducted our study by obtaining exoskeletons and exposing them to highly acidic and highly alkaline liquids. We then exposed them to a certain gravitational force to determine their durability before and after the exposure. The major findings from our analysis included some changes to the exoskeletons that occurred prior to the applied pressure. Judging from our results, we concluded that pH definitely affects insect exoskeletons, and one end of the spectrum affects them more than the other.

6875

How Different Diets Affect People Physically and Mentally

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Our experiment tested three different diets to determine how they affect factors in our bodies both physically and mentally. One person tested the Atkins® Diet, two people tested a pescatarian diet, and two people tested a vegetarian diet to observe changes in body mass, weight, and blood pressure. In addition to these quantitative factors, we also took into consideration qualitative factors such as changes in mood, sleep patterns, and energy levels. In an effort to accurately measure the changes and effects of the diets, we performed weekly tests to compare our final results to our initial data. There were many sources of error that skewed our data. Due to the COVID-19 pandemic, we were not able to purchase the necessary foods that were required in the diets and we were not able to test factors such as blood pressure because we did not have the appropriate tools to do so. Other factors such as gender and metabolic levels – things that we could not control – served as further sources of error. The results of the different diets showed the changes in body mass index (BMI) and different trends in blood pressure. We also observed any possible changes in weight. Other than noting a few increases and decreases, we were not able to definitively formulate a conclusion as to how diets affect BMI, weight, and blood pressure. This was not only because we did not collect enough data due to a lack of resources, but

also because we did not perform the study long enough to see possible variations in the results. However, there were some aspects of the data that allowed us to make small conclusions. The Atkins Diet did aid in weight loss, based on the decrease in BMI and weight that we noticed in our Atkins Diet participant. Those who followed the pescatarian diet experienced similar trends in blood pressure data, as there were observable wave patterns in the bar graphs we prepared. Lastly, the data demonstrated that the vegetarian diet participants experienced little change.

6876

Which Exercise Impacts Heart Rates the Most Quickly?

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The study we conducted was designed to determine which exercise impacts one's heart rate the most quickly. A multitude of factors affect heart rate, including one's body size, overall health, circulatory system, and activity level – all of which vary from person to person. The reason exercise was tested is because it is one factor that impacts heart rate and because it requires the additional function of muscles. Muscles typically need more blood (for transporting oxygen) to produce energy to meet the extra needs of the body to exercise. For the study, our nine test subjects performed four different exercises (push-ups, sit-ups, squats, and jumping jacks), all for the same length of time (20 seconds). Right after each exercise, each participant measured their heart rate for 15 seconds, and with this information we calculated the rate at which their heart rate increased. The control was their resting heart rate, which was compared to their heart rate after each exercise. Ultimately, we concluded that jumping jacks had the greatest impact on heart rates, followed by squats, then push-ups, and then sit-ups. This conclusion was based on the average percentage increase in heart rates after each exercise. The data showed the highest percentage increase (by a large amount) for the jumping jacks, then squats (which barely edged out push-ups), and finally sit-ups, which ended up far behind the others.

6877

Angular Momentum

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The purpose of this project was to determine if the rules of angular momentum can be applied to BEYBLADES, and if heavier BEYBLADES can spin and last longer than lighter BEYBLADES (<https://usa.beyblade.com/>). In the shows, the BEYBLADES that were more tilted lasted longer, and could hit heavier and burst the other one. Each BEYBLADE has an advantage over the other one, with the weight being one advantage. Another example is that the attack BEYBLADE has

an advantage over the stamina and balance types. The experiment began by determining which BEYBLADE is the heaviest. I determined that the stamina BEYBLADE is the heaviest. Then I decided to spin three different BEYBLADES four times each and take the averages, which meant I had to add up all of the times and divide them by four. The author found out that weight does affect how long a BEYBLADE lasts. If it is heavier it lasts longer, because it has more angular momentum and can reach the x-axis and y-axis in a shorter amount of time. When the BEYBLADE is heavier, it is harder to knock over and has more balance. If the BEYBLADE is lighter, it spins faster and lasts longer. The hypothesis was accepted because the heaviest object has more balance and lasts longer, and can take a slower amount of time to slow down. The lighter the BEYBLADE, the faster it spins, and uses up its steam more quickly. But when the BEYBLADE is heavier, it spins more slowly and uses its steam more slowly, and can take more time spinning. In conclusion, my hypothesis was correct. Angular momentum does apply to the heaviest BEYBLADES, the stamina type, which lasted the longest. Something I could have done to improve my experiment was to increase the number of tests I did to get a more accurate average. I could have tried to use different launchers. One of the BEYBLADES wouldn't hold on the launcher. That was the only problem. As I progressed, there were no other problems with the experiment.

6878

Elephant Toothpaste Experiment

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The purpose of my project was to determine how dishwashing liquid soap brands with different ingredients affect the formation of elephant toothpaste. First I put a spoonful of potassium iodide in two separate bottles that each had 100 ml of hot water in them. Then I put two soaps – Ajax® and Dawn® Ultra – into their separate bottles, added 3% hydrogen peroxide, and placed them on a tray for the foam to fall onto. After that, I added the potassium iodide-filled water into the soap and hydrogen peroxide mixtures and waited for the results. My hypothesis was that the Ajax foam would not form as quickly as the Dawn foam because it included more ingredients or a larger amount added to Dawn. In conclusion, my hypothesis was correct. Dawn not only beat Ajax to reach the top of the bottle, but also had more foam by the time it was cooling down.

6879

Speed of a Marble

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The purpose of this project was to determine if the material used to roll a marble on affects its speed. The experiment was performed by gathering the materials needed, which were

plastic, foam, and cardboard tubes; a marble; and a timer. I rolled a marble on each material three times each while recording the speed. I found out that the cardboard tube made the marble go the fastest, then the plastic tube, and finally the foam tube. My hypothesis was that the plastic tube would make the marble go the fastest because it has a sturdy surrounding compared to foam and cardboard. In conclusion, my hypothesis was incorrect, because I thought the plastic tube would cause the marble to go the fastest, but it was the cardboard tube.

6880 Science Fair Pancakes

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The purpose of this project was to see what happens when you add too much or too little water to a pancake mix, and then to record how they turn out. This was performed by making five separate pancakes – two with more water added, two with less water, and one with the right amount. After I finished making the pancakes, I wrote down my information and made a bar graph. I concluded that my hypothesis was correct because I expected two gooey/soggy pancakes from the mix that had more water added, bitter/dry pancakes from the mix that had less water added, and a somewhat fluffy and tasty pancake from the mix with the right amount of water. In conclusion, my hypothesis was correct and my project went as planned. If I were to do this again, I would like to take more pictures of my project, and seek/add more information.

6881 Biggest Bubble

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The purpose of this project was to determine which brand of gum out of the three I chose produces the biggest bubble. The brands I used were TRIDENT®, ORBIT®, and EXTRA®, and the experiment was performed by measuring the bubble size of each brand. I performed three trials with each type of gum, recorded its total, and then calculated its average. I found that the TRIDENT brand produced the biggest bubble out of the three. My hypothesis was rejected because I thought that the EXTRA brand would produce the largest bubble, but I was wrong. Its total was 3 inches and its average was 1. For ORBIT, its total was 4 inches and its average was 1.33. Lastly, TRIDENT's total was 8 inches and its average was 2.66. In conclusion, this experiment was something different compared to others that I have done, but it was really interesting and enjoyable since I got to chew gum. Now you know that the brand TRIDENT produces the largest bubble compared to ORBIT and EXTRA.

6882 Does the Temperature of a Magnet Affect Its Strength?

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The purpose of this project was to determine if the temperature of a magnet affects its strength. My hypothesis was that the temperature would have an effect on the magnet's strength. The experiment was performed by first taking the temperature of boiling water and ice water, as well as the room temperature. Then I placed a magnet in the boiling water, ice water, and at room temperature for 15 minutes. Next I picked up the magnet and placed it in a bowl with paper clips. I slowly pulled the magnet straight up with the attached paper clips and placed it in an empty bowl. Finally, I counted and recorded the number of paper clips that were attached. I repeated all of the steps for each magnet at the different temperatures. I found out that the magnet in the ice water picked up the most paper clips in every trial, with an average of 45. The magnet that picked up the second-highest number of paper clips was the one at room temperature, with an average of 36. Finally, the magnet that was put in the boiling water attracted the lowest number of paper clips, with an average of only 29. The hypothesis was accepted because the results showed that temperature did have an effect on the magnet's strength.

6883 Catching Bubbles

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The purpose of this project was to determine which material can catch a bubble without popping it. The experiment was performed by preparing different materials to test, blowing bubbles on each material, keeping track of the bubbles, and then writing down how many bubbles popped and how many didn't. The author found out that wax paper was the material that caught all of the bubbles, and aluminum was the material that made the bubbles pop easily. The hypothesis was that paper can catch bubbles because it has microscopic gaps, but these are larger than the gaps on the other materials, so it can absorb water like a sponge. Different materials have different properties. Whether a material is hydrophobic or hydrophilic depends strongly on its surface roughness. Some materials might have tiny bumps, which can help repel water. The surface of the water, held by surface tension, is unable to enter the tiny gaps in the material. In conclusion, my hypothesis was incorrect. It turned out that the wax paper was the material that caught the most bubbles. Second to that, the paper was able to catch a few bubbles. All of the other materials were incompatible with the bubble solution.

6884

Copper Cleaning*Melissa Gonzalez and R. Avecilla (teacher)*Oliver Wendell Holmes Middle School
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The purpose of this project was to determine what liquid, out of an array of different ones, would best clean a penny. The experiment was performed by getting dirty and clean pennies, submerging a dirty penny in each of the liquids, leaving them for 60 minutes, taking them out and comparing them, and finally recording the results. The author found that some of the liquids worked more effectively than others, given the wide variety of results ranging from no difference to shiny. The hypothesis was that the salt and vinegar combination would work better than the others, and that the milk wouldn't work very efficiently. This hypothesis was only partially correct, because the salt and vinegar cleaned the most effectively, but the milk and soda produced very similar results. In conclusion, most of the liquids either worked very well or didn't work at all; however, some ended up in the middle. I concluded that the salt and vinegar combination worked the best.

6885

Is There a Correlation Between Tempo and Latitude in Music?*Ashley Sandoval and R. Avecilla (teacher)*Oliver Wendell Holmes Middle School
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This project compared music from several different countries to determine if there is a correlation between tempo and latitude. The experiment was performed using the following steps: 1. Listen to 20 different national anthems from countries around the world. 2. Find the tempo, which is measured in beats per minute (BPM), of each song. Do this by clapping out a beat for 10 seconds and multiplying that number by six, and then record each anthem's BPM in a notebook. 3. Use the Internet to research the latitude of each country. 4. Graph the anthem tempo and latitude of each country on a scatter plot. 5. Analyze the data. Was there a weak correlation? Was there a strong correlation? Were there any surprises? 6. Assess if any other factors could have affected the results. The author found out that it was a very difficult project to do, and required more days than expected, but still did it. The results of this project were that the one that had the most percentages of both BPM and latitude, while the one that had one less than the other had the weak correlation. The hypothesis was that the one that had less on BPM and latitude would have the weak correlation, while the one that had more BPM and latitude would have the strong correlation. But my hypothesis was not really correct, and I was expecting to have some of it right. Maybe next time. In conclusion, the ones that did have around the same percentages had a strong or weak correlation depending on how high or low the percentage was for BPM and latitude.

6886

Does the Amount of Baking Powder Affect the Baking of Brownies?*Alyssa Cruz and R. Avecilla (teacher)*Oliver Wendell Holmes Middle School
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The purpose of my science fair project was to determine how different amounts of baking powder in brownie batches can change how the batches bake. The purpose also was to learn different types of scientific methods from fellow classmates' experiments and help them learn new things from my project so all of us could see each other's cool experiments that we did ourselves. I began my experiment by going to the store and buying all of the ingredients that the recipe indicated for making homemade brownies. After getting all of the ingredients, I started making three different batches of brownies with different amounts of baking powder. One batch had too much baking powder, another had too little, and the last one had the perfect amount in it. While the brownies were baking, I took pictures and observed what was happening. After the brownies finished baking and cooled down completely, my sister and I tasted ones from all three batches. The experiment was very useful because it helped me learn that it is very important while baking or doing anything involving measurements to use the exact measurements that are indicated. This is because the batch that had too much baking powder was very cracked, and was sinking in the middle and burnt on the sides. To eat these brownies, my sister and I had to cut around the burnt sides, because that part tasted very disgusting. The second brownie batch, with not enough baking powder, was very burnt on the sides, and when I dipped a toothpick in the middle, the brownies were very raw. I couldn't put them back in the oven because the sides would burn even more, so I threw them away. However, the other two were very delicious. One hypothesis I had was wrong, because I thought that the brownie batch with too much baking powder would bake the same as the one with the perfect amount, but would be burnt on the sides more. I also thought that the ones with too little baking powder would sink and have a lot of air bubbles. So I was wrong in some parts of my hypothesis, but right in other parts. In conclusion, this experiment with brownies was a fun way to learn about science and do work at the same time. It also was very informative and taught me that exact measurements are very important and matter while baking or even if you are doing something very simple.

6887

How Long Fruit Takes to Turn Brown*Genesis Sanchez and R. Avecilla (teacher)*Oliver Wendell Holmes Middle School
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The purpose of this project was to establish that fruit turns brown when it is cut up and exposed to the air for some amount of time. This experiment was performed by doing some

research, cutting up three different fruits, timing how long it took for each one to turn brown, and finally comparing the results/time for each fruit. I found out that the banana took the longest to turn brown (46:07), the apple was in the middle (28:40), and the pear took the shortest amount of time (7:39). Part of my hypothesis was rejected because I thought that the apple would take the shortest amount of time and that the pear would be in the middle. However, part of my hypothesis was accepted, because the banana ended up taking the most time, as I thought. In conclusion, the three different fruits turned brown after different amounts of time, with the banana taking the longest, the apple being in the middle, and the pear taking the least time.

6888

Rocketology (Vinegar + Baking Soda)

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The purpose of this project was to determine what type of vinegar makes a plastic bottle rocket go the highest. The experiment was performed by first building a plastic bottle rocket. Then I put a cup of vinegar in the rocket. Next I put a half tablespoon of baking soda on a toilet paper square, and put this in the rocket. Finally, I put a cork on the bottle and watched it take off. The author repeated this process with different types of vinegar and found that normal vinegar made the rocket go the highest. The hypothesis was accepted because I thought that the normal vinegar would make the plastic bottle rocket go the highest.

6889

Animals' Meal Choices

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The purpose of this project was 1) to determine whether animals (pets) have a food preference since we as owners or caretakers give them what we believe is healthy and/or available, and 2) to see whether the animals show any type of behavior when considering their food choice. The experiment was performed by conducting three tests with the individual animals to determine what meal they wanted to consume: wet food or dry food. Additionally, any behavior of the animals was recorded. The author found that animals (pets) prefer wet canned food over dry food as their meal when pausing to choose. The hypothesis was accepted because the animals did show signs of thinking about their food options and chose the same meal several times. Most of the animals chose a different food type than their usual, showing they do prefer a different kind of food. In conclusion, the experiment to find out if animals show favoritism in meal selection was successful and the

hypothesis was proven as acceptable due to multiple animals demonstrating actions of thinking and pausing to consider their meal choice.

6890

How Long Does It Take For a Liquid to Freeze?

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The purpose of this project was to determine how long it takes for water, apple juice, Coke®, and sparkling water to freeze. The experiment was performed by getting the four liquids, putting them in a freezer, and checking on them every 30 minutes. I then recorded how long each one took to freeze. The author found out that the water froze first, then the sparkling water, then the Coke, and lastly the apple juice. The hypothesis was rejected because I thought that the Coke would freeze last, but the apple juice froze last. In conclusion, I now know how long it takes for these liquids to freeze and have an idea of how they freeze.

6891

Underground Water Flow and Darcy's Law

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The purpose of this project was to determine the flow rate of water going through permeable and non-permeable matter with different output valve heights. The experiment was performed by filling four 2-liter bottles with rocks and dirt, and then creating holes at four different heights to see how long it would take the water that was poured down from the opening at the top to make its way through the substance-filled bottle, out of the valve (hole). The author found that the higher the output valve was placed, the longer it took for the water to make its way up and out. The water moved much faster around the non-permeable matter, whereas with the matter that absorbed the water, the water took much longer to make its way down the bottle when poured through the opening. The hypothesis was accepted because the water moved much faster around the non-permeable matter, whereas the water took much longer with the matter that absorbed it to make its way down the bottle when poured through the opening. In conclusion, if water is poured at a constant force and flow, then Darcy's law (which describes how water flows through different materials) will always equate with accurate results, but if the pressure is changed, there are noticeable differences that don't exactly compute. For instance, if there is a heavy rain and water is running into a gutter and out to the ocean, then the force and constant rain will push that water through at a correct calculated measure. However, if the rain turns into more scattered showers, then the lack of pressure will slow down the force. Thus less water will move through the gutter, and it will take much longer to make it out the other end, if at all.

6892

Which Air Hockey Puck Texture Can Withstand the Most Weight?

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The purpose of this project was to see which air hockey puck texture can withstand the most weight. The experiment was done by placing quarters, taped together, on an air hockey puck. Different materials were taped to the bottom of the puck. I found out that the regular, smooth texture of an air hockey puck held up the best under the weight. My hypothesis was accepted because the regular air hockey puck was able to move under the greatest number of quarters. In conclusion, the smoother the texture of an air hockey puck, the better it moves.

6893

Does Color Affect Taste?

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The purpose of this project was to find out, using different liquids with food coloring, if color changes perception of taste. The experiment was performed by choosing three liquids – sparkling water, mango juice, and apple juice – and adding food coloring to them. For the apple juice I used blue food coloring, for the sparkling water I added orange, and for the mango juice I added red. Next, I gave a liquid to a participant for the experiment. There were three. Each participant tried the three liquids and gave their opinions about what they tasted like. I found out that my hypothesis was correct, and that color does affect taste. Most said that the liquids were sweeter than usual without the food coloring. I thought that the coloring was going to affect the taste in a way where the liquid tasted nothing like apple juice (for example), but according to my results it just made it taste sweeter. In conclusion, I learned that color does affect taste. Maybe next time I can try this experiment with foods such as pasta, eggs, or maybe soup.

6894

Does the Texture of Chocolate Affect How Quickly It Melts?

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The purpose of this project was to discover if the texture of chocolate affects how quickly and how much it melts. The experiment was performed by first buying four different chocolate bars. I then placed them all on a sheet of aluminum foil. After that, I put them outside so they could melt, and did this on a sunny day so they had a better chance of melting. I used a

stopwatch to time how long it took for each candy bar to melt. For this experiment, I was measuring time and speed. I found out that the chocolate bar with the roughest texture melted the most quickly. I believe this was due to the caramel inside. The hypothesis was accepted, because the texture of the chocolate did seem to have an effect on which one melted first. In conclusion, my hypothesis was correct.

6895

Saltwater Freezing Point Experiment

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The purpose of this project was to see how salt affects the freezing point of water. The experiment was performed by getting five cups and pouring the same amount of water in each one. I didn't put any salt in the first cup. In the second cup, I put 1 teaspoon of salt. In the third cup, I put 2 teaspoons of salt, and etc., all the way to the fifth cup. I placed each cup in a freezer and checked on them every 2 hours. I found out that the more salt I added to the water, the longer it took the water to freeze. The water in the fourth and fifth cups did not even freeze because of how much salt was added to them. My hypothesis – that the more salt I added to the water, the longer it would take it to freeze – was accepted, because the water in the cups with more salt took much longer to freeze and in some cases did not even freeze. In conclusion, I learned that salt greatly affects the freezing point of water depending on how much salt is added.

6896

Sound Waves

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The purpose of this project was to determine if age affects the sound vibration you make when you speak. The experiment was performed by recording the voices of three different people from three different age groups, and then using the Science Journal app to play the recordings. By doing this, the app measured vibration acceleration of sounds. When I was done playing the recordings, the accelerometer provided the lowest, highest, and average vibrations, which are measured in meter per second squared. Lastly, I listed the age and meter per second squared and compared them to see if they were the same. The author found that people's voices have different wavelengths, amplitudes, and frequencies. The hypothesis was accepted because people have different voices and speak at different speeds, so their wavelengths will be different. I do not think age matters to the sound vibration you make, because it just matters to the speed you are talking at. One thing I would change is that in the future I would test more people in the experiment so I could get more accurate results. I enjoyed doing this project and discovering different areas of science.

6897

The Coke® and Mentos® Experiment*Samantha Mondragon and R. Avecilla (teacher)*Oliver Wendell Holmes Middle School
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The purpose of this project was to determine whether the number of Mentos you put in a bottle of Coke affects how high it explodes, how long it takes for the soda to stop fizzing, and how much of the soda is left in the bottle. The experiment was performed by adding one Mentos to the first bottle and measuring how long it fizzed, how high it went, and what was left in the bottle. For the second bottle, I added two Mentos; for the third bottle, I added three; and finally for the last bottle, I added four, and each time I measured the same things. I found out that the more Mentos you put in a small bottle of Coke, the longer it fizzes and the higher it goes, and the bottle has the least amount of liquid left. In conclusion, my hypothesis was correct. The more Mentos I put in a small bottle of Coke, the higher it went and the longer it fizzed. It also lost a lot more soda.

6898

Cupcake Weights*Ashley Martinez and R. Avecilla (teacher)*Oliver Wendell Holmes Middle School
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The purpose of this project was to determine if types of flour affect the weights of cupcakes. I baked three cupcakes, each using a different type of flour – all-purpose flour, corn flour, and rice flour. I followed recipes I found online that did not have a huge difference so that the cupcake weight contrast would be more accurate. Each flour I used was different in weight and color. The all-purpose flour was white and thin; the corn flour was very heavy, thick, and yellow; and the rice flour was very thin and also white. The corn flour was the thickest and heaviest type of flour, so I believed that cupcake would be the heaviest, and the rice flour was the thinnest and lightest flour, so I believed that cupcake would be the lightest. I carefully made the cupcakes following the recipes and let them cook. They did have different cooking times, but that wouldn't change them. After they were done, I weighed them and I was correct. My hypothesis was that the corn flour cupcake would be the heaviest and the rice flour cupcake would be the lightest. My hypothesis was correct. In conclusion, the weights of cupcakes are affected by the type of flour used, which can change their density and make them either heavier or lighter.

6899

Does Music Affect Your Blood Pressure?*Elisha Reyes and R. Avecilla (teacher)*Oliver Wendell Holmes Middle School
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The purpose of this project was to determine if music affects your blood pressure. The experiment was performed by testing the blood pressure (systolic and diastolic readings) and pulse rates of some of my family members. I played three different music genres and singers to see if the music raised their blood pressure or not. I found out that Person 1 had the highest diastolic number on my chart. When they listened to the second genre (rap), they had the second-highest number. The third genre (soothing) was the lowest number. Person 2's rate was the same as Person 1's, with the same results. Person 3's diastolic rate was the highest like for Persons 1 and 2, and the rap and soothing genres produced the same diastolic rate for Person 3. Person 4's rate was the same as Person 3's. The rap and the soothing genres, though, were a few inches off. My hypothesis was that some types of music will raise your blood pressure and soothing music will make you calm down. My hypothesis was correct about how some types of music raise your blood pressure and some types of music calm you down. Therefore, can we see a difference in heart rate or blood pressure when listening to different styles of music? Research published in the journal *Deutsches Ärzteblatt International* found that listening to music by Mozart and Strauss for 25 minutes lowered both systolic and diastolic blood pressure readings. In conclusion, while my hypothesis was correct that some music can raise your blood pressure, it was not to the extreme until we noticed an extreme effect. I can improve my project in the future by testing people of various ages so I can obtain more and different results than I did in this project.

6900

How Preservatives in Cheeseburgers Can Affect the Molding Process*Sarah Caballero and R. Avecilla (teacher)*Oliver Wendell Holmes Middle School
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The purpose of this project was to determine how preservatives in cheeseburgers can affect the molding process. The experiment was performed by getting four different cheeseburgers from different places. I got a cheeseburger from both McDonald's and In-N-Out®, an Impossible™ WHOPPER® from BURGER KING®, and a regular WHOPPER from BURGER KING. I separated the buns, patties, and cheese; put them in airtight containers; and left them out for about a month. I observed them daily and noted any changes. The author found that not all fast food places have preservatives in their food, and that the food at some of the places is fresher than at others. The hypothesis was rejected, because I thought that the In-N-Out cheeseburger would mold the most quickly and the McDonald's cheeseburger would mold the most slowly. However, the

McDonald's cheeseburger molded the most quickly and the BURGER KING WHOPPER molded the most slowly. In conclusion, I found out that none of the cheeseburgers I tested had preservatives, so the results were due to the natural molding process.

6901

Which Type of Water Makes Plants Grow the Most Quickly?

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The purpose of this project was to determine if distilled, tap, or spring water makes plants grow the most quickly. This experiment was performed by first putting soil in pots, poking a little hole in the middle of the soil, adding in the seeds, and covering the seeds back up with soil. Then I got tape and labeled the pots so I would know which type of water I would be using for each one. After that I placed the pots by the window so they would get some sunlight, and watered the plants every day for two weeks. Whenever the plants grew or something important happened, I observed it and recorded my results at the end. At the conclusion of the experiment, I found out that the spring water helped the plant grow the tallest, with a final height of 8.5 mm. My hypothesis was that the spring water would help the plant grow the most quickly, and I was correct. I think that it helped in this way because spring water is very oxygen-heavy, which is good for plants since it gives them an added boost.

The results for the other types of water were that the tap water plant grew to 8 mm high, the leaves were kind of pale, and the stem wasn't very strong. The distilled water plant grew to only 6 mm, but it was the strongest and healthiest. Also, the spring water plant was healthy and the leaves were very bright and green.

6902

Pop a Bubble

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The purpose of this project was to determine which material would take the longest to pop a bubble. The experiment was performed by setting up each material neatly, getting the timer ready, and blowing bubbles onto each material. I recorded data for each material, including additional notes, and someone else took photos of the procedure. The author found out that a bubble can stay on glass and cloth longer than on sandpaper. The hypothesis was accepted because I knew that the texture of each of the materials I tested would affect the amount of time the bubble would last. In conclusion, for my hypothesis, I thought that the bubble would stay on the glass the longest because of the material it is made out of. And I was right. The bubble stayed on the glass for 17 seconds. The bubble on the

cloth stayed on for 2 seconds, and the bubble on the sandpaper stayed on for 0.9 seconds. I would like to see if I can try this experiment again, but with different brands of bubble mix to determine which brand of bubbles lasts the longest. I also would use different materials, such as bubble wrap, plastic, and/or tile.

6903

The Sustainability of the Amazon Rainforest

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This project was designed as a creative and innovative way to explain the importance of the Amazon rainforest biome, and was written as a narrative story to appeal to students of all ages. It covers topics such as the location, climate, resources, foods, animals and insects, varied plant species, and natural food chains and survival. From the research, it was determined that approximately one-quarter of the ingredients in medicine come from plants grown only in rainforests. Over 80% of the flowers found in the rainforest are not found anywhere else in the world. Global rain patterns found only in the rainforest are a major source of fresh water on Earth and, as a result, abundant plants flourish. Almost half of all terrestrial animals make their home in rainforests. However, the "Amazon [rainforest] is the biggest deforestation front in the world and interventions are urgently needed to prevent a large-scale, irreversible ecological disaster" (WWF, <https://bit.ly/34DGyID>).

6904

Virtual Robotics

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In the new normal of distance learning and social distancing, virtual robotics has taken the place of physical robotics. As students learn to code with a virtual robotics platform, they learn Science, Technology, Engineering, and Mathematics (STEM) and develop 21st-century skills that will become part of their future. Virtual robotics makes it possible to take education to a new level while teaching pertinent life skills such as critical thinking, problem-solving strategies, creativity, and innovation on platforms that are readily available to anyone. Robotics technology can influence many aspects of work and home. The potential to transform lives and work practices by learning to program robots is within everyone's grasp. Robots will not replace humans, but rather change the pathways of human-to-robot interface. We should embrace robotics, both virtual and physical, and not shy away from it.

6905

Which Soda Cleans Pennies the Best?

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My project began with a question I had: I wondered which soda could clean pennies the best. My experiment started with the selection of sodas, and I made sure to choose enough to properly test which ones cleaned well, because I wanted as much information as possible. First I gathered a total of nine sodas, all different types or brands. Then I took a penny and a SOLO® cup, and put the penny at the bottom of the cup. Once I had done this with all nine pennies, I filled each cup with a different soda. I then waited 2 hours for the pennies to fully submerge in the sodas. After this time, I took the pennies out, wiped them each gently with a paper towel, and examined them to see which was the cleanest. Four of the nine pennies were the same before and after the cleaning, and five of the nine looked cleaner. I saw that Coke® cleaned the penny completely. It looked brand new. Diet Coke® came in a close second, and the rest weren't even close. My experiment showed how detrimental Coke is to your body if it can clean a penny so well. It truly is amazing, yet extremely bad for your body.

6906

Utilizing Silicon Dioxide Powder to Improve and Enhance Plant Growth

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The project's objective was to determine how silicon dioxide powder alters the biological and physiological parameters of *Lepidium sativum* cress plants. The results confirmed the hypothesis: If silicon dioxide powder is added to a plant's soil as a supplement, then the plants are expected to grow at a quicker rate. From this experiment, it was discovered that plants exposed to greater uptakes of silicic acid will obtain the following: sturdier stomatal structures leading to augmented nutrient transportational abilities; proliferated transcriptomic (increased gene activities in plant tissues) and metabolic responses (physiological responses in adjusting carbohydrates and amino acids within the plant); increased resistance to environmental stresses; enhanced metabolic functions; and increased resistance to pathogens. During the experiment, three trials were performed in which the growth results of a pot with 5.8% silica supplementation were compared with a pot with no silica. An unvarying quantity of cress seeds was meticulously distributed in both pots and placed under an artificial light source which contributed to the stomatal opening management and photosynthetic rate of the plants. The results from Trial 1 depicted a trendline of 0.977 (R^2) for added silica, while no silica depicted a trendline of 0.955 (R^2). Although both sets of pots produced sprouting seeds, the pot containing the powder developed sprouts that grew at a quicker pace along

with sturdier stems and vibrantly green leaves. Tilted to the left at a 30° angle, the control plants were not as linear due to the absence of silicon dioxide promoting stronger cell walls which transport considerably escalated proportions of water and nutrients throughout the entirety of the plant. The experiment sought to uncover the benefits of silicon dioxide in cress plants in order to produce healthful and nourishing crops in areas prone to environmental stresses such as cold climatic states. These discoveries can unlatch pathways for extensive crop production that can be implemented on global farmlands.

6907

Investigation of Adhesion Peptide Interactions With Hydroxyapatite Through Computational Molecular Dynamics

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Objectives: Nanomedicine revolutionizes treatment of cardiovascular disease through the design of peptide-labelled nanoparticles that bind to hydroxyapatite (HA), the form of calcium in atherosclerotic plaques. This project evaluated binding efficacies of broad-range adhesion peptides (SVSVGMPKSPRP, STLPIPHEFSRE, and VTKHLNQISQSY) to hydroxyapatite through the use of molecular dynamics (MD) software. **Methods:** Peptide and hydroxyapatite slab structures were generated using peptide configuration software PEP-FOLD3 and molecule editing software Avogadro, respectively. Three 5 ns simulation trials were run for each peptide using MD software GROMACS to model atomic force-field interactions between the peptide and the hydroxyapatite in water solvent. Binding efficacy was evaluated through visual observation and calculation of the surface separation distance (SSD) between the peptides and the HA slab. Binding is indicated by a separation of less than 1 nm between the amino acid binding site and HA slab. **Results:** SVSVGMPKSPRP exhibited binding at its lysine (K) and arginine (R) residues. STLPIPHEFSRE exhibited binding at its first serine (S), and VTKHLNQISQSY exhibited binding at lysine (K) and histidine (H). Consistent adhesion interactions were evident in all three trials of SVSVGMPKSPRP, two trials of VTKHLNQISQSY, and one trial of STLPIPHEFSRE. **Conclusions:** The simulations confirmed that all three peptides possess binding capabilities and identified the specific binding sites. SVSVGMPKSPRP exhibited the smallest surface separation distance from hydroxyapatite over multiple trials, thereby demonstrating the greatest binding efficacy, and suggesting the greatest potential for clinical use. These results are contingent upon the initial peptide structures and would benefit from extended simulation periods and in vitro confirmation.

6908

Genetically Engineering Bacteria to Express Red Fluorescent Protein

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The purpose of this project was to transform bacteria with the red fluorescent protein (rfp) gene. The tested hypothesis was, “If we introduce a plasmid with an rfp gene to a bacteria, then the bacteria will glow red when the gene is expressed.” The workflow we followed was first, we verified the recombinant plasmid by introducing restriction enzymes, BamHI and HindIII, to a plasmid. The restriction enzymes cut an 807 base pair section out of the 5,302 base pair plasmid, resulting in a large (4,495 bp) and a small (807 bp) section. We were able to determine we had the correct sizes by comparing it to a DNA ladder. R+ was our plasmid with the restriction enzymes and this was compared to R-, which didn't have restriction enzymes. We ran our samples through gel electrophoresis. The R- sample showed three different configurations: supercoiled, nicked circle, and multimer. The supercoiled traveled the farthest and fastest, followed by the nicked circle, and the multimer in last. We verified that R+ had two bands that were the correct sizes. After verifying the recombinant plasmid, we transformed *E. coli* with the plasmid that had the following components: the origin of replication (ori), the arabinose activator (araC), the gene for ampicillin resistance (ampR), the promoter (pBAD), and the red fluorescent protein (rfp) gene. To confirm that the transformation was successful, we used a Petri plate filled with Luria broth (LB), one plate with Luria broth and ampicillin (amp), and one plate with LB, amp, and arabinose (ara). For our control, we used bacteria that were not transformed (P-), while P+ were the same bacteria but were transformed with the plasmid that has the rfp gene and ampicillin resistance. The LB and LB/amp plates were divided into two halves, with P- on the left and P+ on the right. The third plate, LB/amp/ara, only had P+ bacteria added. We found that the LB plate showed equal growth of bacteria on both the P+ and P- sides. The LB/amp plate showed no growth on the P- side, while the P+ side had white colonies of *E. coli*. The LB/amp/ara plate with P+ had red colonies. Our hypothesis – “If we introduce a plasmid with an rfp gene to bacteria, then the bacteria will glow red when the gene is expressed” – was accepted. We were able to successfully transform *E. coli* bacteria to express the rfp gene. Only transformed colonies (P+) grew on plates with ampicillin. We discovered that eight of the nine replicate groups had glowing red colonies.

6909

Transformation of *E. coli* to Express Red Fluorescent Protein Gene

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The purpose of this research project was to transform the *E. coli* bacteria with an exogenous gene from sea anemones for red fluorescent protein (rfp). Our hypothesis was, “If we follow the protocol from the Amgen® Biotech Experience, then we can transform the *E. coli* to express the red fluorescent protein gene.” We worked with the pARA-R plasmid, composed of 5,302 base pairs (bp). The plasmid included the promoter (pBAD), red fluorescent protein (rfp), origin of replication site (ori), the ampicillin resistance gene (ampR), and the arabinose activator (araC). We used the restriction enzymes, BamHI and HindIII, to cut out an 807 base pairs (bp) section of the plasmid and verified that we had the correct plasmid with gel electrophoresis. To do so, a sample of an uncut plasmid (R-) and the plasmid cut by restriction enzymes (R+) were run next to a DNA ladder. Next, *E. coli* competent cells were transformed by heat shocking the bacteria, which disrupted the cell membrane and facilitated uptake of the plasmids. Our experiment's success was verified by culturing the bacteria into three different plates. The first plate had only Luria broth (LB), the second plate had Luria broth and ampicillin, and the third plate had Luria broth, ampicillin, and arabinose. The first two plates were split into two halves — the control group (P-) that didn't have plasmid, and the treatment group (P+) that had the plasmid — while the third plate only had the treatment group (P+) that included the araC activator to allow the rfp gene to be expressed. These plates were incubated at 37°C for 24 hours. The results of gel electrophoresis showed that samples cut by restriction enzymes (R+) were split into two pieces into the predicted sizes: one segment with 4,495 bp and another segment with 807 bp. The control (R-) was an intact plasmid with three configurations: supercoiled, nicked circle, and multimer (Figure 1).

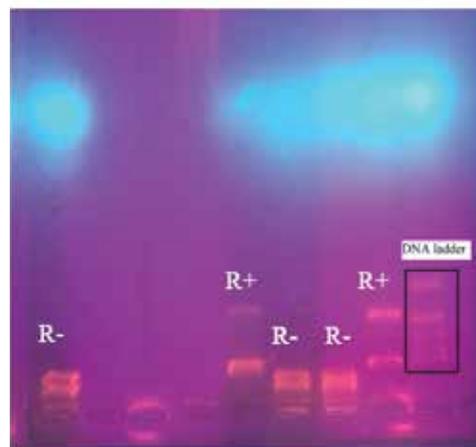


Figure 1: Supercoiled, nicked circle, and multimer plasmid configurations (R-), two bands (R+)



Figure 2: LB plate



Figure 3 (left): LB/amp plate, and Figure 4: LB/amp/ara plate

The bacteria grew equally on both the control (P-) and the treatment group (P+) in the LB plate (Figure 2); in the LB/amp plate (Figure 3), the bacteria only grew in the treatment group (P+), forming white colonies; and in the LB/amp/ara plate (Figure 4), the bacteria had red colonies. Our hypothesis, “If we follow the protocol from the Amgen Biotech Experience, then we can transform the *E. coli* to express the red fluorescent protein gene,” was accepted. The Luria broth fed the bacteria and there were no substances that harmed the bacteria on the first plate (Figure 2), allowing unimpeded growth. The LB/amp plate (Figure 3) had surviving colonies on the P+ side, which were transformed with the plasmid that had the antibiotic resistance gene (*ampR*), allowing colonies to grow even with the presence of ampicillin. The LB/amp/ara plate (Figure 4) glowed red because the *araC* activates the gene in transformed colonies to express red fluorescent protein.

6910

Is the Pacific Herring Fishery Sustainable Off the Coast of California?

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Many marine ecosystems are prone to suffering the negative effects of overfishing. This creates problems regarding whether the fish are sustainable or not for the years to come. One species affected by this deleterious act is the *Clupea pallasii*, more commonly known as the Pacific herring. I studied the reproductive potential and analyzed data to determine whether the Pacific herring fishery could be sustained off the coast of California. I hypothesized that if the current conditions continue, the Pacific herring fishery could be sustained. To begin, I acquired commercial annual landings data from the National Marine Fisheries Service, NOAA (www.fisheries.noaa.gov) for the time frame between 1950 and 2017. The analysis of the data was first done using an area graph in order to show landings over time. Next, to find if a possible supply and demand component to the Pacific herring fishery was present, a supply and demand combo graph was created consisting of a linear and area function. Last, I created an annual landings scatter plot with a polynomial trendline as an attempt to analyze possible trends over time regarding the annual landings of the fishery. The results from the area graph indicated that the landings experienced many spikes, but overall still went down compared to 1950. The area/line combo graph implied that even though landings and prices per pound varied, there was no correlation between them other than when there were major spikes in either of the two components. The scatter plot indicated that the landings could be modeled using a sixth-degree polynomial trendline that fit the data very well according to its R^2 value, which was 0.811. Overall, my initial hypothesis proved to be wrong and the Pacific herring fishery cannot be sustained if the current trends continue. As shown by the area graph, the landings are at an all-time low when looking at the time frame of 1980 to 2017. The demand also seems to be decreasing significantly compared to the prior years, especially before 2000. Since there is a low demand for the fishery and the landings are at a significant dip, the fishery cannot be economically sustained. Also, the fishery's sustainability is greatly put at risk because of the many external factors such as oil and chemical spills that contaminate the water. According to the Alaska Department of Fish and Game (www.adfg.alaska.gov), Pacific herring have an average reproductive potential of 20,000 eggs per year, but recruitment to the adult population is immensely less. One study found that even though the recruitment rate for Pacific herring greatly fluctuates from year to year, for a good given year the recruitment rate could be up to 50% (Schweigert et al., 2009). Although high recruitment rates help ensure fishery sustainability, environmental factors such as the Exxon Valdez oil spill in 1989 have severe negative impacts. The Exxon Valdez incident caused a collapse in the population of Pacific herring in the affected area, which has not even recovered today. Oil spills off the California coast are a constant concern. Moreover, purse seine and gill nets used to harvest *C. pallasii*

have a high incidence of bycatch. *C. pallasii* play an important role as forage fish off the coast of California, providing a bridge between the lower trophic levels of primary producers and consumers to the upper trophic level predators such as California sea lions, as well as the bottlenose dolphin. They are a central element of the food web off the coast of California, supporting the species to which they serve as prey. In order to make the *C. pallasii* fishery sustainable, primarily the annual landings need to be reduced to 40,000 pounds to ensure stability after the multiple environmental factors that have an effect on the fishery. These factors, including predation, climate change, overfishing, and different types of pollution, all place an immense amount of unpredictable pressure on the population, preventing a specific estimation of conditions needed for sustainability. Additionally, since the Pacific herring spawning locations are limited by the water temperature, climate change is causing an unpredictable migration for the species between their inshore spawning locations and offshore feeding areas, producing additional pressure (Levin et al., 2015). Ultimately, the population of the Pacific herring fishery off the coast of California is under pressure from many different factors and needs an immediate reduction in landings to increase its chances of sustainability.

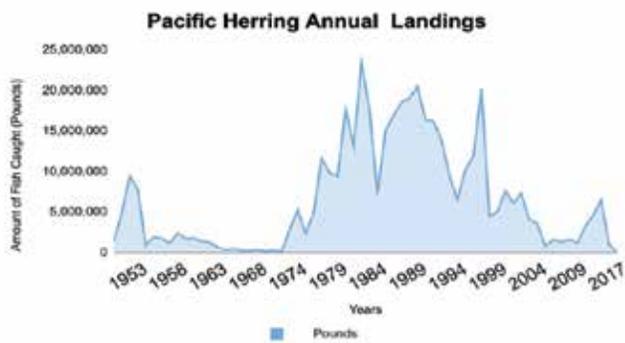


Figure 1: The area graph shows the annual landings of the Pacific herring between 1950 and 2017.

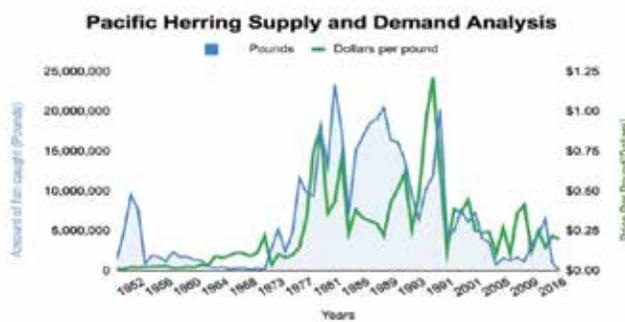


Figure 2: The combo graph shows the annual landings (area graph) of the Pacific herring compared to their price per pound (line) between the years 1950 and 2017.

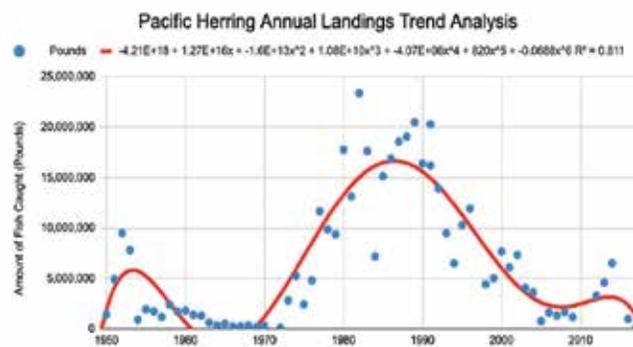


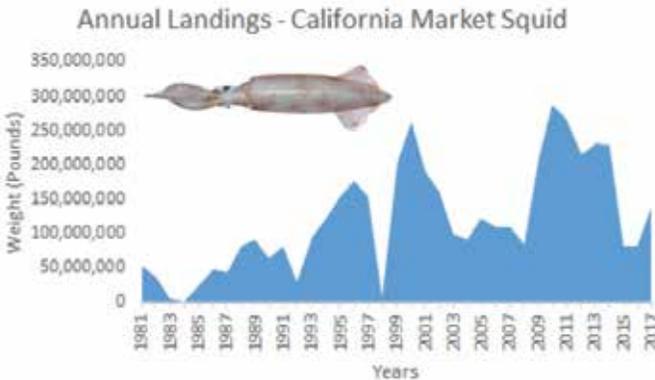
Figure 3: This graph shows the trend of the Pacific herring annual landings between the years 1950 and 2017.

6911 Is the California Market Squid (*Doryteuthis opalescens*) Being Overfished in California?

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The purpose of this study on the California market squid was to determine whether or not this fishery is sustainable. I hypothesized that if current trends in annual commercial landings continue, then the California market squid will remain sustainable. The California market squid is caught in all of the major fishing blocks off of the California coast. Data from 1980 to 2017 were analyzed in Microsoft Excel charts. All of the data used is from the National Marine Fisheries Service, NOAA (<https://www.fisheries.noaa.gov/national/commercial-fishing/commercial-landings/annual>). The first graph I made is an area graph depicting the number of pounds caught yearly for the California market squid so I could view the varying trends in landings as the years passed. The second graph is an area/line graph showing the price per pound of squid versus the number of pounds caught yearly. It was used to determine if there is a supply/demand component to the fishery. The third and final graph is a plot of annual landings with a polynomial trendline using the equation $y = -10.061x^6 + 120398x^5 - 6E+08x^4 + 2E+12x^3 - 2E+15x^2 + 2E+18x - 6E+20$ to make a six-degree polynomial trendline. An R^2 value was used to determine how well the data fit the given trendline, so if the R^2 value ended up being 0.5 or above, the line showed a trend. The R^2 value ended up being 0.554, so the trendline did fit the data well. It was determined that all of the graphs showed signs of sustainability within the fishery because, in spite of the occasional dips and spikes within the graphs, it stayed relatively stable. It has been documented that populations are highly variable in response to environmental factors, with El Niño being one of the most influential factors (OPC, 2013 & Ralston, 2018). The graphs show that 2010 had the highest landings on record, 288 million pounds. The minimum number landed was in 1984, just after a strong El Niño year, when only 1 million pounds of squid were caught. Another low point was 1998, another strong El Niño year. Whenever there was a significant dip or rise in the number of landings, there

was also a correlation in price that responded accordingly, so if there was a large dip in the number of landings, there was also a spike in price that year. My hypothesis, "If current trends continue in its ecosystem, then the California market squid will remain sustainable in California," was conditionally accepted. In recent years, the number of squid caught every year has greatly decreased from the maximum landings of the 2000 and 2010 seasons. I recommend keeping the landings at the 2017 level along with current regulations, like seasonal catch limits, monitoring programs, time-specific and seasonal closures, limitations on the usage of lights to attract the squids in certain areas, and a permit system. However, I also recommend that the number of landings during El Niño events, such as an SST anomaly of +0.5°C in the Niño 3.4 region for three consecutive months, be decreased significantly so the squids are able to fully recover from the event. With my recommendations in place, the California market squid fishery will remain sustainable.

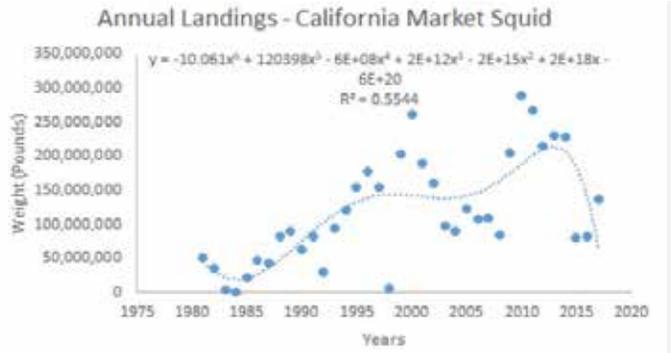


The first graph shows the number of pounds of California market squid that were harvested every year from 1981 through 2017. In this graph, you can see that the number landed started off rather small at around 50 million, but during 2011 it peaked at almost 300 million, and then it started to go down, dropping to 100 million, the lowest it's been since 1998. However, it is again rising, going up to 150 million in 2017. There was a sharp dip from 2001 to 2003 that lasted until 2011. In 2001 it was 250 million pounds, and then in 2003 it dropped down to 125 million, staying around there until 2011, when it jumped back up to almost 300 million.



The second graph is an area/line graph that compares the pounds of squid caught to the price per pound. This is the same area graph as in the first graph; however, it now has a

line graph over it representing the price per pound during each year. As you can see from the graph, it is very evident in years like 1984 and 1988, when there was an extreme decrease in the number of squid caught, that it prompted a dramatic increase in price per pound. Most years, the number of squid stayed relatively steady and so did the price per pound.



The third graph is a scatter plot representing the pounds of squid caught per year, with a trendline showing how the data follow. This trendline shows that the data fluctuated quite a bit. The trendline peaked in 2014 with 200 million pounds of squid caught. After this, the data trendline fell dramatically, dropping down to 50 million pounds of squid caught.

6912
Bacteria's Clean Demise

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This project showed the effects of proper hand washing on the hands, including the amount of bacteria killed. I chose this project to see how I really affect my hands when washing them, and to understand my hygiene better. In the experiment I used swabs and Petri dishes to capture and measure the bacteria on my and my partner's hands. First my partner and I got our hands dirty with the same dirt at the same time and swabbed them. We then proceeded to wash our hands using a World Health Organization (WHO)-approved method. After completing the hand wash, we swabbed again in the same two places — the index finger and palm. Following this I let the Petri dishes sit for two days and monitored them every 10 or so hours. Afterward I charted all of the information and did the math. Washing our hands had killed roughly 82%-94% of the bacteria on them. So, with proper hand washing, you can greatly reduce the amount of bacteria.

RESEARCH REPORTS

In recognition of Dominique Evans-Bye's significant achievements — including receiving the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring — we proudly invited her to submit the following two full-length student research reports in addition to abstracts for publication in this year's journal.

R1 Bombala's Crater Topography: Evidence of Erosion From Landslides on Mars

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I. Introduction

When exploring the geography of Mars, our big-picture question was: "How does erosion affect the Bombala Crater topography?" We narrowed it to a research question: "Is there evidence of landslides eroding the Bombala Crater wall?" We found this question to be important and interesting because it allowed us to explore what features erosion can cause, as well as how the crater can change due to erosion. Moreover, it allowed us to measure and gather scientific data such as the integrity of the crater wall. Furthermore, it is interesting to compare the same geologic processes on Mars that occur on Earth. To answer our research question, we proposed three hypotheses: First, if landslides eroded the Bombala Crater, then we would see evidence of debris and/or fallen material. Second, if wind erosion modified the Bombala Crater, then evidence of sand dunes, yardangs, and dust devils would be found. Third, if water eroded the Bombala Crater, then there would be evidence of features such as water channels. We narrowed down our working hypotheses to focus on one: "If landslides eroded the Bombala Crater, then we would see evidence of debris and/or fallen material."

II. Background

Some definitions, specific knowledge, and hypotheses from other scientists about geologic features on Mars, relating to our science question, include that craters are circular cavities formed by objects striking the surface which is found on Earth and Mars. More craters are found on Mars compared to Earth due to faster erosion on Earth. The region on Mars has an arid climate and lack of vegetation, which causes erosion to become slower and more craters are present. The thick atmosphere on Earth protects Earth from meteor strikes. However, on Mars the atmosphere is thinner; thus more meteors strike and impact on the surface.

(Source: NASA Science, <https://go.nasa.gov/3iVbDot>.)

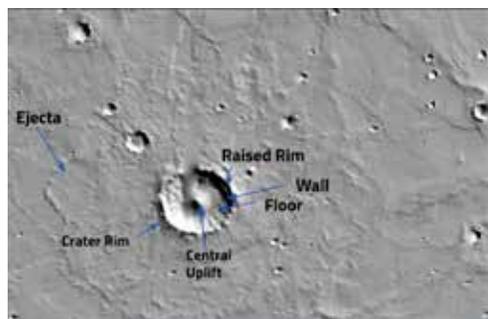


Figure 1: Bombala Crater
Source: THEMIS



Figure 2: Here is what a landslide on a crater wall looks like on Mars.
Source: Arizona State University

Seismic tremors and water saturation contribute to gravity pull, which pushes materials from the cliffside to create a landslide. The features we are studying that are found on Earth are thought to be formed by landslides that are large pieces of rock and Earth (in this case Mars dirt) that have fallen from a mountain or cliff. The craters on Mars also can have landslides big enough to see because of the size of the craters; because of the lack of vegetation and fluid in the ground, it is easier for landslides to occur. The landslides on Earth and on Mars are very similar to each other even though they are two different planets. There are many ways that a landslide can occur, listing a few: seismic tremors; wind, causing a chain reaction (think like dominos); and water, which helps soften and loosen material. Ultimately, gravity is responsible for pulling material from the wall toward the crater floor. (Sources: THEMIS: Mars Odyssey Mission, <http://themis.asu.edu/feature/44>; United States Geological Survey, www.usgs.gov.)



Figure 3: "V"-shaped scars form from landslides. Multiple scars were found within the crater and are outlined in light green. Blue lines show the position of the debris from the landslide. Photo source: THEMIS



Figure 4: The green and blue lines represent the movement of land and differentiate where the landmass was previously.
Source: <https://bit.ly/3748rom>

III. Methods

The geographic region we focused on in the process of collecting our data was the Bombala Crater in the Hesperia Planum region. Our feature of interest was landslides, which can be identified by surrounding erosion, fallen debris, rocks, and land. The specific spacecraft and camera we used to collect data for our research was the Mars Odyssey, which has the Thermal Emission Imaging System (the THEMIS camera). THEMIS views the infrared and visible reflections from the Mars surface and makes a map of the different locations of minerals and their relationship to landforms. We also used HiRISE (High Resolution Imaging Science Experiment), which studies the active surface processes and landscape evolution of Mars, and CTX cameras (Context Cameras) on the Mars Reconnaissance Orbiter to provide a high-resolution analysis of important areas on Mars.

For the methods, we used JMARS, which is a computer program developed by NASA that is used to analyze images from Mars. Since our main focus was landslide analysis, we used tools in JMARS that would help us for our further research of whether there were landslides on Mars. JMARS was used to render the CTX and HiRISE stamps. The Elevation Tool was very useful to us for plotting and finding critical points of elevation to find a pattern between each scar and its landslides. JMARS was also used to see the Bombala Crater in depth. The 3D tool helps determine topography and elevation changes. The Investigate Layer Tool was used to find information about specific areas of the crater along with the Measuring Tool, which was used to measure certain distances from one another.

To gather our data, we followed the protocol from the Mars Student Imaging Project (MSIP) developed by Arizona State University in collaboration with NASA. The United States Geological Survey (USGS) and Universities Space Research Association (USRA) were two other major websites we used to gather evidence to support our hypothesis investigating landslides and crater features. USGS provided background information on landslides on Earth, and we took those details into account to identify possible landslides on the crater that would support our thesis of mass erosion. USRA provided background information on crater topography as a whole and focused on the impact that created the crater, along with the outcome of features such as central peak and ejecta. (Sources: USGS, <https://on.doi.gov/3doDFr4>; USRA, <https://bit.ly/34SnjTP>.)

IV. Data

We focused our research on one specific THEMIS image (V64728007), showing the Bombala Crater as part of the MSIP protocol.

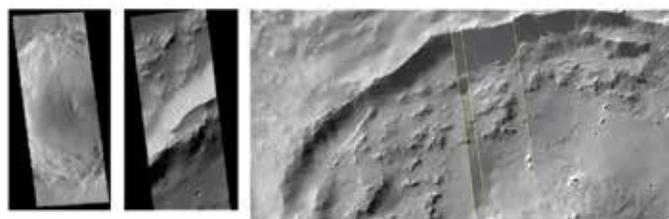


Figure 5: CTX rendered stamps from the Bombala Crater

The Bombala Crater is located in the Hesperia Planum region of Mars. The measurements of the Bombala Crater are 38 km in diameter.

Latitude	-27.6207
Longitude	106.081
Orbit Number	64728
Captured	2016-07-17 12:42
Posted to the Web	Tue, 2019-12-24
Instrument	VIS
Image Width	512 pixels (17 km)

Table 1: Bombala Crater project data

V. Discussion

	A	B	C	D	E	F
2 Scar 1		1907	1981	1928	1900	1854
3 Scar 2		1722	1707	1805	1886	1766
4 Scar 3		1786	1726	1632	1685	1578
5 Scar 4		1259	1294	1343	1400	1497
6 Scar 5		1429	1449	1487	1547	1590
7						
8 Debris 1		1296	1401	1348	1348	1271
9 Debris 2		584	973	1043	966	966
10 Debris 3		972	979	1012	1071	1207
11 Debris 4		1022	1104	1127	1156	1087
12 Debris 5		665	1009	1114	1176	1041

Table 2: Landslide data from Bombala Crater

Based on the data table above, collecting data samples from five different scars and elevation points proved that there were landslides present in the Bombala Crater. Area graphs were made by separating each scar with its fallen debris. They were all graphed on a 3D area graph by their scars and the correlated fallen debris under them.

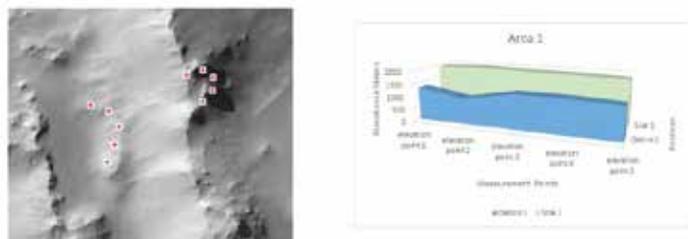


Figure 6: Image with measurement points and graph of Scar/Debris 1. Graph shows measurements of suspected landslide, Area 1. Source: JMARS CTX

	Elevation Point 1	Elevation Point 2	Elevation Point 3	Elevation Point 4	Elevation Point 5
Debris 1	1298	1001	1348	1348	1271
Scar 1	1907	1989	1928	1900	1854

Table 3: Landslide data from Bombala Crater, Area 1

The red points seen in Scar 1 are the scars from the landslides, captured by CTX, and the red points below, Debris 1, show the outcome of where debris from the landslide is located.

Scar 2 and Debris 2

The red points seen in Scar 2 captured by CTX are the broken off parts on the rim due to a landslide, and Debris 2 is the outcome of the landslide.

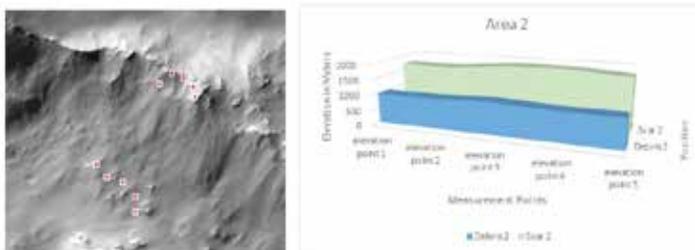


Figure 7: Image with measurement points and graph of Scar/Debris 2. Graph shows measurements of suspected landslide, Area 2.

Source: JMARS CTX

	Elevation Point 1	Elevation Point 2	Elevation Point 3	Elevation Point 4	Elevation Point 5
Debris 2	984	973	1043	956	956
Scar 2	1722	1707	1885	1888	1766

Table 4: Landslide data from Bombala Crater, Area 2

Scar 3 and Debris 3

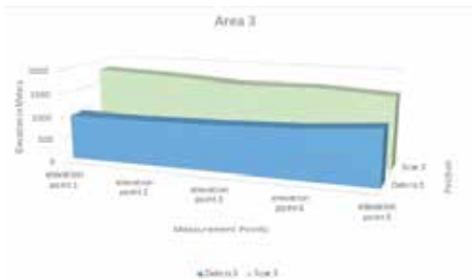


Figure 8: Measurements of suspected landslide, Area 3

	Elevation Point 1	Elevation Point 2	Elevation Point 3	Elevation Point 4	Elevation Point 5
Debris 3	972	979	1012	1071	1207
Scar 3	1786	1726	1632	1669	1578

Table 5: Landslide data from Bombala Crater, Area 3

Scar 4 and Debris 4

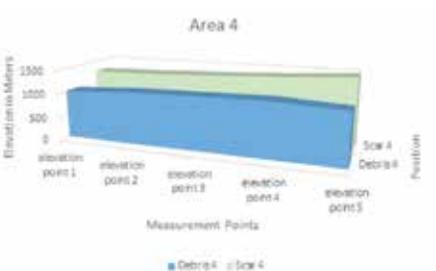


Figure 9: Measurements of suspected landslide, Area 4

	Elevation Point 1	Elevation Point 2	Elevation Point 3	Elevation Point 4	Elevation Point 5
Debris 4	1022	1104	1127	1556	1087
Scar 4	1259	1294	1343	1406	1497

Table 6: Landslide data from Bombala Crater, Area 4

Scar 5 and Debris 5

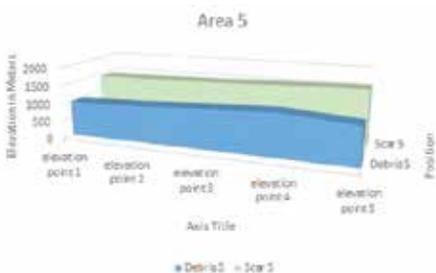


Figure 10: Measurements of suspected landslide, Area 5

	Elevation Point 1	Elevation Point 2	Elevation Point 3	Elevation Point 4	Elevation Point 5
Debris 5	969	1009	1114	1176	1041
Scar 5	1429	1449	1487	1547	1590

Table 7: Landslide data from Bombala Crater, Area 5

Possible Inaccuracies and Misinterpretations: There could be inaccuracies in the way we measured the scars of the crater, as well as the debris. The measuring tools can be a bit off when they are eyeballed. It's also very difficult to accurately measure the correlating elevation points. Also, when measuring the debris, to our eyes it may seem like fallen debris, but in reality, it may be something else.

VI. Conclusions

We successfully found evidence of debris and fallen material seen by JMARS to accept our hypothesis: "If landslides eroded the crater, then we would see evidence of debris and/or fallen material." By observing and understanding the geological processes and features of Mars, we observed the Bombala Crater, using topography in which we found evidence of ero-

sion and landslides. Diving into this project, we only observed one crater and its landslides in multiple regions on the crater wall. In the future, to better examine the hypothesis, we would add more craters to research as well as compare and recognize patterns on JMARS. Many questions are asked in order to help prove the hypothesis, such as, “Do smaller craters experience more inconsistencies in crater wall integrity? Do certain areas of Mars cause craters to have inconsistent rims?”

VII. References

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“What Triggered a Martian Landslide?” | Mars Odyssey Mission THEMIS, <http://themis.asu.edu/feature/44>.

R2

A Unique Ejecta Pattern: Erosion’s Effect on a Martian Dual Crater

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I. Introduction

The research question that we investigated for this project was: “Has the ejecta pattern around the double crater in stamp V15272005 been modified by erosion?”

We found our research question interesting because as we were looking over Thermal Emission Imaging System (THEMIS) images, we noticed a double crater, which means there were two impacts. It appears the impacts were simultaneous, seeing as one crater does not overlap the other and the ridge cuts right in between the craters. The ejecta is unique because it does not match the shape of the other typical patterns such as butterfly, radial, or offset. The crater’s edges seem to be smoothed by erosion.

We came up with the following hypotheses for our project:

- If the ejecta has been modified, then we will find evidence of erosion.
- If the ejecta has been modified by water erosion, then we will find evidence of channels.

II. Background

Known as Earth’s sister planet, Mars is thought to have been very similar to present day Earth millions of years ago (Anderson, 2019). Surprisingly, both Mars and Earth have

roughly the same amount of dry land surface area. This might seem like a strange claim when objectively looking at the two planets, but two-thirds of Earth’s surface is covered by water. Because the diameter of Mars is roughly half that of Earth, Mars’ gravity is much lower. The gravity of Earth is 2.66 times that of Mars. The composition of their atmospheres is greatly different. While they do share many of the same gases, the most abundant gas on Mars is carbon dioxide, with a whopping 95.32% compared to Earth’s 0.038%. On Earth, the most prevalent gas is nitrogen with 77%, while on Mars it is 2.7%. Arguably the most important gas for the presence of life, oxygen, is 21% of Earth’s atmosphere and only 0.13% of Mars’. The atmospheric pressure for Mars and Earth is 7.5 millibars (on average) and 1,013 millibars (at sea level), respectively (Phoenix Mars Mission, 2007).

In addition, Earth is much more geologically active than Mars. Earth has a “hot interior” with a core, mantle, and crust. Earth also contains a lithosphere, the rigid rock that forms the outer layer of a planet. These help with conducting heat flow around the planet, with gravity helping by sorting the materials in terms of density (McGrath, 2005). These differences in the two planetary bodies provide a reasonable explanation as to why it is less common for certain features to form, why they look different on Earth, or why they do not remain as long.

While there are a myriad of different features that form on both Mars and Earth, there are specific features that pertain to the stamp V15272005 (*Figure 1*). (See Figures 1–8 on page 61.) These features include double craters, ejecta patterns, and channels (*Figure 2*). These features are thought to form the same way on Mars as they do on Earth. Craters are formed in three stages: compression, excavation, and modification (*Figure 3*). During the compression stage, the impact from the meteor causes a shock wave to pass around the area. The energy is converted into heat and kinetic energy. The impact causes solid materials to behave like fluids. During the next stage, excavation, the shock waves continue outward through the material surrounding the impact. The material then moves upward and outward, causing it to form an ejecta blanket. In the third and final stage, the loose debris will move and slide into the crater’s walls.

As seen in *Figure 4*, these ejecta blankets can be modified by erosion, future impacts, lava, or tectonic activity (Wiggins, 2017). Double craters form when a pair of meteorites simultaneously hit the ground next to each other. If both asteroids are comparable in size, the pair of craters they create may be the same size as well. If the impactors vary in size, they will also have different sizes for the resulting pair. If the two impact explosions occur simultaneously, the result would be the interconnected ejecta shooting debris sideways. Debris is the material that is formed during a meteor strike. Also as seen in *Figure 4*, debris is what creates “wings,” or ejecta patterns, on the sides of the double craters (Arizona State University (ASU), 2020). There are three different types of ejecta patterns — radial, butterfly, and offset. Radial ejecta patterns are those with concentric shapes that extend outward (*Figure 5*). Butterfly ejecta patterns do not extend all around the crater. Instead, they are off to the sides of the crater (*Figure 6*). Offset

patterns form when the ejecta branches out on a specific side of the crater. This occurs when the meteorite hits at an angle (*Figure 7*).

Channels form through flowing water (*Figure 8*). Today, it is impossible for water to flow through channels on Mars. Because of Mars' thin atmosphere, water would evaporate or freeze before traveling anywhere (ASU, 2020). However, scientists hypothesize that Mars had a much warmer and wetter climate when it had an atmosphere up to five times thicker than Earth's current one (Redd, 2018). This atmosphere would have made it very possible for water to flow and create channels. It is a common belief among scientists that Earth's thick atmosphere causes meteorites to burn up before they can hit Earth's surface (NASA, 2015). Because of this theorized thicker atmosphere, it is very likely that there were fewer craters on the surface of Mars in the past than now.

III. Methods

We used the THEMIS camera on the Mars Odyssey spacecraft to collect data for our research. We chose THEMIS stamp V15272005 to be the focus of our research, noting the double crater, its ejecta pattern, as well as the banks on either side of the crater. We used JMARS (Java Mission-planning and Analysis for Remote Sensing) to find images of craters with different ejecta patterns, and also referred to the Mars Image Analysis Feature ID Charts to identify the geological features we were observing on Mars.

We obtained our research image using the THEMIS stamp tool in JMARS. We rendered a CTX (Context Camera) stamp to provide the highest-resolution image available. We used the MOLA (Mars Orbiter Laser Altimeter) color over THEMIS Day (plus MOLA Numeric Elevation Layer) to not only visualize the changes, but to obtain graphs of each of the different types of ejecta patterns. We used the Elevation Profile Tool to record the elevation change and to determine the direction water would flow through our study area. We worked on the premise that if ejecta has been eroded, then the elevation change would be lessened. To investigate this, we used the Elevation Profile Tool to measure the change in elevation in one radial, butterfly, and offset crater ejecta sample. To support our claim of a water channel eroding away some ejecta, we measured the elevation changes from our study area down what appeared to be a floodplain, to a well-defined channel.

IV. Data

We collected four THEMIS images of craters, one of each crater type.

Type of Crater	Data Collected	Tool We Used
Radial crater with ejecta	Average elevation change: 73 m	Elevation Profile Tool
Butterfly crater with ejecta	Average elevation change: 75 m	Elevation Profile Tool
Offset crater with ejecta	Average elevation change: 45 m	Elevation Profile Tool
Our crater with ejecta	Average elevation change: 31.5 m	Elevation Profile Tool

Table 1: Data collected and tool used for each crater type

Type of Crater	Difference Between Average Level of Elevation for Other Craters and Our Crater
Radial crater	41.5 m
Butterfly crater	43.5 m
Offset crater	13.5 m

Table 2: Elevation level information for each crater type

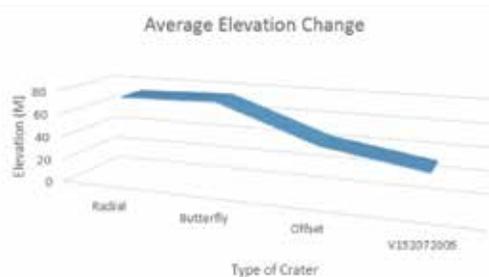


Figure 9: This three-dimensional graph shows the different average elevation changes of the ejecta patterns of each type of crater.

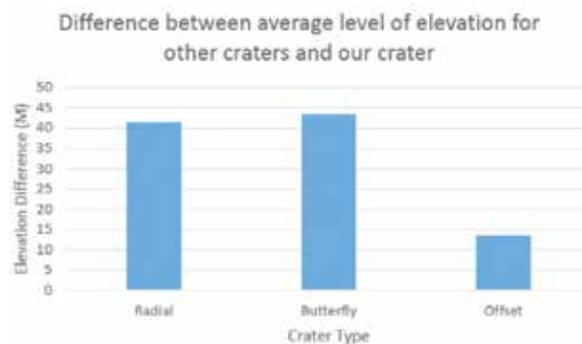


Figure 10: This is a graph of the differences between the average levels of elevation change. The offset crater and our crater have the least difference in value.

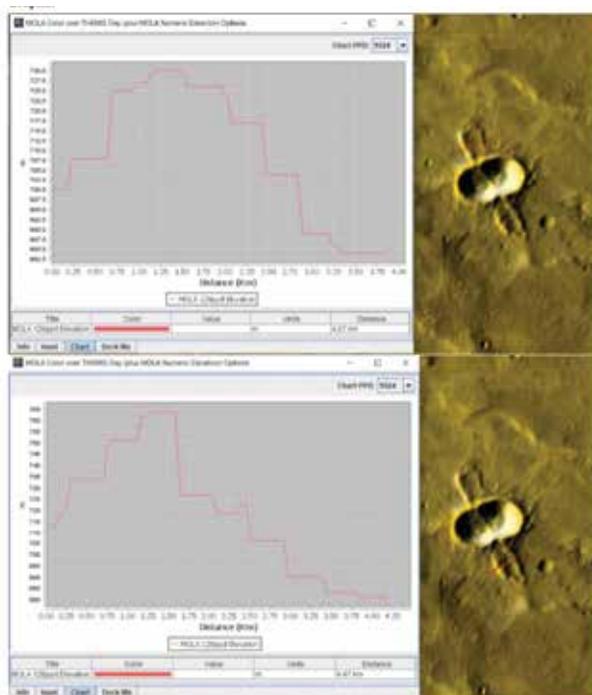


Figure 11: Elevation of cross-sections of ejecta patterns for our study area

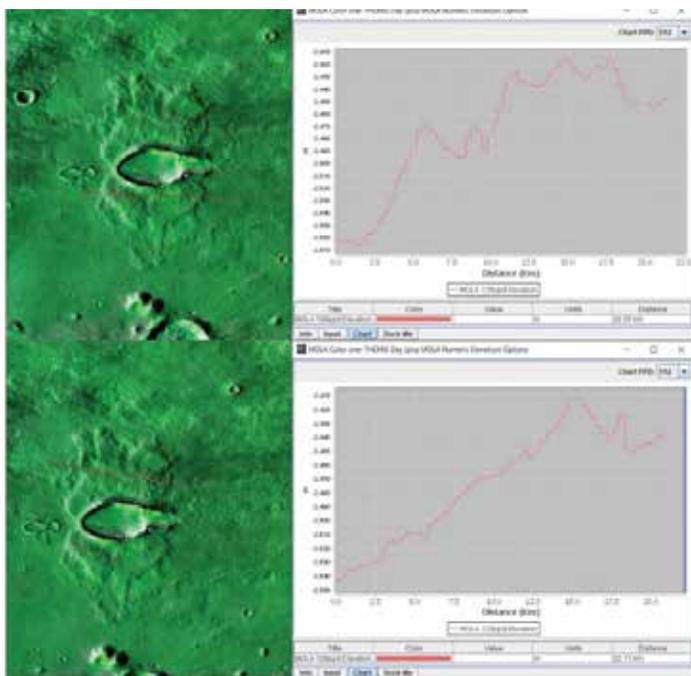


Figure 12: Elevation of cross-sections of ejecta patterns for a butterfly crater

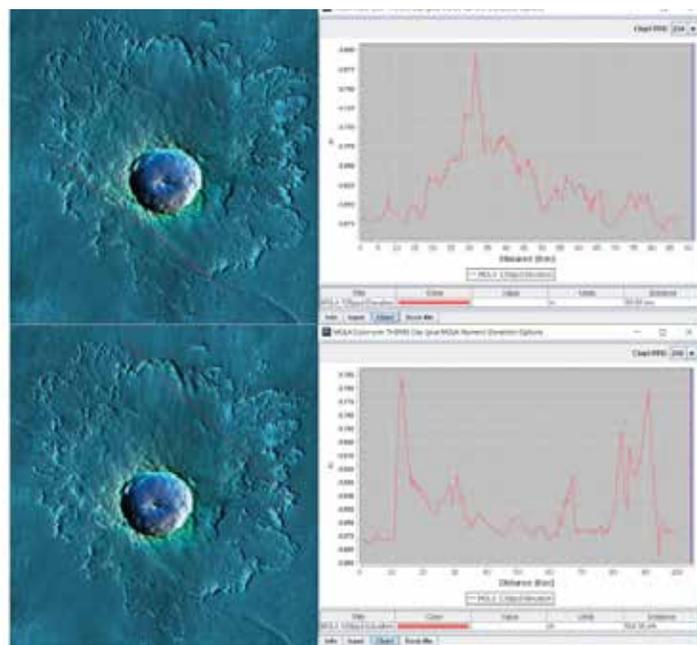


Figure 14: Elevation of cross-sections of ejecta patterns for a radial crater

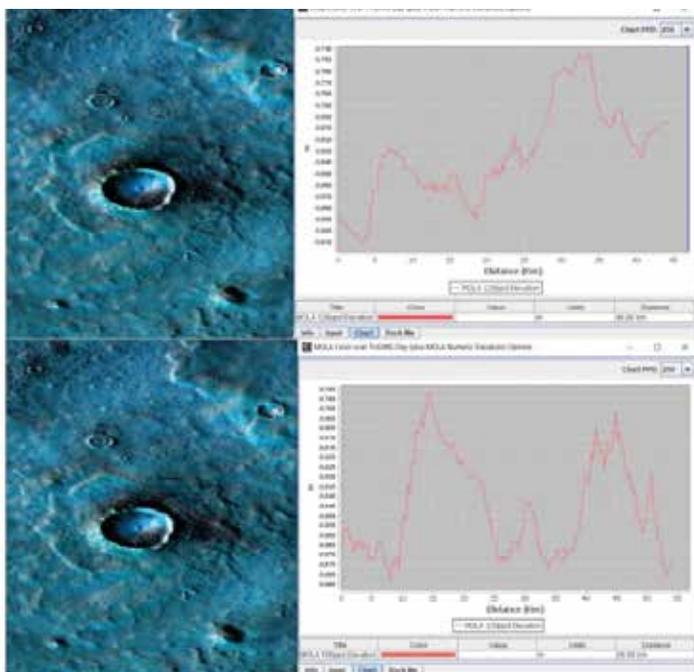


Figure 13: Elevation of cross-sections of ejecta patterns for an offset crater

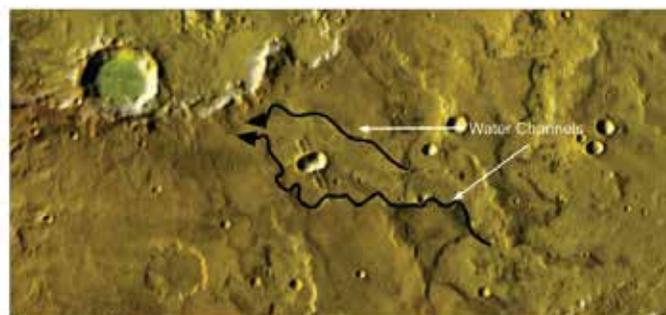


Figure 15: Map of two water channels showing water flow from our study area

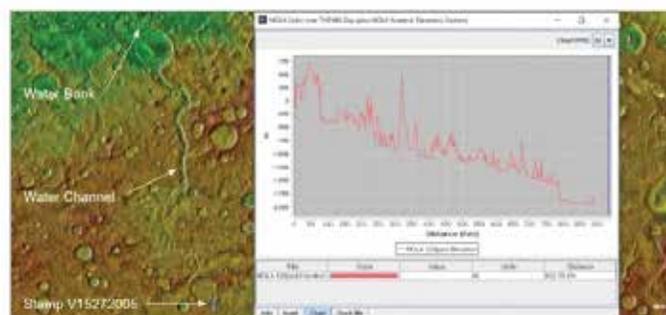


Figure 16: Map of a floodplain flowing from near our study area to a water channel

V. Discussion

Table 1 shows the type of object that was studied, the data we collected from that object, and the tool we used to get the information. Data collected show the average elevation change. Finally, the “tool used” column shows which tool in JMARS was used to find the information. In this case, we used the Numeric Profile Tool for all parts of the table. In the second table we have two sections: the “type of crater” and the “difference between average level of elevation for ejecta around other craters and the ejecta around our crater.” The “type of crater” shows which crater we are studying and the “difference between average levels” shows an estimate of the average elevation change of the ejecta.

Our project consists of 10 graphs. Our data map (*Figure 15*) shows the crater in stamp V15272005, as well as a water channel flowing toward a water bank. By using the tool, we saw that the elevation was decreasing as the channel was getting closer toward the bank (*Figure 16*).

During our research we also found potential errors for the data collected. Because we were able to analyze only one crater of each type, that left some room for inaccuracies. It also was difficult to find craters with the same radius. In addition, there is a possibility of misinterpretations in this project. Because the edge of the ejecta is sometimes hard to define, it's difficult to determine where it starts. Additionally, we need to find craters that are younger, because in that case the average elevation changes would be greater than those of ones that were already eroded. An original ejecta pattern would have more fluctuation in the change of elevation, since erosion blows off parts of the ejecta pattern, thus smoothing the surface and decreasing the change in elevation.

VI. Conclusions

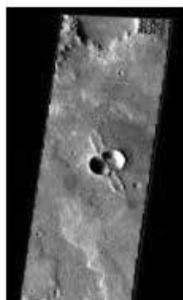
Our research question was: “Has the ejecta pattern around the double crater in stamp V15272005 been modified by erosion?” and we found that yes, the ejecta pattern has been modified by erosion because we found evidence of a bank formed from a water body. Using the Elevation Profile Tool, we were able to find the direction the water would flow based on changes in elevation (*Figure 15*), with our ejecta pattern being right in the middle of the flow path.

Our hypothesis was: “If the ejecta has been modified by water erosion, then we will find evidence of channels.” We want to continue this project on ArcGIS to create a watershed and do a downstream water trace. Additionally, we still need to do statistical analysis to find out if our data show significant differences in erosion levels.

We would like to acknowledge our GIS & Remote Sensing teacher, Ms. Dominique Evans-Bye; Don Boonstra with Arizona State University (ASU) for his helpful suggestions on the Mars Student Imaging Project (MSIP) program; ASU and NASA/Jet Propulsion Laboratory (JPL) for developing the project; and the National Science Foundation for funding the MSIP.

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V15272005 From Arizona State University

Figure 1: Our study area

Figure 2:
Teal: Channels
Blue: Ejecta patterns
Purple: Double crater

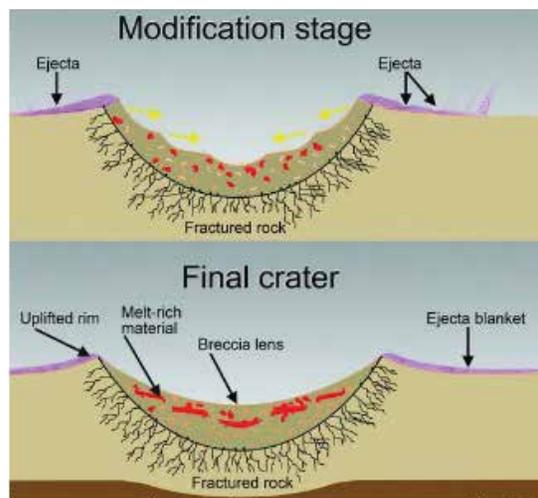


Figure 4: Formation of ejecta blankets and patterns
Source: Lunar and Planetary Institute

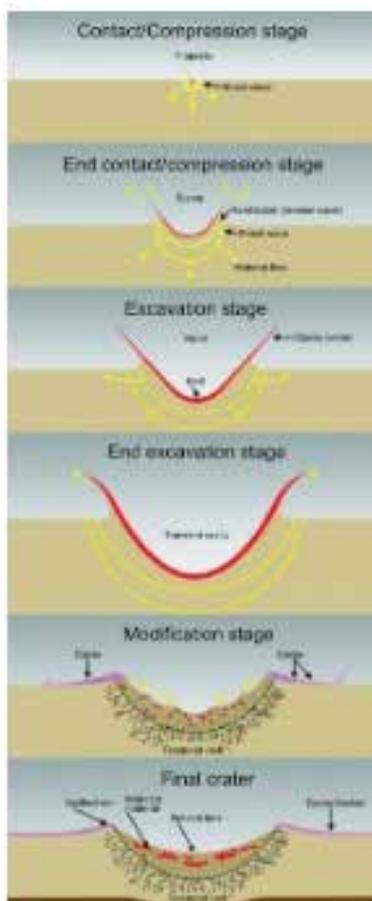


Figure 3: Formation of craters
Source: Lunar and Planetary Institute

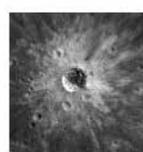


Figure 5: Radial ejecta pattern

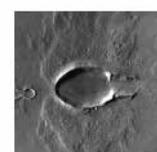


Figure 6: Butterfly ejecta pattern

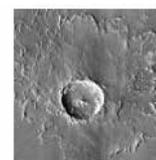


Figure 7: Offset ejecta pattern

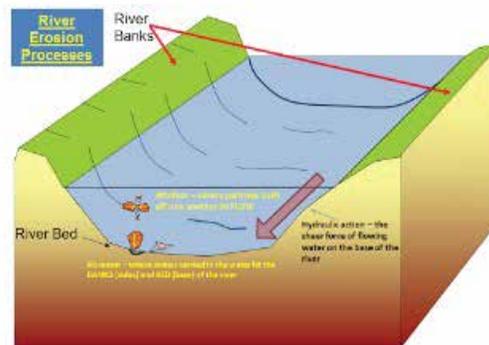


Figure 8: Channel formation
Source: Coolgeography.co.uk

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