

**15th**  
Annual

# Southern Connecticut Science & Engineering Fair

Saturday,  
February 7,  
2015



**Inspiring & Educating Students**

Sponsored by:

**Southern  
Connecticut  
Science &  
Engineering  
Foundation, Inc.**  
[www.scsef.org](http://www.scsef.org)



# Fair Schedule

## **7:30 am:**

Judge Check-In (Main Lobby)  
Breakfast (Cafeteria) followed by  
Orientation (Auditorium)

## **8:30 am:**

Exhibitor Check-In (Main Lobby)  
Breakfast (Cafeteria) and  
Set-Up (Gymnasium)

## **9:30 am – 12:30 pm:**

Judging of Exhibits (Gymnasium)

## **12 pm – 1:30 pm:**

Fair Exhibits Open to Public (Gymnasium)  
Lunch for Exhibitors & Judges (Cafeteria)

## **1:30 pm:**

Keynote Presentation by  
Dr. J. Alan Clark (Auditorium)

Followed by Awards Ceremony



## Keynote Speaker

# 15th Annual Southern Connecticut Science & Engineering Fair



We are honored to welcome

**Dr. J. Alan Clark**

*Associate Professor of Conservation  
Biology at Fordham University*

Dr. J. Alan Clark is an associate professor of conservation biology at Fordham University. Dr. Clark's impressive background extends beyond the field of biology. He also holds degrees in law, natural resource policy, music education, and religious studies. He founded a conservation law practice, and has worked with such notable institutions as the Environmental Defense Fund, National Wildlife Federation, Society for Conservation Biology, U.S. Fish and Wildlife Service, and the EPA. Dr. Clark's recent research interests involve behavioral ecology and have included topics such as conservation of Little Blue Penguins, night migration of birds and bats through New York City, the effect of urban landscapes on bird and bat migration, and population structure in wild cats.



# Special Thanks

The Southern Connecticut Science & Engineering Foundation, Inc.  
Gratefully Acknowledges the Generous Support of

## The Sexauer Foundation

Grants from the Sexauer Foundation have provided crucial support for the work of the Southern Connecticut Science & Engineering Foundation (SCSEF) as it expands its mission.

Sexauer's donations have underwritten major expenses associated with producing a fair at which the number of exhibitors has grown each year, and have allowed SCSEF to fund the enrollment of teachers from a variety of schools and districts in a program enhancing their ability to teach science research effectively.

And they offer the possibility that SCSEF will eventually be able to send its fair winners on to national and international competitions.

Our thanks go out to this visionary benefactor.

# Acknowledgements

**The Southern Connecticut Science & Engineering Foundation, Inc.**  
gratefully acknowledges these generous contributors:

**Presenting Sponsor:**  
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The Southern Connecticut Science and Engineering Fair could not exist were it not for the contributions of dozens of volunteers who devote their considerable talents and thousands of hours to fair activities.

Volunteers include approximately 250 judges, 40 individuals who prepare materials for the fair; 25 who assist with fair day activities, and the members of the SCSEF Board of Directors who manage the fair.

We acknowledge in a special way the Faculty and Staff of Newtown High School, which hosted the fair.

**For Their  
Valuable Services:**

Paul & Karin Cook  
(medals & banners)  
Elizabeth Helling (program design)  
Barbara Garelick (program printing)  
Infinite Web Designs (web site)

**For Hosting &  
Supporting the Fair:**

The Faculty & Staff of  
Newtown High School

**For Their Endless Hours  
of Service:**

Ziaul Mannan: Fair Coordination  
Fran Walker-Lichtenberg: Judging  
Coordination  
Dale Lichtenberg: Logistical  
Coordination  
Tim DeJulio: Newtown High School  
Science Teacher  
Joop deGroot: Software  
Development

**For Their Dedicated Service  
on the Day of the Fair:**

Our Talented and Hard-Working  
Judges  
Members of the Board of Directors  
Newtown High School National  
Honor Society  
Ms. Sydney Brown  
Mr. Nic Pisarro  
Dr. Harry Rosvally  
Ms. Nancy Yates

**For Their Dedicated Service:**

Our Talented and Hard-Working  
Judges (as of 1.22.2015)  
Chirag Adhia  
Lamar Ager  
Bruce Allen  
Kathy Almeida  
Linda Andrew  
Herbert Auslander  
Steven Autieri  
Sundararajan Balaraman  
Andy Bangser  
Dianna Bartel  
Steven Baumann  
Claudia Bertuccio  
Carl Binner

Russ Blair  
Sandy Bogdon  
Sahin Boluk  
Ryan Bower  
Larry Bowman  
Jim Boyle  
Bart Bradbury  
Randall P. Bright  
Rachel Cain  
Dave Callan  
Bob Carangelo  
Ty Chatchaidech  
Alice Chen  
Golam Chowdhury  
Franklin Chung  
Mark Conklin  
Robert Cordery  
Mark Costello  
Craig Cuttner  
Vincent D'Agostino  
Rick D'Amico  
Greg D'Andrea  
Robert Davis  
Michael Doery  
Arthur Doweyko  
Anna (Dr.) Duran  
Ryan Earl  
Avery Erwin-McGuire  
Joseph Esposito  
Mark Estacion  
Linda Farber  
Frank Fazekas  
John Feder  
Gene Feldman  
Paul Ferencz  
John Fleming  
John Francis  
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Mari-Ann Gaynes  
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John Glaberson  
Ken Goldman  
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Kevin Green  
Marshall Greenspan  
John Grimardi  
Rob Grosso  
Michael Gugger  
Akshar Gupta  
Sanjeev Handa

Amy Handmaker  
Roseanne Haughton  
Jennifer Hensel  
Aaron Herold  
Kevin Hess  
Steve Heyman  
Robert Higgins  
Dave Hill  
John Honey  
Michael Honsberger  
Tony Hwang  
Rene Hymel  
Jeff Infusino  
Linda Jacob  
Haya Jamali  
SoRi Jang  
Ron Janis  
Lu Jin  
Tommy John  
Robert H. Johnson  
Christoph Juchem  
Andy Judge  
Eduardo Kamenetzky  
Mat Kastner  
Karin King  
Roger King  
Rajeswari Kompalli  
Lori Kovanda  
Alex Kwan  
Danielle (Dani) LaChance  
Julie Laifer  
Jean Larson  
Tom Larson  
Marc Lash  
Jon Lawrence  
Judith Leahy  
Nina Levine  
Stewart B. Levine  
Paul Lipof  
Bob Logano  
Carolyn Macica  
Sylvia Malinski  
Steve Marlin  
Chris Marlor  
Kent Marshall  
Ray Martinelli  
Robert Mauri  
Michael McAlear  
Brian McCabe  
Robert McDougal  
Sharen McKay  
Sharon McNeal

Marie McPadden  
Ruth Montgomery  
Hector Morera  
Sean Morley  
Nina Morrisson  
Thomas H. Morrisson  
F. Carl Mueller  
Suresh Nagumalla  
Bikshandarkoil (BA) Narayanan  
Angela Njo  
Lisa Nori  
Paul Oestreicher  
Michael Ogrinz  
Michael Opuszynski  
Michael L. Oristaglio  
Kate Otley  
Chaitanya (CK) Pai  
William H. (Bill) Papazian  
Eric Paradis  
John Pelegano  
Candice Pelligra  
Karen Pierce  
Christopher Pittenger  
Bill Poirier  
Frank Pompeo  
Atif Rakin  
William Rappoport  
Jeremy Richman  
Forest Robertson  
Diego Rodriguez-Gil

Gary Romeo  
Stephen Roux  
Mark Rubino  
Karin Russo  
Joseph Ryan  
Marie Sabo  
Anthony J. Salvate  
James Saulnier  
Taku Shimura  
Beth Siegelbaum  
Deirdre Silberstein  
Ray Skorupa  
Penny Snetsinger  
Nina Stachenfeld  
Gregory Stanford  
Jonathan Steinberg  
Dan Stigers  
Elizabeth Sun  
Sruthilaya (Sruthi) Swaminathan  
Sherri Swihart  
Carol A. Tomczyk  
Jack Tracey  
Yu-Cheng Tsai  
Michael R SIK Urban  
David Valovich  
Karen Varco  
Edward Varians  
Robert Wagman  
Yanbin Wang  
Lee Warren

Pamela Weiss  
Jim West  
Amy Wu  
Ye Xu  
Ben Yarmis  
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If you'd like to support **SCSEF** with a donation so we can continue to expand our Fair and educational programs, please visit our website at [www.SCSEF.org](http://www.SCSEF.org).

Your contribution, of any amount, is greatly appreciated.

We'd also welcome volunteers to assist with outreach, web development and fundraising.

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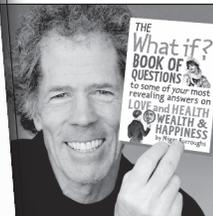
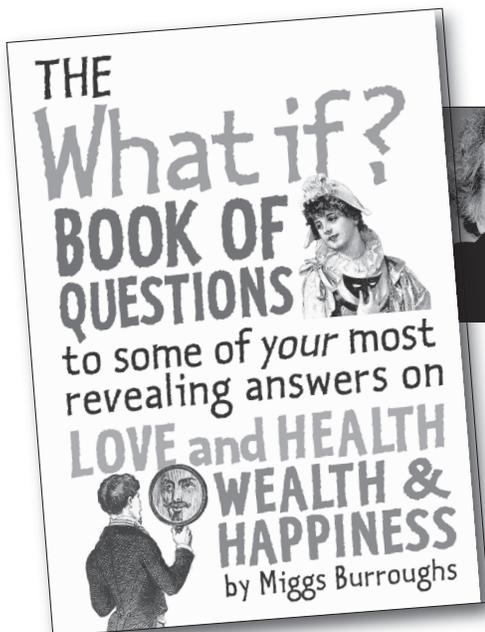
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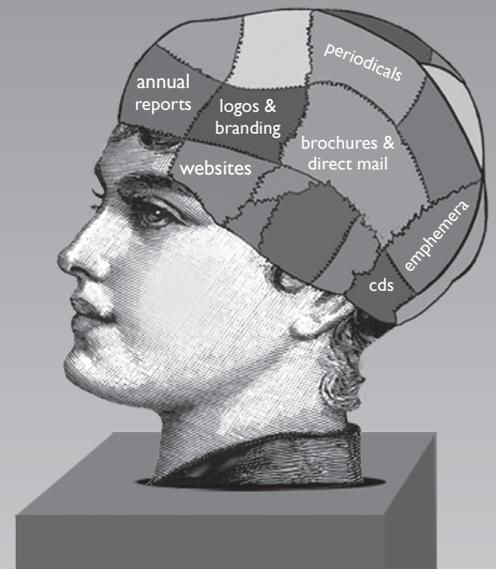
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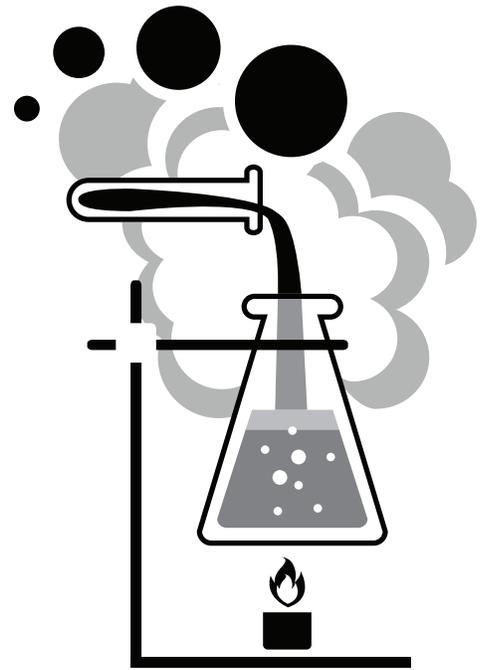
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***Yale-New Haven Hospital  
congratulates the  
Science Fair participants***



Yale-New Haven Hospital is committed to the best possible care for every patient – a mission that extends to our community. We are proud to be part of such a caring community where so many organizations work together.

Congratulations to all the participants in the Southern CT Science & Engineering Foundation's Science Fair.

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**The Board of Directors of SCSEF  
would like to congratulate  
Fran Walker-Lichtenberg &  
Dale Lichtenberg  
recipients of this year's  
Paul Heilman Award**

**Their extraordinary hard work,  
Fran as Judging Coordinator, and  
Dale as Logistical Coordinator  
make our Fair run smoothly  
and professionally.  
Congratulations on a  
very well deserved Award.**



**The Board of Directors of SCSEF  
would like to thank  
Joop deGroot  
for his extraordinary work  
creating a new and updated  
scoring program and  
implementing it on our  
new computers.  
We could not have done it  
without him.**





Proud to Sponsor the  
Southern Connecticut  
Science & Engineering Fair  
for Physical Science Award

## The Southern Connecticut Science & Engineering Fair

The Southern Connecticut Science & Engineering Fair (Fair) was started in 2001 by the Southern Connecticut Science & Engineering Foundation, Inc. (SCSEF) and has seen rapid growth. SCSEF promotes critical thinking skills, and motivates students to pursue science and engineering after high school. Students receive awards in four categories: health sciences, physical sciences, environmental sciences and behavioral sciences. Within each category, awards are given for both completed projects and research proposals. The Fair is supported in part by the Sexauer Foundation. For more information, please visit the Fair web site at [www.scsef.org](http://www.scsef.org).

## The Southern Connecticut Science & Engineering Foundation, Inc.

SCSEF, an IRS Sec. 501(c)(3) non-profit organization, advocates for the study, understanding and practice of science and engineering, and seeks to inspire and educate students, academics, parents and other members of our communities. In addition to sponsoring the Fair each year, SCSEF has supported advanced teacher training, and held some extraordinary events for students to see the practical application of science. These have included a visit to Pratt & Whitney's aircraft engine facilities, a physics lesson using an actual LeMans race car and a seminar by "citizen astronaut" Greg Olsen. For more information, sponsorship opportunities, or how to make an individual financial or in-kind donation, please visit the SCSEF web site at [www.scsef.org](http://www.scsef.org). Follow us on Facebook and LinkedIn by searching for Southern Connecticut Science and Engineering Foundation.

## Scholarship Program for Graduating Seniors

The Southern Connecticut Science & Engineering Foundation, Inc. (SCSEF) is pleased to announce a scholarship program open to all graduating seniors. .

Seniors who have participated in this year's Southern Connecticut Science & Engineering Fair are eligible to apply for financial support to help pay for their freshman year college expenses.

Scholarships will be awarded to four (4) graduating seniors, majoring in each of four (4) categories: Behavioral Science, Environmental Science, Health Field or Medicine, and Physical Science or Engineering.

For more information about these scholarships, either to receive a scholarship application packet, or to contribute to the Scholarship Program, please send an email to [SCSEF@aol.com](mailto:SCSEF@aol.com) and put "scholarship" in the subject line.

**Deadline for submission of completed scholarship application is April 30, 2015.**

# Welcome & Thanks to the Science Teachers

## **Amity Regional High School**

Deborah Day  
Catherine Piscitelli  
Scott DeMeo

## **Convent of the Sacred Heart**

Mary Musolino

## **Darien High School**

William Heher  
Christine Leventhal  
David Lewis

## **Glastonbury High School**

Diane Pintavalle

## **Greens Farms Academy**

Mathieu Freeman

## **Joel Barlow High School**

Katherine Nuzzo

## **Newtown High School**

Tim DeJulio

## **Old Saybrook Senior High School**

Kellie Sutliff-Brady

## **Ridgefield High School**

Ryan Gleason  
Patrick Hughes  
Michael Yagid

## **Staples High School**

Nickolas Morgan  
Michele Morse

## **Southern Connecticut Science & Engineering Foundation, Inc.**

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Ms. Nancy Yates

# Directory of Student Participants

Student	School	Category	Project #
Adison, Tasha	CSH	Research Proposal, Health and Medical	1
Ahern, Lauren	RHS	Research Proposal, Health and Medical	2
Ahmad, Yusuf	ARHS	Completed Project, Behavioral	3
Alderson-Smith, Lucy	CSH	Research Proposal, Health and Medical	227
Almeida, Kensi	CSH	Research Proposal, Health and Medical	4
Alter, Jonathan	SHS	Research Proposal, Physical Science	5
Ambler, Melanie	JBHS	Research Proposal, Health and Medical	6
Antaya, Joseph	ARHS	Research Proposal, Physical Science	129
Aparicio, Samantha	DHS	Research Proposal, Physical Science	7
Augenbraun, Nathan	NHS	Research Proposal, Physical Science	8
Bailey-Schetlin, Amelia	ARHS	Research Proposal, Environmental	9
Balaji, Suvasini	ARHS	Completed Project, Behavioral	10
Banks, Colin	DHS	Research Proposal, Health and Medical	11
Barbour, Sophia	DHS	Research Proposal, Environmental	12
Barnett, Sarah	SHS	Research Proposal, Behavioral	13
Beg, Emir	SHS	Research Proposal, Physical Science	14
Benson, Erik	NHS	Research Proposal, Physical Science	15
Benz, Andrew	DHS	Research Proposal, Physical Science	16
Berrigan, Brendan	DHS	Research Proposal, Physical Science	17
Beshoory, Jackie	CSH	Research Proposal, Health and Medical	18
Bhattarai, Nitya	ARHS	Completed Project, Physical Science	19
Bi, Jimmy	ARHS	Completed Project, Physical Science	20
Borecki, Claire	DHS	Research Proposal, Health and Medical	21
Bortniker, Max	SHS	Completed Project, Behavioral	22
Boutros, Thomas	ARHS	Completed Project, Behavioral	23
Bozzone, Lia	JBHS	Completed Project, Environmental	24
Brakman, Anna-Luisa	CSH	Research Proposal, Health and Medical	25
Brandon, Will	DHS	Research Proposal, Health and Medical	26
Briand, Giselle	SHS	Research Proposal, Physical Science	27
Britto, Aneeka	RHS	Research Proposal, Health and Medical	28
Burke, Quinn	ARHS	Completed Project, Health and Medical	29
Butler, Margot	CSH	Research Proposal, Health and Medical	30
Butler, Quinn	CSH	Research Proposal, Health and Medical	31
Campanella, Escher	DHS	Research Proposal, Physical Science	32
Campbell, Grace	CSH	Completed Project, Health and Medical	33
Carotenuto, Sabrina	CSH	Research Proposal, Behavioral	34
Cashman, Jackson	RHS	Research Proposal, Health and Medical	35
Castro, Olivia	ARHS	Completed Project, Physical Science	36
Chang, Andrew	RHS	Research Proposal, Health and Medical	37
Chang, Rees	SHS	Completed Project, Environmental	38
Chen, Alicia	ARHS	Completed Project, Behavioral	39
Chinitz, Sam	SHS	Completed Project, Environmental	40
Chung, Dana	ARHS	Completed Project, Health and Medical	41
Clark, Charlie	CSH	Research Proposal, Behavioral	34
Collins, Maude	CSH	Research Proposal, Environmental	42
Comer, Stephanie	CSH	Research Proposal, Health and Medical	1
Coughlin, Sloan	RHS	Research Proposal, Health and Medical	43
Criscuolo, Emily	ARHS	Completed Project, Health and Medical	44
Criscuolo, Teddy	ARHS	Completed Project, Environmental	45

**AHS:** Amity Regional High School, Woodbridge  
**CSH:** Convent of the Sacred Heart, Greenwich  
**DHS:** Darien High School, Darien

**GHS:** Glastonbury High School, Glastonbury  
**GFA:** Greens Farms Academy, Westport  
**JBHS:** Joel Barlow High School, Redding/Easton  
**NHS:** Newtown High School, Newtown

**OSSHS:** Old Saybrook Senior High School, Old Saybrook  
**RHS:** Ridgefield High School, Ridgefield  
**SHS:** Staples High School, Westport

## Directory of Student Participation (continued)

Student	School	Category	Project #
Crow, Joshua	ARHS	Research Proposal, Physical Science	129
Cunningham, Katherine	DHS	Research Proposal, Physical Science	46
Dardik, Kevin	ARHS	Completed Project, Physical Science	213
Davidi, Barak	ARHS	Completed Project, Physical Science	47
Davidovich, Adam	RHS	Completed Project, Behavioral	48
Davis, Ben	SHS	Research Proposal, Physical Science	49
Davis, Alex	SHS	Completed Project, Physical Science	50
Deng, Randy	RHS	Completed Project, Physical Science	51
Depuy, Burke	RHS	Research Proposal, Health and Medical	52
Depuy, Cathryn	RHS	Completed Project, Health and Medical	53
Desai, Sarishka	DHS	Research Proposal, Health and Medical	54
Dharani, Himay	ARHS	Completed Project, Environmental	55
Dimm, Katie	RHS	Research Proposal, Environmental	56
Ding, Howard	ARHS	Completed Project, Behavioral	57
Diorio, John	RHS	Research Proposal, Health and Medical	58
Dirvin, Brooke	DHS	Research Proposal, Health and Medical	59
Dixit, Agrani	ARHS	Completed Project, Behavioral	60
Dodge, Erika	DHS	Research Proposal, Behavioral	61
Dolan, Daniel	JBHS	Research Proposal, Environmental	62
Dolberry, Mahoghany	DHS	Research Proposal, Behavioral	63
Dowrich, Thea	CSH	Research Proposal, Health and Medical	31
Du, Weixin	ARHS	Completed Project, Behavioral	64
Dubovik, Ulada	ARHS	Completed Project, Health and Medical	65
Dushyanth, Deah	CSH	Research Proposal, Health and Medical	140
Effman, Zachary	SHS	Completed Project, Health and Medical	66
Ehrlich, Kyle	SHS	Research Proposal, Physical Science	67
Elias, Alexander	SHS	Completed Project, Physical Science	68
Ewing, Ben	ARHS	Completed Project, Behavioral	69
Feder, Evan	SHS	Research Proposal, Physical Science	70
Finnegan, Catherine	CSH	Research Proposal, Health and Medical	71
Fitzgerald, Ryan	NHS	Research Proposal, Environmental	72
Foley, Ann	ARHS	Research Proposal, Behavioral	73
Friedman, Alexander	ARHS	Completed Project, Health and Medical	74
Gallant, Noah	ARHS	Completed Project, Physical Science	80
Gamble, Christopher	NHS	Research Proposal, Physical Science	75
Gandhi, Sonia	DHS	Completed Project, Behavioral	76
Gerig, Virginia	SHS	Completed Project, Environmental	77
Gianukakis, Ariel	DHS	Research Proposal, Environmental	78
Gibbons-Morales, Jacob	ARHS	Completed Project, Behavioral	79
Giebisch, Daniel	ARHS	Completed Project, Physical Science	80
Golbazi, Arvene	ARHS	Completed Project, Physical Science	112
Gontzes, Alyssa	JBHS	Completed Project, Environmental	81
Gordon, Richard	RHS	Research Proposal, Environmental	82
Gorey, Catherine	DHS	Research Proposal, Behavioral	83
Gowda, Jethin	ARHS	Completed Project, Physical Science	84
Granath, Will	DHS	Research Proposal, Environmental	85
Green, Aviva	ARHS	Completed Project, Health and Medical	86
Greifenberger, Courtney	ARHS	Research Proposal, Environmental	87
Gross, Jacob	ARHS	Research Proposal, Behavioral	88
Grusky, Alexandra	CSH	Research Proposal, Environmental	89
Gunya, Katherine	DHS	Research Proposal, Health and Medical	90
Gysling, Sophie	GHS	Research Proposal, Health and Medical	91
Gysling, Seana	GHS	Research Proposal, Health and Medical	92
Hague, Theodore	ARHS	Research Proposal, Physical Science	129
Halabi, Kate	DHS	Completed Project, Health and Medical	93
Han, Paul	GHS	Research Proposal, Physical Science	94
Handler, Katherine	ARHS	Completed Project, Environmental	95
He, James	ARHS	Completed Project, Behavioral	96

## Directory of Student Participation (continued)

Student	School	Category	Project #
Heinzerling, Kelly	CSH	Research Proposal, Behavioral	183
Henrie, Madeline	CSH	Completed Project, Environmental	97
Hogan, Maeve	CSH	Research Proposal, Health and Medical	31
Hornick, Kyle	DHS	Completed Project, Physical Science	98
Hovstadius, Malin	SHS	Completed Project, Health and Medical	99
Howard, Katia	ARHS	Research Proposal, Behavioral	100
Jain, Anisha	ARHS	Research Proposal, Behavioral	101
Jajoo, Arpita	ARHS	Completed Project, Environmental	102
Jarad, Haya	ARHS	Research Proposal, Health and Medical	103
Johns-Woodby, Yahnah	CSH	Completed Project, Health and Medical	33
Juan, Avery Katherine	CSH	Research Proposal, Environmental	104
Kachru, Ananya	ARHS	Completed Project, Behavioral	105
Kadimi, Sricharan	ARHS	Completed Project, Physical Science	106
Kadysheva, Valerie	NHS	Research Proposal, Health and Medical	107
Kasak, Chloe	NHS	Research Proposal, Health and Medical	108
Keena, Henry	DHS	Research Proposal, Health and Medical	109
Keenan, Colleen	RHS	Research Proposal, Health and Medical	110
Khan, Haseeb	ARHS	Completed Project, Health and Medical	111
Khan, Owais	ARHS	Completed Project, Physical Science	112
Khani, Nikzad	ARHS	Completed Project, Health and Medical	113
Khire, Priti	ARHS	Completed Project, Behavioral	114
King, Jennifer	GHS	Research Proposal, Environmental	115
Klasky, Evan	SHS	Research Proposal, Health and Medical	116
Kline, Camilla	DHS	Research Proposal, Health and Medical	117
LaManna, Corinne	RHS	Research Proposal, Environmental	118
Lang, Karen	RHS	Research Proposal, Health and Medical	119
Lang, Patrick	RHS	Research Proposal, Behavioral	120
LeMay, William	NHS	Research Proposal, Physical Science	121
Lensky, Yevgeny	SHS	Research Proposal, Environmental	122
Levine, Corey	JBHS	Research Proposal, Environmental	123
Li, Vince	ARHS	Completed Project, Behavioral	124
Li, Victoria	ARHS	Completed Project, Health and Medical	125
Li, Catherine	RHS	Research Proposal, Health and Medical	126
Liang, Kimberly	ARHS	Research Proposal, Physical Science	127
Liang, Jingzhao	ARHS	Completed Project, Behavioral	128
Lingareddy, Harika	ARHS	Research Proposal, Physical Science	129
Lippolis, Francesca	CSH	Research Proposal, Health and Medical	130
Liu, Helen	ARHS	Completed Project, Environmental	131
Liu, Victoria	ARHS	Completed Project, Physical Science	132
Loery, Maggie	JBHS	Research Proposal, Environmental	133
Logan, Hannah	NHS	Research Proposal, Health and Medical	134
Lowe, Courtney	DHS	Research Proposal, Environmental	135
MacDonald, Erika	SHS	Research Proposal, Health and Medical	136
Malani, Kanika	GHS	Research Proposal, Health and Medical	137
Manfredonia, Peter	NHS	Research Proposal, Physical Science	138
Marcus, Rachel	ARHS	Completed Project, Health and Medical	139
Massello, Alexandra	CSH	Research Proposal, Health and Medical	140
Mather, Grace	CSH	Research Proposal, Health and Medical	30
Mathur, Anubhuti	GHS	Research Proposal, Health and Medical	141
McCormack, Kelsey	ARHS	Research Proposal, Health and Medical	142
McGonagle, Elizabeth	GFA	Completed Project, Health and Medical	143
McGowan, Andrea	JBHS	Completed Project, Health and Medical	144
McKenna, Matthew	ARHS	Completed Project, Physical Science	145
McManus, Ryan	ARHS	Completed Project, Environmental	146
Meachem, Cal	RHS	Research Proposal, Environmental	147
Meehan, Quinn	ARHS	Completed Project, Behavioral	148
Meehan, Katherine	ARHS	Completed Project, Health and Medical	149
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Miller, Emily Ann	CSH	Research Proposal, Environmental	104
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Mohseni, Aria	ARHS	Completed Project, Behavioral	79
Molkenthin, Allegra	DHS	Completed Project, Environmental	154
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Mongillo, Leah	ARHS	Completed Project, Behavioral	156
Moon, Jasmine	ARHS	Completed Project, Behavioral	157
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O'Connor, Kelsey	NHS	Research Proposal, Health and Medical	171
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Ross, Julian	SHS	Research Proposal, Behavioral	195
Rotondo, Catherine	SHS	Completed Project, Physical Science	196
Rutledge, Lauren	DHS	Research Proposal, Behavioral	197
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Schwartz, Jen	RHS	Research Proposal, Health and Medical	207
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Shankar, Nikhita	SHS	Completed Project, Environmental	209
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Siciliano, Katherine	CSH	Completed Project, Environmental	97
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Sutherland, Grace	CSH	Research Proposal, Health and Medical	221
Tananbaum, Avery	NHS	Research Proposal, Behavioral	222
Tannian, Caeleigh	RHS	Research Proposal, Health and Medical	223
Tavakoli, Sara	GHS	Research Proposal, Health and Medical	224
Teepireddy, Vimratha	ARHS	Research Proposal, Physical Science	129
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Thomas, Cynthia	CSH	Research Proposal, Health and Medical	227
Thomas, Alfston	RHS	Research Proposal, Health and Medical	228
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Yu, Alexandra	CSH	Research Proposal, Health and Medical	248
Zhang, Lillian	ARHS	Completed Project, Behavioral	249
Zhang, Yiran	ARHS	Completed Project, Behavioral	250
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Zhou, Yuqi	ARHS	Completed Project, Behavioral	252
Zieman, Will	RHS	Research Proposal, Physical Science	253

## **Adison, Tasha & Comer, Stephanie**

### **Project #1**

Health and Medical, Research Proposal

#### **Testing Natural Performance Enhancers for Athletes**

It is not uncommon today to learn that athletes may be using drug enhancements to help improve performance within their sport. These drugs may be harmful to the body and can cause death if taken too far. The goal of this study is to determine if natural enhancers found in food products are just as effective and produce the same improvements within the human body. This study will research and test natural drug enhancements that may improve performance without being harmful to the body. These more natural enhancements will be tested on mice for their effectiveness, and compared to the drugs currently being used. One group of mice will be given a placebo for the control. This study will include natural substances found in foods, such as Omega 3's, L-glutamine, iron, and anthiocyanin. The athletic performance, behavior, and health of the mice will be studied and compared. It is hoped that this study will demonstrate that the natural enhancements are effective, less harmful, more acceptable, and possibly cheaper than current performance-enhancing drugs.

## **Ahern, Lauren**

### **Project #2**

Health and Medical, Research Proposal

#### **Type 1 Diabetes**

Individuals with type 1 diabetes lose their ability to produce insulin which is caused by the immune system destroying insulin producing beta cells. Cells for transplant have been created from stem cells but remain unprotected from the immune system. A device that protects the beta cells can potentially lead to a cure. T1D is an exhausting, costly, and potentially deadly disease that affects over 3 million people in the US. I would like to conduct an experiment that involves the encapsulation of new stem cell derived beta cells involving the evaluation of the stability of SC-beta cells once encapsulated in a device such as TheraCyte. In the future, if the beta cells are robust once encapsulated, they can be used for transplant and tested in a murine model. The expected results would be the stem cell derived beta cells function properly within in the capsules. This will be measured by glucose stimulated insulin secretion, calcium fluctuation, and the presence of other characteristics of a bona fide beta cells. The capsules should prevent the immune system from getting to the beta cells, as well as, prevent cell escape. This research will contribute to the knowledge of encapsulation techniques. If successful, encapsulation will protect the beta cells and allow them to function properly and restore insulin independency in type 1 diabetics. This can be used as a universal treatment for diabetes, improving the lives of millions.

**Effect of Hunger on Memory**

The objective of the study is to find out if fasting for two hours affects memory. The hypothesis was that if an individual has eaten a half hour before, then their memory is better than someone who is. The results of the study could help students do better in school. The first test required the participants to fast for two hours prior to the test while the second test required the participant having eaten thirty minutes prior. The tests were reading passages, with questions that followed, but the questions had to be answered without the use of the passage. The independent variable was the participants that have eaten food. The dependent variable was the efficiency of the memory. The preliminary results show that the participants did better when they had eaten before the test. The scores of the first test were compared to the scores of the second test. The average score of the second test was greater than the average for the first test. Eating before the test did help with memory. Seeing that hunger does affect memory, it is possible for the efficiency of memory to improve even more. Efficiency can change depending on how much food is consumed, the time it has been since the food has been consumed, or the type of food.

**Optimizing DNA Extraction from Buccal Cells for use in Chronic Lymphocytic Leukemia**

Research involving chronic lymphocytic leukemia (CLL) includes the study of the expression of gene mutations. This research proposes finding the yield of DNA using different extraction methods of buccal cells in order to use the DNA to find cell mutations in CLL. It is hypothesized that a novel approach, such as using energy drinks to extract buccal cells, will be just as effective as traditional methods. The types of extraction methods tested will be traditional saliva, buccal swabs, mouthwash, and energy drinks. The materials used in this experiment will be mouthwash, energy drinks, Oragene saliva kits, buccal swab kits, and the Qiagen Genra pure gene kit to extract the DNA. After evaluation of the DNA yields, it is expected that the energy drinks will be just as effective as mouthwash or buccal swabs, which have traditionally yielded the largest amount of buccal DNA for gene expression analysis. Determining that energy drinks are just as effective as other methods may allow for a more pleasant experience for the patients and may result in an even greater yield for optimizing DNA extraction. This information will be used in the future to obtain sufficient DNA for use in cancer research and clinical trials, particularly in chronic lymphocytic leukemia.

**Optimized Network Spread Infrastructure for the Mitigation of Distributed Internet Attacks**

Online security has become one of the greatest concerns for the average user. While there is an abundance of individuals working to create an internet that is safe for everyone, equally as many attempt to exploit flaws in encryption, data, and server infrastructure. When one of these loopholes is found, data can be lost or stolen as a result of hackers stressing key points on the network. However, issues will always exist in even the most secure networks, and trying to eliminate them is improbable. The best method to prevent malicious groups from targeting these sectors is to remove such an ability. Distributed Denial-of-Service (DDoS) attacks are those of most concern, as they function such to overload a server and cause its collapse -- at which point, hackers can attempt to steal data and other resources. By using a new type of server infrastructure known as Spread Identity (SI), internet traffic can be better analyzed. When a company adopts the SI algorithm, it will scan and divert malicious packets from the server nodes that appear to come from a DDoS attack. It is in this way that malicious traffic can automatically be blocked and rerouted, while enabling legitimate users to continue accessing the website or server. Therefore, by testing a number of DDoS-protective algorithms, especially against SI, it can be found which is the most effective in mitigating such an attack. In combination, a dynamic firewall can be added for another variable, which will also algorithmically block access to certain regions on a network based upon trust metrics. This will provide a quantitative analysis of packet flow for malevolent versus true intent, thus reducing DDoS risk.

**The effect of Hsp 70 on the survival of *Anopheles gambiae* when exposed to extreme temperatures and its relevance to the proliferation of infectious diseases.**

The state of our world is greatly influenced by humans. We use fossil fuels and contribute to global warming and climate change. There are far-reaching effects of such a major change in our environment. Namely, one of these effects is the proliferation of diseases. The relationship among the vector, pathogen and host is sensitive. Because of this, these diseases are most affected by climate change. I am interesting in medicine as a career choice and to find a relationship between climate change and infections disease would be extremely interesting. Material and Methods Mosquitoes in their larval stage, 3 trays, Tap Water to fill the trays with Thermometers to measure the temperature of the water baths. Purina cat food, ground up to use as food for the mosquito larvae cheesecloth to cover the trays three mosquito cagessucrose solution for adult mosquito foodheated water bath at differing temperatureshumidifier (80%)liquid nitrogen freezer to store frozen mosquitoes mortar and pestle to grind mosquitoes (to homogenize tissue) TRIzol reagent (extracts proteins from mosquitoes) Hsp70 antibodies Western Blot kit (electrodes, dish, gel). Procedure Obtain materials. Pour water into three separate trays and put about 20 mosquito larvae into each bin. Maintain three differing water temperatures, all at 80% humidity. Place one pinch of Purina cat food into the bins as nutrition for the mosquitoes and continue to monitor their growth, placing a cheesecloth over the trays to make sure that no adults escape from the trays. Full maturation should take about 12 days. Once the mosquitoes have reached their adult stage and their developmental temperatures have been held constant, gather each of the three groups into separate containers.

## **Aparicio, Samantha**

## **Project #7**

Physical Science, Research Proposal

### **The Effect of a Subsurface Water Body on the Magnetic Field of Europa**

Europa, one of Jupiter's moons, is a recent topic of interest to scientists, as Europa might harbor an environment suitable to support habitable life. Studying Europa is vital because finding another planet other than Earth that has an environment able to harbor life would lead to an immensely greater depth of knowledge pertaining to life on other planets. However, since there have been no mission landings on Europa, only flybys from the Voyager and Galileo missions, much of Europa is undiscovered and unknown. Numerous studies on Europa have shown a possible subsurface water body (H<sub>2</sub>O), the most essential attribute a planet needs in order to support life. Additionally, Europa's atmosphere and geology need to be similar to Earth's in order to support life. If Europa's magnetic field is similar to Earth's, then a salty subsurface ocean will be present on Europa. In order to test this hypothesis, CubeSats, which are small and simple satellites, can be used to obtain measurements from Europa. CubeSats, measurements obtained from previous missions, and models of Europa's magnetic field and potential subsurface ocean with varying salinity of H<sub>2</sub>O will be used in this experiment. If Europa's magnetic field is generated by a saltwater conduct, just as Earth's secondary field is, then the presence of a water body is expected and there is a greater possibility Europa could support life. Data derived from the model and CubeSats will be analyzed in a laboratory with supervision of a research scientist currently studying Europa. The results of this study can lead to further research on the eminent possibility of life on Europa.

## **Augenbraun, Nathan**

## **Project #8**

Physical Science, Research Proposal

### **Epigenetics**

Just as DNA is very important in the life of all living organisms so is regulation of the DNA. Ever since I learned of transcription I have ventured deeper into cell function and came across the topic of epigenetics. Scientists have just recently discovered histone methylation, there is still much to learn about how this process works and the effect it has on gene expression. Since this is just a proposal other methods have yet to be explored, but at the moment I have determined the following information: the organism that will be tested on is yeast (most likely brewers yeast), and a western blot will be used to identify protein concentration. The experiment will be conducted in either or both the level 2 bio lab at Newtown High school, and a research facility. Since this is just a research proposal I have not conducted an experiment yet, but I have researched the topic. The point of my project will be to try and confirm suspicions about certain proteins that are thought to be involved with the process of Histone Methylation. Epigenetics provides possible treatment and cures for many genetic diseases. By better understanding how histone methylation works future progress can be made towards using an epigenetic process like this one as treatment for a genetic disease.

**The Effect of Aquatic Plants on the Growth of Fish**

Live plants are said to benefit an aquatic environment containing fish in many ways. The most beneficial component of live aquatic plants to an aquarium is their ability to produce oxygen and absorb the carbon dioxide and ammonia that fish generate which can be toxic to fish. Additionally, natural, live plants mimic the natural ecosystem, which help keep aquarium fish more comfortable. The focus of this research is to investigate whether these factors have any impact on the growth rate of aquarium fish. For this experiment, three fish tanks will be set up, keeping everything constant except the types of plants in each tank. One tank will be used as a control containing no plants, one tank will contain three plastic plants, and the third tank will contain three similar looking (relative size and leaf structure) Tropical Fern plants. The weights of the fish will then be measured twice a week in 200 milliliters of water using a gram scale. Each tank will be fed one half a teaspoon of goldfish flakes each day. During this study, it is expected that the fish in the tank with the live plants will grow more than the fish with the plastic plants and no plants. This may be attributed to the similarity of a natural ecosystem, ensuring that the fish are healthier and comfortable, thus facilitating growth. This research could help identify the ideal environment for freshwater fish living in an aquarium by measuring the rate and amount of their growth. A continuation of this research could include testing this theory with additional types of fish, in order to acquire more data to analyze.

**The Effect of Categorization Ability on the Likelihood of Developing False Memories**

Although the human brain is generally well-designed to accurately perceive its surrounding world, the development of false memories is a common psychological phenomenon in which a person recalls a memory that did not actually occur. Enabling humans to remember words through categorization, one of the fundamental tasks conducted by the brain involves comparing words it hears with those from previous events in order to recognize and unravel their meaning. As a by-product of this process, does a person's word-categorization ability affect their likelihood to develop false memories? In the experiment, participants were initially tested for their ability to select words from a category in which they did not belong. Next, they were requested to memorize a different collection of words to their best capability, of which they were later required to recall. By comparing the participants' percentage of incorrect answers on the categorization test with their percentage of falsely recollected words, the relationship was analyzed. Although the hypothesis was that participants keener on their capacity to formulate word-connections would be increasingly prone to false memories, the data has thus far displayed no significant correlation. Instead, there has been a somewhat opposite trend, indicating that perhaps possessing an efficient categorization ability is related to having a lower disposition to false memories. These results could be further investigated and applied to their implications in the courtroom, where false memories could create misleading eyewitness testimonies and drastic consequences.

## **Banks, Colin**

## **Project #11**

Health and Medical, Research Proposal

### **CCSVI and BBB junction molecule treatment in EAE induced mice within variant regions**

Multiple sclerosis (MS) is a neurodegenerative disease that affects the myelin sheath of the neuron. Current studies have looked at the effect of chronic cerebrospinal venous insufficiency (CCSVI) procedures examining the width of veins, and certain blood-brain barrier (BBB) junction molecules. CCSVI is the compromised flow of blood in the veins draining the central nervous system (CNS). The BBB is a highly selective membrane separating the CNS from the blood to allow for proper function of the CNS. The purpose of the experiment is to develop a treatment that will lead to curing MS. The proposed treatment would test the effectiveness of treating the blood flow to the brain. In addition, there would be injections of BBB junction molecules to slow the damage MS has caused. The animal model of MS that would be used is experimental autoimmune encephalomyelitis. This form of MS would be tested in mice in different latitudes to examine Vitamin D levels as well. A control group would be used to compare the treatments. The CCSVI and BBB treatments would be combined to see what the most beneficial combination is, and if one works best on its own. It is expected that the separate treatments would slow MS, but a combination would be more beneficial. To account for Vitamin D, the mice living closest to the equator would have enhanced benefits. The data will be analyzed by measuring the average change in the amount of myelin in each mouse. The implications of this research are treatments moving towards a cure for MS. With millions affected worldwide, a treatment would be a great leap forward. In continuation, this research could lead to a vaccine for MS.

## **Barbour, Sophia**

## **Project #12**

Environmental, Research Proposal

Can the specimen of Ichthyosauria Shastasaurus be classified in a suction-feeding genus? PAUP 4.0 (Phylogenetic Analysis Using Parsimony) phylogenetic system used for naming dinosaurs. Also a regular microscope used for inspecting bones. Ultimately, the scientists need more data. They need to find not only more specimens of Shastasaurus, but suction feeding dinosaurs, as well as modern day crocodiles and suction feeders for comparison. Studying habits of organisms that lived before humans evolved is important because it can help us to understand other animals like dinosaurs. It can also help people to understand suction feeding and history of where it originated. The scientists need more data.

**The Use of Technology to Help Children with Autism Communicate**

Individuals with autism have significant communication impairments, making it very difficult for them to express their emotions and desires. The pressures of communicating face to face are alleviated when communicating online, which has also been proven to boost autistic individuals' confidence, give them more control, and allow them to find others with similar interests. These benefits translate into everyday life, and have the promising ability to result in more positive relationships for a child with autism. The hypothesis of this study is that the use of technology, such as social media, can help children with autism communicate, resulting in more positive relationships. After being granted the parents' permission, the experiment would involve communicating with autistic children through email or social networking, mostly about topics that they are interested in. Ideally, subjects would be verbal children ages 8-10 with a diagnosis of autism. The experiment would most likely be carried out over a period of six months, in which frequency of the conversations would be the independent variable, and quality of relationships between the child and his or her parent would be the dependent variable. Findings of the experiment would be analyzed to determine if there is a correlation between frequency of online conversations and quality of relationships. This analysis will determine if establishing relationships through the Internet can beneficially impact autistic children in their everyday lives. Findings that support the hypothesis may demonstrate the need for further research of the impact of social media on autistic individuals. The Internet will hopefully prove to be an accessible, simple, and quick method of improving the quality of autistic individuals' relationships by helping them communicate.

**Radio Sources Observed Through an Ultraviolet Lens**

The universe contains a number of unexplored places, regions that may contain answers to galaxies that have been unknown to us previously. There are places in the sky that give off very strange amounts of radio waves. These radio waves are invisible to the naked eye, so infrared images are taken in order to find the location from which they originate. These radio waves are invisible to the naked eye, so infrared images are taken in order to find the location from which they originate. This project aims at measuring the distance between radio sources and the black hole at the center of the galaxy, by comparing it to the luminosity of the radio sources. In order to complete this project, pictures and locations of the radio sources, and the galaxy from which they originated from would need to be taken. Then by graphing the distance from the black hole at the center of the galaxy and the luminosity of the radio sources, a correlation may be or may not be found. If a correlation is found between the the luminosity of the radio sources, scientists will be able to determine what these radio sources are, and what they originated from. Another event that might occur is not finding any correlation in which case further research would have to be conducted.

**Optimizing Predicated Execution on ARM Processors Using Machine Learning**

Although the central processing unit of a computer only executes machine code, computer programs are typically written in a high-level programming language such as C or C++. In order to convert a program written in a high-level language into machine code, the program must be processed by a compiler, which is a special type of computer program that converts other programs into machine code. The compiler can also optimize the machine code instructions that it produces, typically resulting in a faster and more memory efficient program. However, it is also very difficult for the compiler to predict whether or not a certain optimization will result in more efficient machine code. This can be detrimental to the performance of the resulting program, which is especially significant for programs that are executed on the ARM architecture, which is found in processors that execute instructions at slower clock speeds and are typically used in platforms with less memory. This purpose of the research is to use techniques from the field of machine learning to design better compilers that produce machine code instructions that are statistically more efficient than those produced by conventional compilers. This research will focus on the ARM architecture for two reasons: first, the efficiency of programs will be more noticeable due to the slow clock speeds and short pipelines of ARM processors, and second, conditional statements can be optimized on ARM architectures using predicated execution. The latter provides a useful metric for the efficiency of a program, which is required in order to apply machine learning techniques to the problem.

**Speeding up Multiparadigm Compilation through Machine Learning**

As time progresses, code bases at large corporations are growing in size and paradigm complexity. With this growth, the time it takes in order to compile code becomes longer. Some projects can even take days to compile. In order to prevent development from slowing down as code bases grow larger and to different paradigms, it is necessary to speed up compilation. If machine learning were implemented for selecting optimizations in a compiler based on common optimization of multiple front ends of varying paradigms and a retargetable back end such as the LLVM, then compilation would be faster than with the standard LLVM system. This is because unnecessary and incorrect optimizations are one of the most time consuming components of compilation and can even cause slowdowns in the generated binaries. A machine learning algorithm will be implemented as an add-on to the LLVM optimizer and trained through supervised learning on code bases of various languages and paradigms. Projects can then be compiled using the LLVM optimizer both with and without the add-on to compare compile time and optimization quality. The predicted results are a speed up of at least a factor of two in compilation with a reduction in execution time bounded to a constant factor, due to the inevitable loss of some minor optimizations. If the algorithm succeeds, it would lead to widespread reductions in compilation time, giving developers the ability to create better tools faster, speeding up the growth of computers' computational ability. If the algorithm is unsuccessful, it would indicate the correct direction for development to continue as the use of single paradigm compilers with machine learning capabilities, a lesser but still powerful improvement over what exists today.

## **Beshoory, Jackie**

## **Project #18**

Health and Medical, Research Proposal

### **DNA Barcoding: St. Johns Wort and Echinacea**

Researchers have uncovered mislabeling in the food and herbal supplement industry. It is predicted that if samples of St. John's Wort and Echinacea are tested, there would be some unlisted ingredients that may pose a health risk to consumers. Five types each of St. John's Wort and Echinacea will be tested. It is hypothesized that at least one type each of the St. John's Wort and Echinacea will be mislabeled or contain fillers not listed on the label. Since extracts cannot successfully be barcoded, only non-extract samples will be used. In order to test the samples, DNA from each supplement will be extracted and then amplified using polymerase chain reaction (PCR) in a thermal cycler. After the PCR products are confirmed using gel electrophoresis, they are sent out for sequencing. The sequencing results are then analyzed using an online database. It is expected that the findings will demonstrate that St. John's Wort and Echinacea contain ingredients that will not be listed on the packaging. It is believed that out of all samples tested, at least 20% will contain unlisted substances. Due to the lack of research on this topic, this work will further uncover what consumers are actually putting into their bodies when they choose to take herbal supplements such as St. John's Wort and Echinacea. Mislabeled herbal supplements could cause health risks to consumers while not assisting them with their health. This project is significant to the individuals of the world who are active users of herbal supplements.

## **Bhattarai, Nitya**

## **Project #19**

Physical Science, Completed Project

### **Identifying Cell Phone Dead-zones and Recommending Optimal Placement of Cell Phone Towers by Measuring 3G/4G Radio Frequency**

The ideal distribution of radio waves for cellphone communication depends upon perfectly placed cellphone towers within 10 square miles in hexagonal coverage pattern incorporating the effect of geographical topography [Legrady, George Experimental Visualization Lab]. Intensity of wave decreases according to Inverse Square Law [3], so test points not covered in a honeycomb cell, or too far away from towers will get poor coverage. This research was geared to measure and recommend better placement of cell-phone towers based upon the technology and providers (AT&T, T-Mobile for GSM and Verizon, Sprint for CDMA) to eliminate cell-phone dead zones. This research determined signal strength based upon variables a) distance between test-point and the cell tower b) transmitter height (elevation + antenna height), and c) technology being used such as GSM or CDMA at 130 coordinates in 10 cities in Connecticut. Signal strength data was analyzed based upon variables altitude, distance from the tower and technology and carrier used. Tower locations were presented and analyzed using Google Maps API as well as recommendations for new placement of cell-phone towers. If the geo-location was closer or lower in elevation to the tower, then it was found to receive more signal. There was no distinction based upon the technology of GSM vs CDMA. However, based upon the carrier the impact on reception was clearly noticed. The outcome of this research can be used by cell phone companies to determine where to best place cell phone towers. The second outcome can help users check reception at various locations within the tested area.

**Developing an OCD Testing Application**

Obsessive Compulsive Disorder (OCD) is a behavioral disorder. An individual suffering from OCD is typically subject to a pattern of irrational, repetitive thoughts causing stress defined as obsessions. To alleviate anxiety, individuals with OCD often carry out compulsions. Additionally, as observed in the study Disruption in the Balance Between Goal-Directed Behavior and Habit Learning in Obsessive-Compulsive Disorder in the year 2011 conducted by Claire M. Gililan at the University of Cambridge, those diagnosed with OCD tend to rely more heavily on habitual behaviors compared to goal-directed ones. The study provides an examination of how a patient associates three concepts: stimulus, response, and outcome, beginning with a training phase to have participants learn of key relationships between the three categories. Various methods were taken to program an application in Visual Basic. An existing paper and pencil test was converted into an electronic format through use of a compiler. The instrument includes eighteen questions, with six per group for 18 points total. Additionally, the test questions vary in fruits (A/B) and sets (1-6) based off of subject ID. Participants are also able to rate their confidence in answers. The program is complete, and it will soon be ready for mentor verification prior to use. The new electronic variant will be used in future trial experiments of the Gililan study to search for mental impairments in those diagnosed with OCD through a computer application. The test occupies a phase in the study as an examination to determine whether the participants have learned the associations from the training phase correctly.

**Autism: A Deficiency in Synaptic Pruning**

Autism, an incurable neurodevelopmental disorder, affects about 1 in 68 children in the U.S. In recent studies, overactive mTOR (protein) signaling is identified as a cause of excess synapses (lacking synaptic pruning) in the temporal brain lobe in autistic patients. Rapamycin, an mTOR inhibitor, is found to relieve autism in mice. In temporal lobes, there is a period of rapid spine pruning that is deficient in autism. The purpose of this experiment is to determine if synaptic pruning in different parts of the brain occurs at different times in development, or if synaptic pruning occurs in the whole brain the same way it does in the temporal lobe. In the experiment, autistic and control brains from young children and adolescents (including all lobes of the brain) are subjected to western blotting looking for synaptic markers. They are imaged for the number of dendritic spines per square nanometer. Mice induced with autism will have mTOR signaling monitored through western blotting and be dosed with rapamycin, with all lobes of the brain examined before and after treatment. Expected results are that synaptic pruning will occur in the same time frame at the same rate in all parts of the brain, because deficiencies in communication in the temporal lobe (as the central social node of the brain) would disrupt the function of other lobes. Researchers will have an idea of the best timing for autism therapies if time frames of synaptic pruning are identified in control patients, and these time frames in the development of autistic brains are lacking pruning. The major implication is that as understanding of autism increases, it will be easier to develop treatments.

**The Innate Counting Ability Araneidae**

Spider webs are complex looking structures; they make spiders look like natural architects. The geometrical shapes a spider can execute in their webs designs are complex and elaborate. The designs these spiders can construct are done with impressive precision. I am proposing that orb-weaving spiders use counting to construct the symmetrical designs in their web. I am hypothesizing that when a spider's legs are longer than the average leg length it will dramatically impact the construction, execution, and outcome of the web. This will illustrate that spiders are able to count because having a shorter stride length will yield a smaller area for the central hub. Using photos of spiders I put the photo in a photo-editing program and counted the pixels of the photo to find the measurement of the leg and the area of the central hub. I created a scale free method of measuring the size of the spider's legs as compared to the size of the central hub, which does not depend on how zoomed in or out the image is, namely average leg size squared divided by surface area of the central hub. Some preliminary data from about half a dozen spider web designs suggests that spiders do not count their steps to create their webs. That is, the size of spider's legs do not scale with the size of the central hub.

**Ferguson: Mapping and Analyzing the Relevancy of Tweets During Major Events**

On August 9, 2014, an unarmed African-American teenager named Michael Brown was shot by a member of the police force in Ferguson, Missouri. Since then, Twitter has had constant coverage of the events in Ferguson coming straight from the source. The purpose of this study is to see how reliable and relevant the events in Ferguson have been since the day of the shooting until present day, as the tragedy is still being investigated. It is hypothesized that when a tweet's location is closer to Ferguson, then the content of the tweet is more likely to be more relevant versus a tweet from a place farther from Ferguson. In this study, the location and personal information of the tweet were taken into account, along with the relevancy of the tweet in relation to the original conflict in Ferguson (rated on a -1 to 1 scale) with -1 being irrelevant, 0 being neutral, and 1 being relevant. Along with this information, a screenshot of the actual tweet was taken, and inputted into a log with all of the tweets in them. Thus far in the research (about 100 tweets), it has been seen that there is not a significant relationship between location and the relevancy of the tweet it was sent from. For example, the amount of irrelevant or neutral tweets has been consistent no matter where the tweets were sent from, including the Ferguson area. Therefore, it can be concluded that just because a tweet was sent from the Ferguson area, it does not mean that the tweet is relevant to the original conflict.

**Sequestration of CO<sub>2</sub> by Lithium Orthosilicate in a Clay Body in Ambient Air**

Carbon dioxide in our atmosphere is increasing. Lithium orthosilicate has been known to sequester carbon dioxide in lower temperature ranges such as room temperature (about 25 degrees Celsius) (Kato, 2001). I am seeing if lithium orthosilicate in a clay body can absorb carbon dioxide (in ambient air) at room temperature, reducing the amount of carbon dioxide in the atmosphere. I expect to see less than 30% increase in mass (of lithium orthosilicate added). There are 4 samples of clay, two of which have lithium orthosilicate added to them (the ones without will be used as a baseline). I put them in an oven to simulate a kiln and massed them at certain degrees. I then took them out and let them sit for 20 days, massing every day. I am expecting to see less than 30% increase in mass from the amount of lithium orthosilicate added, as Kato (2001) found when testing pure lithium orthosilicate in ambient air (500ppm) and room temperature (25 degrees Celsius), as my experiment has around 200ppm and 20 degrees Celsius. If the lithium orthosilicate clay absorbs CO<sub>2</sub>, it could become a possible way for an individual to limit his or her own carbon footprint. In addition, the reverse reaction becomes predominant at 973 K (to 1273 K) (Yamauchi, 2007), meaning that carbon could be regenerated for capture, hypothetically speaking. This would allow the ceramic piece to be reused, absorbing more CO<sub>2</sub>, or it could also be used in higher temperatures (such as in a furnace).

**Blocking Quorum Sensing Communication Systems in Pathogens to Prevent the Spread of Harmful Bacterial Traits**

When certain types of bacteria are present at high levels, they have been shown to turn on harmful genes that might otherwise not exist. It has been shown that certain chemicals can be added to bacteria to slow down and even completely stop the growth of certain malignant traits of bacteria by blocking the quorum sensing system used by bacteria to communicate. This study is needed because very few experiments have been done testing the ability of outside chemicals to prevent harmful traits in bacteria; not enough specific chemicals that block communication between bacteria have been determined.

In order to conduct this experiment, bacteria would need to be grown with a designated control and experimental groups. The experimental groups would be tested with a variety of chemicals such as tea tree oil, alcohol, and caffeine. The bacteria would then be tested for the concentration of signaling molecules used by bacteria in quorum sensing. The lower the concentration of signaling molecule, the more dramatically the bacteria's communication system was impaired by the chemical tested in the bacteria. It is expected that some of the following chemicals (tea tree oil, alcohol, and caffeine) inserted into bacteria samples will decrease the concentration of signaling molecules used in quorum sensing by bacteria. A significant number of chemicals are also expected not to affect the concentration of signaling molecules. The purpose of this experiment is to determine which chemicals affect the concentration of signaling molecules. If certain chemicals are found to reduce the amount of signaling molecules produced, this will demonstrate the ability that certain chemicals have to significantly decrease quorum sensing in bacteria and ultimately lead to the prevention of harmful traits present in bacteria at high levels. This is significant because it can stop the quick transformation from harmless into harmful bacteria when present at high levels.

## **Brandon, Will**

## **Project #26**

Health and Medical, Research Proposal

### **The Effect of salmonella typhimurium Injections on Tumor Growth in Immuno-deficient Mice**

Salmonella typhimurium is a toxic bacterium and common cause of food poisoning. That wild type has been genetically modified into salmonella typhimurium AR-1, a less dangerous version which through selective auxotrophy has been made to exclusively grow in tumors. Injections of salmonella typhimurium AR-1 have been shown to cure nude mouse models of prostate cancer at a rate of 40%. Toxicity and the host immune response are both factors cited for the bacteria's anticancer properties. Isolating the two factors will provide a better understanding of the bacteria's anticancer process. The effect of the bacteria's toxicity can be isolated by treating tumor bearing mice that lack an immune response with the S. typhimurium AR-1. NSG (NOD scid gamma) mice will be tested, because they not only lack helper T-cells like nude mice but also functioning dendritic cells and macrophages, rendering the immune system all but completely ineffective. S. typhimurium AR-1 will be injected into the tail vein of tumor bearing mice at weekly intervals. A control group of NSG mice will have tumors, but not be treated with S. typhimurium AR-1. If the treated mice survive significantly longer than the untreated, the study will show that S. typhimurium AR-1's toxicity plays an important role in its anticancer properties. It is predicted that treated mice will survive longer than untreated mice, because the bacteria's mild toxicity hinder tumor growth. If S. typhimurium AR-1's toxicity is shown to play an important role in fighting tumor growth, further work to improve the bacterium's toxicity will improve the treatment's efficacy.

## **Briand, Giselle**

## **Project #27**

Physical Science, Research Proposal

### **The Study of Genomics in the HIV Retrovirus**

This project will explore genomics in the study of the HIV retrovirus, and examine its drug treatment effectiveness within the genome of CD4 cells inside various affected persons. This proposal will be executed digitally through a gene-analyzing computing software that will allow certain genes to be manipulated and will view gene interactions. The expected results include that some drug treatments will not be as potent or efficient as others. An evident conclusion that will be made from the expected results is that there are better approaches to assure the drugs used to control the virus will work for every infected individual despite the barrier of differentiation between human DNA. This project is meant to incite further research and exploration of the HIV retrovirus within the preliminary medical and scientific world. The results may lead to more in-depth analytic work and research towards the implications of this project on a personal level.

**Brown Adipose Tissue**

According to the CDC, 78.6 million adults are obese. Obesity is a leeway into life-threatening conditions such as strokes and several heart diseases. These conditions can be prevented by preventing obesity, and that is where we should look at brown and white fat. If brown fat in adult humans could be burned at quick rates, then it would help adults that have an abundance of white fat and are obese. To look at how brown fat could be activated, and thus burned, I would have two groups of mice. One group would be exposed to cold temperatures, 40°F, and a PET-CT scan would be performed to detect how much fat was burned in the mice. The second group (control group) would be exposed to a normal room temperature, 72°F, and a PET-CT scan would be performed as well to compare. The expected findings of this experiment would be that Peroxisome-proliferator-activated receptor would be enhanced in the mice exposed to cold temperatures. This would activate the UCP1 protein that helps brown fat burn and release heat. Additionally, the PET-CT scans would show a larger presence of brown fat in the cold-exposure mice because they are burning more as a result to the cold. If the expected findings occur in both groups of mice, it would help with fighting the obesity epidemic in the United States. Cold exposure can lead to a faster burning of brown adipose tissue, that results in less fat in the body mass index of an adult. This would help lessen the amount of fat-storing white fat and increase the amount of brown adipose tissue burned.

**Does Playing Contact Sports Affect Brain Function?**

The problem that I wanted answered was whether playing contact sports affects brain function. The motivation behind my research was the fact that I play contact sports. I want to know how my body and brain especially are being affected by sports. I felt a need to better understand the risks of contact sports. My hypothesis is that if you participate in contact sports regularly i.e. (football, basketball, and hockey) then you will have decreased brain function. To measure brain function I used the King-Devick test. The King-Devick test is an assessment of rapid number naming which measures saccadic eye movements. The King-Devick test is used to assess people with concussions or who are suspected of having concussions. I tested players on the hockey team at the beginning of the season in the middle of the season and once more at the end of the season. The players are timed as they read the numbers and the test is repeated three times per session.

**Butler, Margot &  
Mather, Grace**

**Project #30**

Health and Medical, Research Proposal

**Reducing Levels of Amyloid Beta Protein  
to Improve Memory in Alzheimer's patients**

There is currently no known cure for Alzheimer's disease. The effects of the disease include cognitive damages to memory, thinking, language and reasoning, as well as behavioral effects such as delusions, trouble sleeping, sudden agitation, anxiety, and depression. The condition is known to worsen dramatically over time, causing a rapid deterioration in the quality of life for the patient. To learn more about factors that may help improve the effects of Alzheimer's disease, it is planned to test the role of different nutritional supplements on the formation of the amyloid beta protein. Lowering amyloid-beta protein levels may decrease plaque buildup in the brain which contributes to Alzheimer's. Caffeine, magnesium, curcumin, and the nutrients CoQ10 and PQQ will be tested separately in mice and then in different combinations. Finally, all will be combined into one supplement to determine the cumulative effect. It is expected that the amount of amyloid beta plaque formation in brain cells will be reduced, resulting in improved memory and behavior in the mice. Several of the combinations will likely prove more effective than each supplement alone. If there is an improvement in the brain and memory of the mice due to the supplements, this will further the research to finding effective treatments for Alzheimer's disease. The results will likely cause an improvement in memory, a decrease in plaque buildup, and an overall improvement in the mice's condition.

**Butler, Quinn, Dowrich, Thea &  
Hogan, Maeve**

**Project #31**

Health and Medical, Research Proposal

**Improving Concussion Recovery  
in Adolescent Athletes**

Concussions are a common injury in young adults due to head trauma most normally occurring in athletics. Concussion rates have doubled in young people within the last fifteen years. After getting a concussion, the athlete is often instructed to rest. However, it is hypothesized that if the athlete gradually exercises both their bodies and brains, their symptoms will gradually decrease and cease sooner than with rest alone. There will be two different groups, and imPACT testing will be conducted for both groups as a baseline. One group will be a concussion control group that will simply rest and avoid reading and exercise. The other group will consist of individuals treated using gradual exercise and gradual brain activities such as puzzles and limited amounts of reading to stimulate the brain. A comparison of the results and recoveries of the members of both groups would be conducted, again using imPACT testing, to determine whether or not the change in treatment affected the length of the healing process. It is expected that a quicker recovery and return to academic and athletic activities in most cases of concussions will occur for the experimental group. The control group will experience a longer recovery time. This research will be useful for athletes, coaches and trainers to help aid the recovery process for young adults suffering from concussions. Future research will include ways to reduce the number of concussions for teenage athletes who play in contact sports.

**CatHealth: Wearable sensing and tracking of a cat's activity to detect symptoms of disease**

The serious and obvious symptoms of a deadly disease usually show up in the last few days. To solve this issue of time, CatHealth, a wearable electronic, is being developed. A wearable electronic is a sensor-based device that is worn on the body which uses many different forms of sensing. CatHealth enables tracking of an animal's location, behavior and other activities. It's worn on the legs of an animal. For this device, the focus is *Felis catus* (cat). The goal is to inform a pet owner of any unusual activity by the pet.

The device will have a small speaker, GPS tracking system, a step tracker, and many other sensors like a rest timer. The data recorded from the various sensors will be sent to the mobile device or computer of the owner. If the data shows many unusual activities, there will be notifications warning the owner. This device will help anyone with a cat catch something unusual like limited movement or lack of eating which are symptoms of cancer. Also, this device is very reliable because it has accurate sensing techniques and is comfortable for the animal. In the future, the program of this device can be improved to work for a larger variety of animals like dogs.

**The Role of Asthma and the Drug Hydroxyurea on the Quality of Life in Patients with Sickle Cell Disease**

Sickle Cell Disease (SCD), a lifelong disease, occurs in 1 out of every 500 African American births and 1 out of every 36,000 Hispanic American births. The disease affects the ability of red blood cells to distribute oxygen throughout the body, and previous studies have shown that this can contribute to the formation of other diseases as well. The quality of life in patients with SCD should be studied in order to assist patients with the disease. The Adult Sickle Cell Quality of Life Measurement Information System (ASCQ-Me) will be used to determine the role of asthma and the drug hydroxyurea on the quality of life of patients with SCD. The ASCQ-Me is a set of measures particularly important to adults with SCD and was developed using extensive qualitative research. The de-identified data from the administered surveys will be analyzed to make the necessary comparisons. It is expected that the patients with asthma will have lower quality of life scores than those who do not. In addition, patients who take hydroxyurea, a drug that is used to reduce the number of painful crises caused by the disease and to reduce the need for blood transfusions, will have higher quality of life scores. Discovering more about the factors that influence the quality of life in patients with SCD will inform doctors regarding the best treatments for patients with the disease.

**Carotenuto, Sabrina &  
Clark, Charlie**

**Project #34**

Behavioral, Research Proposal

**Improving Reading Comprehension in  
Students with ADD and ADHD**

Studies have suggested that students with ADD/ADHD may perform better on verbal assessments. It is hypothesized that a form of test taking that allows for verbal processing and student engagement will help students excel in school. This study will determine if changing the way an assignment is presented can improve reading comprehension. Assessments will be presented to students verbally via an app. This specific app will allow teachers to enter questions prior to the student taking the test. The students will have extended time and the app will enable them to listen to each question verbally while they are able to write their answer down on a piece of paper. A control group will take the same test, but in standard format with extended time and no verbal processing. The test scores from the students who use the app will be compared to the those taking the standard test. In this research, it is expected that the scores of the children who used the app will be higher than the scores of the children who took the standard test. It is expected that hearing the questions being asked will improve reading comprehension in students. If the scores of the students who use the app are higher as predicted, teachers will have an additional tool to help improve student achievement. We believe the results will likely point to further avenues of research that will extend the ability to help those who have difficulty with reading comprehension.

**Cashman, Jackson**

**Project #35**

Health and Medical, Research Proposal

**Decomposition of Amyloid Beta  
across a Blood-Brain Barrier**

Today, five million Americans are living with Alzheimer's disease. Alzheimer's disease is caused by the overgrowth of Amyloid Beta proteins on brain neurons. If the buildup of the proteins in the brain reaches a certain level, then it can cause neuron death and eventually organism death. The problem faced is to remove the Amyloid Beta proteins from the brain before they become harmful. The method in which the Amyloid Beta will be removed will be by using catalytic antibodies. Immunoglobulin G and M are two promising antibodies to be tested, with IgM having more promising and effective results. Doing an in vivo trial to determine if IgM penetrates a simulated blood-brain barrier. Additionally, measurements of Amyloid Beta diffusion out of the brain will be attempted. Results are expected to be that the IgM will be too large to enter past the blood-brain barrier. However, previous research shows that IgM causes cognitive improvement in mice. It is therefore possible that IgM decomposes Amyloid Beta in the blood stream around the brain, drawing out Amyloid Beta. Problems with diffusion might occur if there is not enough Amyloid Beta in the bloodstream to draw out the protein. This study would identify whether or not IgM can cross the blood-brain barrier. This information is vital in order to develop IgM into a drug for Alzheimer's treatment. Also, the study would find out if there is enough Amyloid Beta in the bloodstream to draw out the harmful Amyloid Beta from the brain. This is important information to know if IgM is unable to cross the blood-brain barrier.

**The Creation of an Ankle Brace for Horseback Riding**

Many, if not all, horseback riders have difficulty keeping their heels in the correct position for riding equitation. In the show ring, points are commonly deducted for incorrect heels position. During training, keeping your heels down in the correct position can be a struggle when also try to focus on various other equitation. With hopes of bettering the riding community, a brace has been designed to assist the rider in the correct positioning while training. The first approach for designing this brace was to create various sketches of what the brace could look like. An analysis was conducted on a fabric like material that consisted of cotton, polyester, and elastic yarns woven together and Poly-Ethylene Terephthalate Glycol sheets. The fabric material was chosen based on cost, time, accessibility, safety, and the ability to adjust to various users. As of now the phase of the project being conducted is the actual wrapping style of the brace around the ankle. The next phase is to test the brace on participant riders. To gather feedback a survey will be created which participants will be asked to complete after riding in the brace. Necessary adjustments will be made after the results of the survey are analyzed. With the consideration that the brace is made of a soft stretchy material and can be wrapped to the users desired size or degree of ankle flexion, when the brace is tested it is expected that there will be very little adjustments needed. The brace is made of a very versatile material and precautions were previously taken for safety of the rider. Once data is analyzed and no further adjustments to the brace are needed.

**The possibility of creating colored percepts through electrical stimulation within the brain when time parameters are set between time of blindness to time of operation**

My father as a young child had an accident in which he lost vision in his left eye and he was red-green colorblind. These visual impairments limited him severely in life. It is important to study the field of visual prostheses to offset blindness, and to improve the lives of many people. If the time between blindness and the implantation of a visual prosthetic is between certain parameters and electrodes are implanted within the occipital cortex, then colored phosphenes and more acute vision will be possible vs electrodes implanted into the LGN. By setting parameters on the time between blindness and the procedure, then by testing what types of phosphenes are elicited by microstimulation, the specific parameters can be determined. By using current data, one can determine this information by using the length of time the patient was blind and the data that is available about what sort of percepts are possible in the occipital cortex. It is expected that the results of the experiment will be a weak connection between acuity of vision and length of time after initial event where blindness occurs and the implantation of the visual prosthesis. Hopeful results are as follows: the specific time parameters after blindness can be determined and the comparison between the occipital cortex and the LGN will show which is better for a colored visual prosthetic. The possible implication of this experiment, is to clarify whether the color pathways in the brain atrophies any faster than the rest of the visual pathway. In addition it will aid in understanding what happens in the connection in the brain when patients have no light perception, therefore aiding future experiments on creating visual prosthetics with the implication of eliciting colored percepts.

**An Investigation of Copper as an Oxygen Carrier for Chemical Looping Combustion with Oxygen Uncoupling**

Coal-fired power plants provide for about 40% of global electricity, producing copious amounts of CO<sub>2</sub> to be emitted into the atmosphere, and causing acid rain through sulfur oxide and nitrous oxide production. One concept, called chemical looping, which has not yet been commercialized, is a novel method for implementation in power plants to produce only pure CO<sub>2</sub>, which can be captured and stored away from the atmosphere. One variation of chemical looping in particular, chemical looping with oxygen uncoupling (CLOU), can be used for solid fuels such as coal. However, this process can only be done with certain metal catalysts, ones that have multiple oxidation states and can thus release oxygen for combustion with the solid fuel when changing states. One such catalyst for CLOU is copper (Cu). Copper II oxide (CuO) can be decomposed into copper I oxide (Cu<sub>2</sub>O) at high temperatures, which can be further decomposed into pure copper (Cu) at higher temperatures. In this study, the temperatures for ideal reactivity of each of these reactions were found by measuring the oxygen production of copper oxide at increasing temperatures in a thermal gravimetric analyzer (TGA). The ideal temperature for CuO decomposition was found to be 770 degrees Celsius while the ideal temperature for Cu<sub>2</sub>O decomposition was found to be 800 degrees Celsius. These temperatures can now be applied commercially to determine temperatures for optimal cost efficiency and also to accurately predict the rate of oxygen production for copper.

**The Effect of Experience with Visual Art on Observation Skills**

Visual artists, having practice with observing objects to capturing three-dimensional objects into two-dimensional images, will likely have a different way of looking at the world than non-artists. This experiment investigates how experience with visual art affects observation skills. Participants had their background with art assessed by asking what, if any, art class they were taking or had taken and if they practiced art on their own. Participants were then shown 3 pictures for 15 seconds each and thought about which image was best for the entrance to the media center while looking at the pictures. After, participants were told to write down observations they made about the three images. The participants were split into artists - ones that are currently or have taken an art class - and non-artists. The number of observations made about each picture was counted and totaled up for each participant, then the total number of observations made was averaged for artists and non-artists. Trends show that artists, on average, make more observations than non-artists. Artists on average made more observations than non-artists. A link between greater experience with art and better observation skill also could have applications in the scientific world; since good observation skills are an important trait for scientists, if there is indeed a link between enhanced observation skills and experience with art, it could mean that experience with art would be beneficial for scientists to improve one's observation skills.

**Chinitz, Sam****Project #40**

Environmental, Completed Project

**Finding the Optimal Conditions for Energy Recovery in an Electric Car**

Improving the efficiency of vehicles has become a priority for many automakers and countries due to environmental issues with inefficient vehicles, the economic repercussions that come with inefficient cars and the limited amount of oil available. The innovations in the auto industry have led to advancements in the fuel economy of vehicles such as hypermiling and electric cars. When people became unsatisfied with the fuel efficiency of their cars, they began hypermiling by drafting and coasting, leading to a noticeable improvement in the fuel efficiency of their vehicles. A key reason for the efficiency of electric cars is their ability to recover some of the energy that it loses, and there may be conditions in an electric car that could positively affect the effectiveness of its energy recovery. This project has obtained data regarding those variables, among others, from a Ford Focus electric car running a simulated test as if it were driving in an urban environment. In order to collect the data, a Ford Focus electric car was placed on a dynamometer and an urban driving experience was simulated. Measuring equipment was attached to the car and gave the data necessary. This data has been analyzed to determine the main factors that affect the energy recovery in an electric car and what the optimal conditions may be for an electric car to recover the most energy possible. A possible connection could lay in the difference in torques in the different axles, and another could lie in the traction force.

**Chung, Dana****Project #41**

Health and Medical, Completed Project

**Awareness and Knowledge of HPV Among High School Students**

Human Papillomavirus (HPV) is a sexually transmitted pathogen that causes 332,200 cases of associated cancers in the US. Despite the available vaccines, many teens are unaware of HPV. The purpose of this project is to investigate the awareness and knowledge of HPV infection among students with respect to their gender, academic achievement and socioeconomic status. It is hypothesized that students are not aware about the health risks of HPV infection. To conduct this study, participants with different backgrounds from both suburban/urban schools and various pediatric centers will be administered a questionnaire. The questionnaire will require the student to answer a series of multiple-choice questions regarding HPV and the vaccine. The questionnaire requires the student to answer questions about grade level, age, academic achievement and socioeconomic class. Results thus far show that a majority of students, even students with a GPA over 3.5, do not have sufficient knowledge of HPV. Many students confused HPV with HIV and do not know about the dosage of vaccines that are used for prevention. Detailed results are pending and will be analyzed. Comparisons and statistical analysis will then determine possible correlations between HPV knowledge and students' background status. The initial conclusions of this project have implications that result from a smaller sample size. Further studies ought to be conducted before more conclusions can be made.

## **Collins, Maude**

## **Project #42**

Environmental, Research Proposal

### **The Current State of Cyanotoxins in Rochester Lakes Adjacent to a Sewage Plant**

Blue-green algae (cyanobacteria) produce cyanotoxins that are harmful to the environment. In this study, cyanotoxin levels will be tested in lakes in Rochester due to prior cases of cyanobacteria. Cyanobacteria growth is encouraged by phosphorus from sewage plants and runoff. In Rochester, the sewage system is old and may be responsible for growth in nearby lakes. There is a sewage plant (Van Lare Treatment Plant) close to 4 lakes (Eastman Lake, Durand Lake, Trott Lake, and Pat Lake), and there is also a golf course nearby. It is hypothesized that cyanobacteria will be present in these lakes adjacent to the sewage plant. A microbiotest for rapid detection of water contamination (Rapidtoxkit) will be used. The Rapidtoxkit procedure is performed in vitro using *thamnocephalus platyurus* hatched from cysts. Test organisms are exposed for a short period of time (1 hour) to the suspected (polluted) water samples and to fresh water as a control. Red microspheres will be added to the organisms. If their digestive tracts turn a deep red, there are no toxins in the water. If toxins are present, the rate of uptake of the microspheres will be lower and fewer red beads will be present in the digestive tract. It is expected that the Rochester lakes will still contain harmful cyanotoxins. If so, the toxins need to be added to the EPA's contaminated list in order to remedy the issue and prevent the poisoning of the organisms in the water as well as the people who frequent the lakes.

## **Coughlin, Sloan**

## **Project #43**

Health and Medical, Research Proposal

### **Genetic Mutation Association in the Etiology of Autism**

Autism is the fastest growing serious developmental disability in the US. The cause of autism is still unknown, yet genetic and environmental factors play a role. In previous research, many genetic variations have been linked to autism, yet not one mutation that explains a majority of cases has been found. This leads to the theory that a combination of gene alterations could have a more detrimental affect. Through research of past studies that have located gene mutations that have pathogenic links to autism this research will focus on combinations of these genes that lead to increased autism risk. Through looking at genomes of people who are diagnosed with autism, from databases like the American Genome Project consortium, patient's genomes can be analyzed to look for genetic alterations and the effect that they can have. Through analysis of a wide variety of genomes alterations of genetic DNA could and have been found that have some association with autism. Many of the genes already found are only the cause in a very low percentage of cases. It is expected to find that a combination of gene mutations may be responsible for a higher percentage. The implications of the research could lead to findings combinations of gene alterations that increase the risk for autism. Once the genes are found that have high association with autism then treatment and prevention can then be looked into. Treatment can focus more specifically on the patient, which would be more productive. Also this provides families with the cause for their child's autism, which comfort to many people.

**Determining the Most Effective Tick Repellent in Replace of DEET Based Products**

Which of the following chemicals will be the most effective in repelling ticks: Picaridin, Nikethamide, and Oil of Lemon Eucalyptus? Ticks containing hazardous bacterium are extremely prevalent in the North East. The recommended repellent thus far are products containing DEET. Unfortunately, these products pose health risks to humans the more they're used. It was hypothesized that the Picaridin will perform the best in repelling ticks out of the listed chemicals. *Ixodes scapularis* nymphs were placed individually on a petri dish with each chemical applied to two opposite quadrants. The ticks' behavior was examined, first without a chemical to take note of their random movement, then with one of the chemicals applied. DEET acted as the control, each chemical was the independent variable, and tick's behavior was the dependent variable. As expected, the ticks exposed to DEET and Picaridin were repelled. With the Oil of Lemon Eucalyptus, the ticks entered the liquid, then changed direction. When exposed to the Nikethamide, the nymphs acted similarly to those exposed to the former repellent, but they appeared to become more sluggish and showed symptoms of confusion. The results are still being analyzed. It was determined that all of the chemicals were effective in repelling ticks to a certain extent and induced varying behaviors. Further studies may investigate how ticks containing the bacterium act differently than those without it, or examining their RNA to see how each chemical altered it.

**The Effect of Different pH levels on Brine Shrimp Survival to Adulthood**

The burning of fossil fuels and other human actions are rapidly increasing the carbon dioxide emissions on earth. These massive emissions that are normally kept in balance are now spelling disaster for the inhabitants of the planet. About one third of these emissions have been absorbed by the ocean since the industrial revolution (Science Daily, 10 Dec. 2014). When this happens, the carbon dioxide turns into carbonic acid, which lowers the pH of the ocean. The purpose of this experiment is to see how the acidifying ocean affects its inhabitants through the use of brine shrimp exposed to different pH's. Brine shrimp were hatched in 3 different cones all at a pH of 8 to ensure hatching success. 1/2 of a cup was taken from each cone once the shrimp had hatched and placed into 3 different containers. One container is maintained at a pH of 6, one at a pH of 7, and one at a pH of 8. Water chemistry is monitored and the shrimp are fed spirulina powder. It is hypothesized that the shrimp living 8 pH range will have the highest rate of survival. Each week a cup of water is taken from each container and the number of alive shrimp are counted. The data is currently inconclusive, but research is being conducted. Analyzing of the data, over the next few weeks, may begin to show a trend. The results of this experiment will lead to the knowledge to what degree the effect of the changing pH of the oceans will be on ocean creatures and how urgent we as humans must address this issue. It could also lead to the further protection and conservation of all marine life.

## **Cunningham, Katherine Project #46**

Physical Science, Research Proposal

### **Testing the Effect of Altitude (Feet Above Sea Level) on the Number of Epiparietals in**

One of the foremost families of dinosaur found in the Hell Creek Formation of Montana is the sub-family Chasmosaurinae. This group encompasses many horned species of dinosaur, including Triceratops marsh and Torosaurus marsh, recently proposed to be the same dinosaur. Triceratops marsh is typically found to have five to six epioassifications on its frill while Torosaurus marsh generally has ten to twelve. However, the possibility of stratigraphic variation within species of chasmosaurine ceratopsids was not taken into account when writing the paper proving them the same species, as not enough research had been conducted into this area. We hypothesized that if specimen of Triceratops and Torosaurus were both examined for the number of epiparietals and altitude (above sea level), then the number of epiparietals on the frill will decrease with the altitude due to a change in pressure. Specimen skulls were examined for number of epioassifications on the parietal of the frill (including and identifying those lost taphonomically by obvious jagged edges and by examining the larger ventral impressions on the skulls). Information was collected on the altitude at which the specimens were discovered. The hypothesis was partially supported by a trend in the data: as the altitude at which the Torosaurus specimen was found increased, the number of epiparietals decreased. However, Triceratops did not show much stratigraphic variation. This study holds major importance in the understanding of chasmosaurine ceratopsids. Stratigraphic variation is a fairly new topic in paleontology and it could unlock many dinosaur secrets, as well as proving here that Triceratops marsh and Torosaurus marsh cannot be proven the same species through examination of epiparietals.

## **Davidi, Barak**

## **Project #47**

Physical Science, Completed Project

### **Optimization of ACV Design**

Air Cushion Vehicles, ACVs, show great promise as a form of transportation over variable terrain. They are currently implemented by select military powers, environmental scientists, and short distance transportation businesses. This project seeks to design an ACV that could apply to a wide range of tasks and surpass conventional transportation. The completion of this experiment included extensively researching the physics and mathematics involved in ACV design. Points of fault were noted in existing designs and various solutions per fault were considered. After deciding the ideal solution for a select fault the process repeated until no more faults were noted. This project also included the creation of a functional scaled model of the proposed design. Several faults have already been noted and resolved in outdated hovercraft design simply with the simple incorporation of better materials and more easily manufactured structures. Currently, some more difficult issues are yet to be resolved, but viable solutions are being researched and considered. The combination of changes in the proposed ACV design include new technologies and the incorporation of numerous, currently supported, ideas. Changes made thus far point towards a definite increase in overall performance. Given the nature of this study, the results will surely point to further research. When considering the engineering process, it will be necessary to reassess all changes made and consider altered combinations of fault resolutions. If successful, this study may also lead to a continuation including the consideration of factors unable to be manipulated at the present time. The completion of this study may lead to greater awareness of ACV potential.

## Davidovich, Adam

## Project #48

Behavioral, Completed Project

### Maximizing a University's Profit by Method of the Lagrange Multiplier

At what price should the tuition of large, prestigious universities be set to maximize their profit in the presence of state universities? The pricing of different universities has been a major issue in the United States, especially as it relates to competition between private and public universities. Thus, I am performing this research to provide a theoretical means by which a university can maximize their profit and an example I will be using the Calculus III method of optimization called the Lagrange multiplier technique. This states that the partial derivative of the function you are trying to maximize/minimize with respect to one variable is equal to the sum of the partial derivatives of the constraint equations with respect to the same variable, each multiplied by a distinct Lagrange multiplier constant. At the end of this research, I will be left with a system of 4 equations which I will then solve this system to get rid of the unknown constants  $\lambda$  and  $\mu$ , then rearrange for the profit of Yale, then substitute in the known variables (which must be gathered through experiment) and will be left with the maximized profit. This is a means by which a university which is struggling to make money due to students electing to go to more inexpensive private schools may maximize their profit by shifting their tuition prices. These universities will be able to utilize the equation defined at the end of this research to calculate the best price, thus easily enabling them to make as much money as possible.

## Davis, Ben

## Project #49

Physical Science, Research Proposal

### Simulating Binary Star Stability

In binary star systems, stability is based on the amount of change in eccentricity. A star with high stability might have an orbit which seldom changes shape, whereas an unstable orbit could be becoming more eccentric or circular. The goal of this project is to simulate the effect of outside forces on binary system stability in order to better understand how they work. The project would use software to model the effects of outside forces, such as passing stars or planets. The change in eccentricity of a system's orbit over a set period of time, depending of the size, speed, and position of an anomaly can be measured. The final goal would be to determine what it takes to significantly alter a binary system's orbit.

## **Davis, Alex**

## **Project #50**

Physical Science, Completed Project

### **Development of Small, Cheap Vibration Sensor Modules in a Wireless Network for Real-Time Monitoring**

This project will explore the development of small, cheap, modular vibration sensors in a wireless network for vibration detection and tracking. A module will be equipped with a microcontroller, a piezoelectric vibration sensor, and a wireless transmitter. These modules will be distributed throughout a target area, transmitting data to a central computer for real-time analysis. In the case of an event, the computer will be able to calculate characteristics of the event, including measures from a triangulation-like analysis. Various applications exist for this system, including earthquake monitoring. The real-time data which this system would create, when paired with existing seismic models, could help identify the implications of an earthquake immediately if it is an isolated tremor, or if it could be the precursor to a major earthquake. If the system finds a major event imminent above a threshold, it would issue automatic alerts to sensitive areas such as hospitals, schools, and directly to citizens through internet services, in the area it would effect.

## **Deng, Randy**

## **Project #51**

Physical Science, Completed Project

### **The Effect of Different Checkerboard Sizes on Steady State Visually Evoked Potentials**

In the world today, millions of people suffer from neurodegenerative diseases such as amyotrophic lateral sclerosis, brain stem stroke, and spinal cord injury. These diseases prevent people from communicating through conventional means. Thus, brain-computer interfaces (BCI) were developed to translate thoughts directly into commands. SSVEP-BCI, a type of visual stimuli BCI, have exhibited high accuracy rates. The goal was to discover which checkerboard stimuli size was optimal for BCI systems. The size of the pattern was evaluated on a continuum from a large pattern to a single pixel checkerboard (256x256 pixels) with the same boundary. The checkerboard lengths doubled with each increase, resulting in the following checkerboard sizes: 1x1, 2x2, 4x4, 8x8, 16x16, 32x32, 64x64, 128x128, and 256x256 (pixels). A Fast Fourier Transform was done to graphical the power spectral density of the SSVEP signals and a paired t-test was done to find any significant power difference between the increasing checkerboard and solid stimuli. Results showed that 2x2 and 4x4 checkerboard stimuli generally create the most distinct SSVEP signal. The general trend was that as SSVEP checkerboard sizes decreased, the associated power became increasingly weak. The power spectral density graphs support this trend, but as it approaches pixel size, the power increased more than predicted, which may be due to noise in the signal for irregular flashing in pixel sized checkerboards. By knowing that 2x2 and 4x4 checkerboard stimuli create the most distinct SSVEP signals, BCI researcher's in the future can incorporate these sizes into their protocol. Whenever researchers are using checkerboard SSVEP stimuli, by using 2x2 and 4x4 sized checkerboards, it may increase the accuracy of the BCI system they are testing. Overall this will improve the reliability of BCI systems for medical use in the future.

**Astrocyte Toxicity in ALS**

**Problem/Motivation:** ALS, or amyotrophic lateral sclerosis is a neurodegenerative disease that affects the nerve cells in the brain and spinal cord. Over 5,000 people are diagnosed with ALS in the United States each year. ALS is a growing problem, and has increased greatly in the last past 20 years. The degeneration of motor neurons is due to the toxicity in astrocytes. This experiment would look to modify the activity of the non-neuronal cells, and block the toxins secreted from astrocytes. **Methods/Procedures:** Astrocytes that have the mutated gene of SOD1(Super oxide dismutase 1) cause a form of ALS. Silencing the SOD1 in these astrocytes were shown to have no effect. Experiments showed that the astrocyte-produced toxin worked by activating a protein Bax, which triggers a process of Necroptosis. By blocking this Bax protein, it could stop the toxins given by the astrocytes, and prevent the death of motor neurons. This experiment aims to identify a possible solution to block the protein. **Results:** Previous experiments with the mut-SOD1, came up with negative results. By blocking off the astrocytes, to stop the secretion of the toxins, it is hoped that it would spare the motor neurons and prevent their death **Implications:** This experiment will not only stop the death of motor neurons, but can also be a potential treatment for ALS. In addition it would be beneficial to find the affect these toxins have on motor neurons. If finding more about the toxins secreted by astrocytes, this could be a new opportunity to make a new drug for treating ALS.

**Treatment effects of therapeutic drug combinations of Gemcitabine, Docetaxel, and Cisplatin on different cancerous bladder cell line tissues**

The problem statement was Will combinations of Gemcitabine, Docetaxel, and Cisplatin drugs kill different samples of cancerous bladder cell line tissues efficiently? . I predicted cells treated with Gemcitabine, Docetaxel, and Cisplatin would die, and drug combinations would kill cells at a more efficient rate. Bladder cancer being the eighth most common cancer, and estimated to cause over 15,000 deaths yearly in the United States, requires new methods of treatment. Beginning with spraying PBS in Class II A2 biological safety cabinet, the next step was splitting the T24 cells, then aspirating the media the T24 cells were swimming in, and washing them with PBS. After adding 5mL of trypsin into the cell plates, the plates were then put back into incubator at 37 degrees F for 10 minutes. These steps were repeated for cell lines 5637 and UMUC3. The cells lines were then transferred into three 50 milliliter conical tubes, and placed into the a spinner at 1000 RPM for 5 minutes. After taking out, the Trypsin and media was aspirated out of the tubes, and 10 milliliters of new media was inserted into each of the tubes as they were placed into individual reservoirs and put in the incubator for 7 hours. The media was then aspirated out of each reservoir, 200 micro-liters of each cell was added into wells (have 2 well plates). Drug concentration in each type of well: Cisplatin 5 micro-molars, Gemcitabine: 5 nano-molars, Doxetaxel: 10 micro-molars, positive control: hydrogen peroxide. Let plates incubate for 16 hours. Cells were then fixed using methanol, and after aspirating the methanol, Crystal Violet was added (concretion: 0.94% Crystal Violet and 20% methanol) and let sit for an hour.

**Inhibition of the PI3K Pathway as an Anti-Cancer Drug Target**

Cancer is disease characterized by the uncontrolled growth of abnormal cells. Understanding the genetic basis of cancer will help scientists identify the basic factors necessary for its growth, and thus develop precise drugs which can be used to target these universal factor. Phosphatidylinositol 3-kinases (PI3Ks) are kinases that are present in all cells, and regulate cellular growth. However, it has been found that dysregulation of the PI3K/ASKT metabolic pathway signaling occurs in one-third of human tumors; as a result PI3K is a viable molecular target for anti-cancer drugs. If the 3 genes coding for Class A PI3K, the PI3K class most strongly associated with human cancers, are suppressed, then the PI3K kinase will not be able to be produced, and malignant cells will not able to grow and metastasize. Lung, breast, and colon cancer samples will be used in this experiment; these three types of cancer will allow scientists a larger data pool as they are the most commonly occurring cancers in the world, making up around 35% of cancer diagnoses each year. An RNA interference machine will downregulate the PI3K gene in malignant tumor cells, inhibiting the production of the PI3K enzyme. The activity of the cells will be monitored using apoptotic assays, and gel electrophoresis and western blotting will be conducted to determine the amounts of PI3K as well as selected molecules which have previously been identified as vital to the proliferation of cancer, including AKT and MTOR. This experiment will allow scientists to determine whether PI3K is vital to a cancer cell's development and has potential to be a universal cancer target, or whether it is simply just an accessory secondary kinase.

**The Effect of Acidity on Microbial Life Growth**

Throughout the last three decades, since the mass discovery of multiple planets in our universe, there has been a question of whether or not life could be sustained on any of those trillions of planets. Because microbial life is the basis for most multicellular organisms that are existent on Earth at the moment, it would be most beneficial to test in what conditions can these microbes grow in order to better understand what planetary conditions would be prime for colonization. It is hypothesized that these microbes will be able to thrive in neutral conditions rather than in any basic or acidic environments due to the natural balance in ph which organisms maintain. To properly test and record accurate results as to what conditions can microbial life properly grow in, this experiment must test one variable out of many, which will be the ph of the liquid they inhabit. I will be dropping 5 mL of water onto a culture of microbes. This will be done at five different ph levels with three trials each. I will be testing each culture in the same conditions (other than the ph), and at the same time. Due to the more neutral atmosphere and climate on Earth, it has been concluded that the bacteria will strain to survive in the more basic ph levels, and due to the fact that most Earth organisms maintain a balanced ph level of their own body, it has also been concluded that the ph of 7.0 is the most favorable condition for microbial life to grow in. The bacterial cultures exposed to more acidic conditions would not grow as healthily, or not survive altogether. Now that it has been understood that bacteria grow most comfortably in neutral ph conditions, the criteria for a suitable planet has been narrowed down. As more and more environmental variables are tested, the perfect planetary candidates will be illuminated. Ultimately, understanding the conditions which normal bacteria can survive in will allow scientists to identify planetary conditions which are the most suitable for colonization.

**Dimm, Katie****Project #56**

Environmental, Research Proposal

**Methylmercury in Sharks**

Every year roughly 100 million sharks are killed to fuel the shark fishing industry, all almost exclusively for the use of their fins. If this current shark slaughter rate continues, scientists predict that within the next few decades, most sharks could be entirely evicted from our planet's oceans. Not only are sharks in critical danger of being wiped out, but they are also dangerous to consume. The plan is to test methylmercury, a deadly neurotoxin that bioaccumulates in the aquatic environment, and examine where methylmercury concentrations stand for pelagic and coastal sharks. The goal is to use a variety of samples, from fresh fin clippings, to meat samples taken directly from the market, and measure the amount of mercury and subsequently methylmercury accumulated in their bodies. In previous studies where mercury concentrations were examined, the levels had met if not exceeded the proposed safe level recommended by government and food safety administrations. Upon completing this study it is expected to find even higher concentrations than those previously seen as mercury levels are steadily rising in the environment and consequently in sharks. In conclusion the goal is to provide further evidence in an extremely important yet so limitedly researched field. In addition, the evidence found could be used to help prevent devastating and unnecessary poisonings from methylmercury. Lastly, the results of this experiment may help change consumption and safety recommendations to control or possibly stop the overfishing of the shark population

**Ding, Howard****Project #57**

Behavioral, Completed Project

**How The Mobile Device You Use Defines What Kind of Person You Are**

Many people use mobile devices nowadays, and mobile devices can range from tablets to mp3 players, and anything in between. Also, many different brands of mobile devices to fit certain people's needs. This experiment was used to analyze and to detect common correlations between people's characteristics and their mobile devices. A survey was used to gather data about the subjects and their mobile devices. Data included: age, hobby, personality (via personality test), brand of device, amount of device usage, etc. Results so far show a trend in the want for fast communication and data speeds for teens and young adults alike. Also, those who are involved in computer related activities seem to care more about the performance of their device over others who care more about the communication speed. It was hypothesized that the usage of the said mobile device will peak at the 18-35 age range, and slowly decrease where the 55+ age range has the least usage of mobile devices, and the older subjects (55+) will not want fast communication as much as the younger ones. Some implications of the current data can be used for more smarter, more relevant mobile advertising or marketing that may have to do with the user's traits.

**Data Analysis of Vitiligo's Predisposing Factors**

Vitiligo is an autoimmune disease that causes skin depigmentation. Although it is neither harmful nor deadly, vitiligo causes emotional distress and social alienation. Because there are numerous variations of vitiligo, each developing differently, it is challenging to find the underlying cause. This knowledge would allow doctors to give more effective and more personalized treatments. The age of onset and presence of comorbidities are likely the strongest indicators of vitiligo severity. Data on vitiligo's predisposing factors and their correlation to disease severity will be analyzed. The Vitiligo Cloud Bank, a database of over a thousand anonymous medical records, will provide its data. A genetic programming software will create and test thousands of data models to measure each variable's correlation to severity. Standard clinical information from the patients will be tested as variables. Disease severity will be indicated by depigmentation percentage. If the hypothesis proves correct, age of onset and presence of comorbidities will have the strongest correlation to vitiligo severity. Because dozens of variables will be tested, there is a chance that an unexpected variable will be most relevant. A variable commonly viewed as substantial, such as location of depigmentation, may have a weak association. In the process of measuring the variables, the data may reveal that some variables coincide. After the most common causes of vitiligo are identified, treatment effectiveness can then be tested. Some treatments may function best when a particular variable is the cause. This would be invaluable knowledge for dermatologists who can only prescribe their best guess for a therapy. It is common for treatments to work only temporarily or partially. This research's results could also support the concept that vitiligo has different variations of progression.

**The Exploration of Regeneration as a Therapeutic Treatment for Ischemic Optic Neuropathy**

Ischemic optic neuropathy is the main cause of blindness in men and particularly women at about age 55. The ischemic neuropathy affects the optic nerve in the brain and inhibits blood flow to the eye. Past research states that ischemic optic neuropathy can be therapeutically treated by the regeneration of the retinal neurons. If a protein that induces the regeneration of neurons surrounding the retina is injected into the optic nerve, then the functioning of the optic nerve will ameliorate and reduce monochromatic vision. Optic nerve treatment would be administered by an incision in the retina, then administering a plaque to the carotid artery. Then, protein inducing the regeneration of retinal nerve cells would be injected into the retina, allowing for regeneration. The progress would be evaluated in five-day intervals. Male and Female Wistar Rats will be used along with a Doppler laser probe and Doppler laser flow meter to measure blood flow before and after the injection. There would be a series of vision tests before and after the exam to test eyesight. The expected outcome of this experiment is that the rats would regain vision and have a normal blood flow from the carotid artery to the retinal nerve cells. By the completion of this experiment, the understanding of retinal blindness and the effect of the optic nerve would be better understood. After this experiment takes place, future work could be researching the effect of ischemic neuropathy on auditory functions.

**Self-Perception of Weight In Teens Associated to Lifestyle**

In 2014, “One-third of school-age children are overweight or obese in the U.S.” With the growing number of obesity cases in the U.S, teens are accustomed to seeing overweight individuals, possibly causing self consciousness to decrease as their body fat increases. In effect, is this making them want to exercise more or do they find it natural, thus creating an unhealthy lifestyle and possible medical problems? The focus of this research is to observe the association between the self perception of weight in a teenager, and the lifestyle the teen lives. To start off the project, research was done on eating behaviors, motor fitness and its correlation to different fat levels in both males and females. I tested the hypothesis that obesogenic environment impacts the perception of young adults towards issues of excess body weight and health in a gender specific manner. A survey was created relating the type of body the subject believes they have e.g. underweight, overweight or normal weight to several different aspects of life such as religious aspects, physical, social, fitness, and dietary. Based on the information gathered, the data suggests that females perceive themselves as having a higher amount of fat, while males think they are normal or underweight. Females show that as fat levels increase, the time of exercise decreases. The trend in data also shows that females who consider themselves to be normal weight participate in an average of 2 clubs, versus no clubs for overweight females. School guidance counselors can use the information from the research to target the population of people who tend to not participate in clubs due to body image. For example, getting the females who believe they are overweight, to strive to participate more.

**The Efficiency of Clicker Training in Canines: Testing Positive Reinforcement**

The goal of this experiment is to determine the efficiency of positive reinforcement in dogs through testing clicker training. If the efficiency of clicker training is tested against different forms of reward based training, then it will be proven that clicker training is the most efficient form of training when training a canine. This is because clicker training allows for canines to associate a certain sound with positive reinforcement, rather than just associating positive reinforcement with food. Using a group of 30 young dogs between the ages of ten and fifteen months from a dog shelter, multiple trials will be done in which different forms of training will be tested. When testing these forms of training, a simple command will be taught to the puppies, the “sit” command. Each dog will be taught the command and tested individually, in a room away from the other dogs being used in the test. It is predicted that the hypothesis will be supported and clicker training will be found to be the most effective form of training in dogs. It is also predicted that clicker training will prove a dogs ability to associate sounds with certain positive or negative emotions in the same way that humans can. By testing the efficiency of clicker training against other forms of training, we may be able to see whether or not canines have the same cognitive ability to associate places, sounds, or smells with positive or negative feelings or experiences.

**Measuring the carbon dioxide reduction capacity of an algae filtration apparatus for an individual motor vehicle and its application to a larger population with motor vehicles**

There is an overabundance of carbon dioxide in our atmosphere, and algae can remove this greenhouse gas from the air through the consumption of it. There have already been roadside apparatuses that harness this carbon-dioxide-reducing capability, and I think that it could be harnessed in an apparatus for individual motor vehicles as well. So I have decided to create and then test the efficacy of such an apparatus. The apparatus will be a simple tube like container to contain the algae that can be attached to either hoods, door panels, or bumpers of motor vehicles: the motion of the motor vehicle will be used to bring air into the algae filter. And the apparatus will be able to hold a volume of at least 2 liters. Two apparatuses will be constructed. Both will be filled with about 2 liters of water. Add algae to one of the apparatuses. Place both apparatuses in identical, sealed containers under a fume hood and fill both containers with 0.25 liters of carbon dioxide that is close to standard conditions. Measure the carbon dioxide remaining in both containers at the end of each day for at least one month. Apply the amount of carbon dioxide reduced by the apparatus with the algae in comparison to the control apparatus over the course of a month to determine how much carbon dioxide could be reduced over the course of a year for one car. Then apply this newly calculated data to the approximate number of cars driven today to determine the ideal amount of carbon dioxide that could be reduced with the implementation of this device.

**Examination of Mere Proximity in Adults Focusing on Intelligence Wealth and Beauty**

Many things can impact children's social evaluations but most research studies the impacts of race and proximity. 5-10 year olds associate traits and judgment about an individual with persons that have been seen in close contact with them. However, this experiment will take this theory one step further and use adults. A group of college students will be shown 3 pictures: 1 of doctors 1 of businessmen 1 of babies. The photos will follow a pattern of either White:Black:White, Black:White:Black and so on. They'll be asked questions that can be answered on a lot to a little scales. Questions for each picture will vary 1 will focus on intelligence/capability 1 on money/respect and one on primarily looks. The questions will also focus on the white and black subjects in the photo. I hypothesize that when tested adults will be biased toward whatever race the subject identifies with. However, when an opposite race person is presented with the same race as the participant, the ratings of the other race person will increase. Depending on the variation in races of the subject's data can be analyzed using all results as a control or divided by race to look for trends in that area. If this hypothesis is supported I believe it would go to support the idea that proximity and race play a role in social evaluations but also social evaluations change from child to adulthood and even allow for further research in when and why that change happens.

**The Relationship Between People, Their Peers, and Their Authority Figures**

I planned to research the area of animal behavior and much of the research I found related to human psychology, leading me to study that area. One article was about how an animal's status affects how successful it's perceived as, leading me to think how this phenomenon is in human society. This led me to the Milgram experiments, which suggested people performed actions requested by an authority figure even if they disliked the actions. Similarly, Asch Conformity experiments suggested that people would conform to the majority even if the majority made a clearly wrong decision. My experiment idea was inspired by questioning what would happen if a person was to choose to conform between authority or their peers. I hypothesized authority, even when outnumbered, would be chosen more often because of higher position in society. Five random classes were selected to take a test, where the students first had to memorize a set of numbers within a minute. and then took a test where they had to choose an identical set of numbers from ten choices of number sets. These sets are labeled either teacher or student, and the participants are told they were collected from other teachers and students (all sets were made up) to enforce a sense of realism. There are five different versions of the test, with a different ratio of teacher to student answers for each one. The idea is that if students continue to choose teacher answers even when there are far more students, then are perceived as more successful. Data would have been analyzed by comparing the number of times the two choices (student or teacher) appeared in each of the survey variations. As of now, the data suggests that students have an inclination to choose teachers.

**Association Between Dental Hygiene Habits and Academic Class Level of High Schoolers**

Proper dental health habits play a vital role in the oral health of all people. However, they are often disregarded, especially by teenagers. It is hypothesized that students enrolled in higher level academic classes will be the ones that have better, and more frequent, oral health habits. Therefore, this study focuses on high schoolers ages 14-18 in order to see how many times a day they engage in the recommended oral health habits (ex: brushing, flossing, mouthwash, etc.) To accomplish this, questionnaires have been, and will be, distributed in order to collect the data about the dental habits that the subjects have. The initial data supports the hypothesis, and shows that the students in the higher level classes have better oral health habits than the students enrolled in lower levels. However, data is still being collected and the final results are pending. The gathered data provides a way to generally improve the oral health habits in teenagers. By knowing that, for the most part, those who receive a higher level education take better care of their teeth, measures could be taken to improve the education of those who, originally, are not as advanced. This will boost the overall oral health in teenagers, as well as adults, and prevent numerous oral diseases.

**An Evaluation of Machine Learning Methods for Genetic Variant Error Detection**

Genomic sequencing has empowered some of the greatest advances in biology and health sciences of the 21 st century. However, the large quantities of data produced are significantly contaminated with error, making it difficult to sift out mutations from noise. Here we compared a wide range of algorithms tasked with separating real and artifactual genetic variants. We performed a grid search over the algorithms' hyperparameters to optimize the expected area under their predictors' ROC curves before evaluating the optimized algorithms against the current standard, the VQSR, using independent data sets to avoid overfitting. We found that our two ensemble-based methods, Random Forests and Adaboost, produced on average better predictors than the VQSR ( $p = 2.58 \times 10^{-455}$ ,  $2.50 \times 10^{-390}$ ). However, our evaluation criteria were not sophisticated enough for us conclude that either algorithm should replace the VQSR. In light of these results, we advise that further refinements of genetic analysis software should pursue ensemble-based methods to obtain the best predictions and computational efficiency, and we suggest that more nuanced evaluation metrics should be designed to identify the proper notion of performance.

**Using Twitter as a predictor of protest violence**

Protests are a powerful for society to communicate its values. A recent example of this is the protests in Ferguson against race-based police violence. Unfortunately, after a court decision did not go the protesters way, the protests turned to riots. What was a peaceful protest turned into a massive force of destruction. With a bit of warning the violence could have been defused or at least prepared for. But to get that warning you would need a peek into the inside of the crowd. One potential place to look is twitter. With many protests being live tweeted, Twitter offers the perfect place to look into the sentiment of the protests. Twitter only allows users to post one thought per tweet, making analysis much simpler. This project will investigate methods of predicting if and when a protest goes violent. Tweets will be extracted through the twitter API and analyzed using sentiment analysis. Sentiment analysis is a type of algorithm that extracts emotion from text. This will be compiled as a graph of sentiment vs time. Various algorithms for predicting the time that the violence broke out will be tested. These algorithms will be designed to only look at data leading up to the event; this will simulate a real-time situation.

**Low-Cost Solid-State Cosmic Ray Observatory**

Proposed is a new design for a cosmic ray observatory consisting of small, low-cost, easy-to-use detector nodes based on PIN diodes. Cosmic rays are particles and nuclei which bombard the earth's atmosphere and create cone-shaped showers of secondary particles. Once constructed, observatory nodes are able to detect and record the time of impact of single gamma ray photons of these showers to within a few nanoseconds, as well as the energy of the photon, and are low-cost enough to create cosmic ray observatories of unprecedented size. Nodes communicate to a central database to upload data, which is later analyzed to determine the energy, angle, and location of the original cosmic rays. This information can be used to test the runaway breakdown theory, which proposes that almost all lightning is triggered by cosmic rays. This information can also be used to learn about the origin of ultrahigh-energy cosmic rays and can help solve the Greisen-Zatsepin-Kuzmin paradox, in which the experimentally determined cosmic ray energies are higher than theoretically possible.

**Integrating Sphero into Pivotal Response Treatment**

Autism is a social disorder that cannot be cured, but the symptoms can be treated. One treatment is called Pivotal Response Treatment (PRT), which is a play-based treatment. The purpose of this study is to integrate activities involving a robotic ball, Sphero, into PRT sessions. If activities can be successfully integrated, Sphero may help make PRT more effective for children with autism. In this experiment, activities with Sphero were tested on children without autism as a pilot for further research. There are four activities in this study, all utilizing key concepts of PRT, such as self-motivation and initiation. Each activity is designed to help with different areas a child with autism may be struggling with. Each participant completed each activity once and their behavior was coded for social behaviors like gestures, head nodding, self-initiated speech, and eye contact. The participants also took the Broad Autism Phenotype Questionnaire (BAPQ), which measures how strongly they exhibit behaviors typically associated with autism. Higher scores on the BAPQ means they exhibit more autistic-like behaviors. It is hypothesized that if the participants that score higher on the BAPQ exhibit more social behaviors in a certain activity, then that activity will be more effective for children with autism. Results thus far indicate that an activity where the participants request an action of the ball shows the strongest correlation between high BAPQ scores and high numbers of social behaviors. In the field of autism therapy, it is hard to implement new activities and test them at the same time. If these activities are tested beforehand on children without autism and it is concluded that the activities will probably help children with autism, then they can be quickly implemented into actual therapy.

**Design of a Modular Energy Cell with Multiple Renewable Energy Sources**

Energy is a frequently discussed topic among today's leaders. As our society slowly switches from non-renewable to renewable sources of energy, many scientists are considering the efficiency and usefulness of each energy source. Different environmental factors will often contribute to which renewable energy source is most efficient in a certain geographical location. To that degree, every individual will have need of a different source of energy, depending upon their location. The purpose of this project is to create a modular device that will gather reasonable amounts of energy no matter what environment the device is located in. This device would have a universal base with a built-in lithium-ion storage battery. The base would allow the connection of several modular units that would produce renewable energy. Some of the modules include wind turbines, solar panels, a thermocouple unit, an electrochemical energy cell, and a handle for mechanical power given by the consumer. Different renewable energy modules will work differently in different environments. For example, during a hot desert day, solar panels will produce a large amount of energy. During the desert's cold nights, the temperature differential will allow a large amount of energy to be produced by thermocouples. In a cold, tundra area, solar panels will produce very little power, while wind turbines will produce great amounts. Depending on where an individual requires a quick source of energy, different sources will produce different amounts of energy. This device would have several primary uses, such as powering phones or GPS devices in emergency situations in the wild, bringing electricity to third world countries, or used as a backup source of small quantities of energy during power outages.

**The Effect of Stress on Memory in Teenage Girls**

Alzheimer's Disease is a progressive mental deterioration that can occur in middle or old age and attacks the brain's nerve cells, or neurons. This attack results in the loss of memory, thinking and language skills, and behavioral changes. The neurons which produce the brain chemical or neurotransmitter, acetylcholine, break connections with other nerve cells and ultimately die. It is estimated that about a half million Americans younger than age 65 have some form of dementia, including Alzheimer's disease. This study tests whether stress in a teenage girl's life leads to memory deterioration and a possibly a greater risk for developing Alzheimer's. In order to test this hypothesis, a significant number of teen girls will be given both a stress survey and a memory test. The results will be statistically analyzed and it will be determined if there is the expected negative correlation; the greater the stress, the lower the memory. Based on the findings from previous studies, higher amounts of stress may lead to a faster deterioration of brain tissue and trigger memory loss in teenage girls. If this hypothesis is correct, decreasing stress during teenage years could be crucial to decreasing memory loss and possibly preventing Alzheimer's Disease later in life.

**A comprehensive and Statistical Analysis of Parasite Population and Effect on Wildlife in Long Island Sound**

What will be investigated is the impact on the health, population and metabolism of invertebrates of Long Island Sound when infected by parasites. As well as the ecological impact that parasites have and their possible use as an indicator for pollution in the area. The motivation behind this is to improve the ecological health of Long Island Sound using evidence and data from research. Live organisms such as clams, oysters, mussels and other invertebrates will be used as test subjects. These organisms will be divided in controlled environments and observed. If parasites can be collected in the form of viruses, bacteria or other animals then they will be added to the environment, but some organisms will be contained within an enclosed environment away from these parasites. The effects in the metabolism of the infected organisms will be observed, as well as their response to changes in the environment. It is expected to find that, when infected with a parasite, the metabolic processes of the organism are weakened, and it cannot function normally. Changes in the environment will affect the infected organisms more severely than those who are not infected, as more resources are being used to account for the infection. Though, pollutants are also expected to lead to death in some cases, as infected organisms cannot withstand the pressure from pollution and infection. The implications of this proposal are to change the way that individuals behave in regards to the ecological health of Long Island Sound, as well as uncovering in greater detail the economic and societal effect that these parasites may have.

**Is Multitasking as Effective as People Believe?**

Multitasking is the process of performing multiple tasks at the same time. It is common belief that multitasking is more efficient than sequentially performing tasks, or completing multiple tasks one task at a time in succession. Some research has shown the multitasking efficiency belief to be a myth. Does a person's belief in whether they are a good multitasker correspond with their ability to multitask efficiently? This is the question I sought to answer in my experiment. My hypothesis was that those people who thought they were good at multitasking would indeed perform better than those who did not think they were good at multitasking. I created a test to analyze a person's multitasking ability and their ability to perform the same tasks sequentially and analyzed the results in conjunction with their own perception of if they thought they were a good multitasker. The data collected and analyzed does not support my hypothesis. Those that thought they were good at multitasking actually performed worse than those who thought the opposite. Since the results were close, the conclusion drawn from this experiment is that whether one believes they are or are not a good multitasker does not correspond as to whether they actually are. Since the results were close, the conclusion I draw from this experiment is that whether one believes they are or are not a good multitasker does not correspond as to whether they actually are.

**Friedman, Alexander**      **Project #74**

Health and Medical, Completed Project

**Can Chitinase Digest Peptidoglycan in Bacteria**

The question that is being studied with this project is to find out if chitinase or chitotriosidase can digest peptidoglycan in bacteria. Chitinase digests Chitin and Peptidoglycan is digested by lysozyme. Because the structure of Chitin and Peptidoglycan are similar, it is believed that the Chitinase will digest the peptidoglycan. This is important because it opens a new field of study which can lead to new antibiotics. Two different experiments will be done. First, the digestion of each chemical will be found. This will be done with all of the other chemicals to find the positive and negative controls by mass spectroscopy. With this experiment the digestion of the Chitinase in Peptidoglycan will be found. Then, a test will be done where the Chitinase is applied to the Peptidoglycan on a petri dish. This will be studied this under a microscope to see if it inhibits the growth of the Peptidoglycan. It is expected that the Chitinase will digest the Peptidoglycan. We expect to find qualitative data with the mass spectroscopy and the peaks of it can be studied and shown. Also, it is believed that the Chitinase will inhibit the growth of Peptidoglycan in different bacteria's on a petri dish. We expect to learn about asthmatics and Chitinase and we will see why more humans are developing asthma and prove why it is an adaptation to protect humans from bacteria. This will ultimately allow us to research and find out other ways that we can produce antibiotics. If the Chitinase can digest bacteria, then it will open up a whole field of study which we have not yet researched. It will also explain our evolutionary adaptation to develop asthma.

**Gamble, Christopher**      **Project #75**

Physical Science, Research Proposal

**The effect of Gold coated silicon nano particles in water**

In this world energy determines the cost of everything. My project has the potential to reduce this cost raising the standard of living for the entire populous. Step one Gather 6 200 ml Beakers Fill 3 with tap water and 3 will distilled water. then add in one tap and one distilled water 1 gram of nano-particles Repeat this process with 10 grams and 20 grams. Then place in equal amounts of sunlight and time the beakers till they steam. Measure the amount of steam produced. I hope to find that the steam produced is in large enough quantity to turn a turbine and generate electricity. If electricity can be generated this would mean that the base cost to do anything would decrease giving every one a larger disposable income. Also since this a green energy it would decrease our dependence on oil. Also since the way to generate power is rather simple this could easily built in developing countries and better their lives.

**Neural Entrainment Occurs Early in Life: An EEG study on Infants and Beat Perception**

Neural processing of music requires multiple sensory pathways, specifically the coupling of the auditory and motor systems. When listening to melodies, the motor system entrains to the underlying beat, causing the listener to move in synchrony with the rhythm. Previous studies have shown that underlying beat affects how adults move to music; however, the way adults move to a melody can also influence how they perceive the underlying beat. This study examines the influence of movement on neural entrainment to meter in young infants. It was hypothesized that the way a baby is bounced influences the perception of beats in an ambiguous rhythmic stimulus. The auditory stimulus can be grouped into sets of two or three beats (duple or triple meter). Each subject was bounced for two minutes on either every second beat or every third beat while he or she listened to the ambiguous rhythmic stimulus. They then sat on their mother's lap for two 9-minute blocks, listening to the ambiguous stimulus while EEG responses were measured. Steady-state evoked potentials (SS-EPs) were analyzed to determine how seven-month old infants encode meter; data was filtered at 0.5 Hz and 20 Hz and artifacts were removed. It was concluded that bouncing the infants did not strongly affect SS-EPs, however the hypothesis was supported since neural entrainment to meter was successfully measured across both bounce conditions. The data suggests that neural entrainment to the beat occurs early in life and plays a fundamental role in music processing. Research into rhythm processing pathways in the brain and the age at which these pathways develop holds greater implications for music rehabilitation techniques for individuals suffering from motor disabilities.

**The Effectiveness of Plant Material as Metal Chelators**

This project's goal was to find a chelator that could successfully remove arsenic/ copper chloride from water. It is important to investigate how to remove arsenic from water in order to save lives in many different countries. My Hypothesis was that chelator would purify the water very well and the 20g of the chelator would be at the optimal chelation level for one liter of water. I found my original data by putting a copper chloride solution in a beaker filled with cilantro or parsley and then would measure how much copper chloride is removed by using a standard curve. My upcoming tests would use different amounts of parsley and then test using a copper chloride solution which amount works the best. The results, include finding that both cilantro and parsley had very high chelation rates and worked effectively in water purification system. Overall, I learned that chelators could work effectively as water chelators. The trials and results proved that a possible eco-friendly and cheap solution to this problem could be using chelators such as parsley and cilantro. Investigating these chelators further such as seeing the optimal saturation for the chelation can help refine the chelation filtration system.

**The Effect of Soil Types on Coccidioidomycosis Rates in Arizona**

Coccidioidomycosis, also known as Valley Fever, is a lung infection that affects many people in the Southwestern United States. The infection is caused when the fungus spore called *Coccidioides immitis* is inhaled and settles within the lung tissue. *Coccidioides immitis* survives in arid soils, and can be brought into the air by wind, construction, and other human activities. If different soils are tested for the amount of clay, sand, silt, and organic material, then there will be a correlation between the percentages, number of spores present, and Coccidioidomycosis case rates in those areas. Arizonan case rates can be taken from the Arizona Department of Health services. Soil samples from different areas within Maricopa County, Arizona can be taken and tested for *Coccidioides* spores. Organic material will be found by weighing and burning the sample, leaving only the inorganic material behind (sand, silt, and clay). When placed in water, this remaining material will separate by mass. Qualitative observations such as texture, color, and particle sizes in the sample can also be used as data. This information can then be used to see if there is a correlation between the two factors. It is expected that soil with clay in it will contain the highest number of spores and relate to a high number of case rates. A statistical equation will be used support or reject the hypothesis. If the hypothesis is supported, then high-risk areas can be identified. This would lead to other states and regions being tested for soil composition to predict the risk of Coccidioidomycosis in a given area. Thousands are infected with Coccidioidomycosis each year, and this research will benefit those people and others living in the Southwest.

**The Working Memory of Mathematics Students Compared to Humanities Students**

The capability of short-term memory, also referred to as working memory, is the brain's ability to temporarily store information. This process varies among humans according to gender, age, occupation, or other factors. For example, in a 2011 study by Ammons Scientific, it was found that there is a significant difference between the working memory capability of males and females. This study will use the rule of  $7 \pm 2$  word chunks, the standard for short-term memory and quick conscious processing. A "chunk" is a unit of working memory space. The sequence of 3 1 7 5 is recognized as four chunks, while the four letter word DOOR or the number 2014 are recognized as one chunk because they are coded into one meaningful unit. The independent variable is the subject matter, either Mathematics or Humanities. The dependent variable is the working memory capability of the individuals. Humanities students will be expected to perform better on the working memory test rather than mathematics students, based on the previously mentioned study that showed math anxiety at a young age can cause students with strong working memories to not pursue mathematics. Possible implications for this study could be personnel selection processes and job-specific training methods can both benefit from the knowledge gained by this experiment. The working memory capacity of a mathematically-oriented student can be found to be inferior to that of the Humanities-oriented students. Thus, a company, whose tasks and work environment requires strong short-term memories, may choose to recruit from humanities-related fields, rather than mathematics fields.

## **Giebisch, Daniel & Gallant, Noah**

### **Project #80**

Physical Science, Completed Project

#### **Echocardiogram-Based Wireless Left Ventricular Assist Device (LVAD) with Mobile Application Monitoring and Control**

Recently, a wirelessly powered left ventricular assist device (LVAD), or heart pump, has been developed that increases patient mobility and eliminates blood infection risk. Unfortunately, the new circuitry does not yet include external monitoring or control of the wireless LVAD. Additionally, LVADs utilize a continuous flow mechanism that does not account for changes in a patient's heart rate, leading to cases of ventricular collapse. The focus of this research was to combat both issues by developing new circuitry and software that controls the LVAD's speed based on ECG signals and pairs the pump to a mobile device. To begin the project, research was done to find power-saving and space-efficient electronic components. Next, a physical system was designed to combine ECG monitoring, motor control, and bluetooth signaling. Then, the circuit board and mobile application were coded to send, receive, calculate, and display information. Finally, the new LVAD system was stress-tested for reliability. The mobile application successfully receives, analyzes, and controls the wireless LVAD. Additionally, ECG leads send signals that are interpreted to regulate the heart pump speed based on heart rate, reducing risk of a collapsed ventricle. This complete system demonstrates the possibility of complex, sensor-based mechanical medical devices that can be easily monitored and controlled by patients and physicians through mobile devices. Future experimentation will include further research for the consolidation of electronic circuitry into a smaller device and subsequent in vivo animal testing.

## **Gontzes, Alyssa**

### **Project #81**

Environmental, Completed Project

#### **Global Climate Change Affects the Ecosystem by Elevating Carbon and Nitrogen Emissions which Increases Allergies**

If time increases then, the number of allergy reports will increase. This is because, over time, if carbon dioxide increases in the atmosphere, plants will undergo more photosynthesis, thus there will be more plants to create a longer pollen season. Also, over time, if nitrogen increases in the atmosphere, plants will absorb highly nitrogen-concentrated water and undergo more photosynthesis, thus there will be more plants to create a longer pollen season. Finally, over time, if greenhouse gases increase overall, temperature and precipitation will increase, thus plants will grow faster, and there will be more plants to create a longer pollen season.

1. Gather data on the increase of carbon dioxide emissions through the time period of 1950-present using the following websites: [esrl.noaa.gov/gmd/ccgg/trends/](http://esrl.noaa.gov/gmd/ccgg/trends/), [epa.gov/climatechange/ghgemissions/gases/co2.html](http://epa.gov/climatechange/ghgemissions/gases/co2.html), [climate.nasa.gov/climate\\_resources/24/](http://climate.nasa.gov/climate_resources/24/), [climate.nasa.gov/vital-signs/carbon-dioxide/](http://climate.nasa.gov/vital-signs/carbon-dioxide/)
2. Gather data on the increase of nitrogen emissions through the time period of 1950-present using the following websites: [epa.gov/climatechange/ghgemissions/gases/n2o.html](http://epa.gov/climatechange/ghgemissions/gases/n2o.html), [ecy.wa.gov/programs/eap/Nitrogen/Trends.html](http://ecy.wa.gov/programs/eap/Nitrogen/Trends.html)
3. Gather data on the increase of global temperature through the time period of 1950-present using the following websites: [data.giss.nasa.gov/gistemp/](http://data.giss.nasa.gov/gistemp/), [nasa.gov/topics/earth/features/temp-analysis-2009.html](http://nasa.gov/topics/earth/features/temp-analysis-2009.html), [ucar.edu/climate/faq/how-much-has-global-temperature-risen-last-100-years](http://ucar.edu/climate/faq/how-much-has-global-temperature-risen-last-100-years), [climate.gov/news-features/understanding-climate/climate-change-global-temperature](http://climate.gov/news-features/understanding-climate/climate-change-global-temperature), [climate.gov/news-features/climate-qa/why-did-earth%E2%80%99s-surface-temperature-stop-rising-past-decade](http://climate.gov/news-features/climate-qa/why-did-earth%E2%80%99s-surface-temperature-stop-rising-past-decade), [epa.gov/climatechange/science/indicators/weather-climate/temperature.html](http://epa.gov/climatechange/science/indicators/weather-climate/temperature.html)
4. Gather data on the increase of global precipitation through the time period of 1950-present using the following websites: [epa.gov/climatechange/science/indicators/weather-climate/precipitation.html](http://epa.gov/climatechange/science/indicators/weather-climate/precipitation.html), [int-res.com/articles/cr\\_oa/c047p123.pdf](http://int-res.com/articles/cr_oa/c047p123.pdf), [ipcc.ch/publications\\_and\\_data/ar4/wg1/en/ch9s9-5-4-2.html](http://ipcc.ch/publications_and_data/ar4/wg1/en/ch9s9-5-4-2.html)
5. Gather data on the increase of (pollen) allergy reports through the time period of 1950-present using the following websites: [cdc.gov/nchs/fastats/allergies.htm](http://cdc.gov/nchs/fastats/allergies.htm), [cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=190306](http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=190306), [ncbi.nlm.nih.gov/pmc/articles/PMC3053965/](http://ncbi.nlm.nih.gov/pmc/articles/PMC3053965/), [worldallergy.org/pollen/index.php?region=all&country=all&infotype=all&language=all](http://worldallergy.org/pollen/index.php?region=all&country=all&infotype=all&language=all), [climate.nasa.gov/effects/](http://climate.nasa.gov/effects/), [ncdc.noaa.gov/data-access/paleoclimatology-data/datasets/pollen](http://ncdc.noaa.gov/data-access/paleoclimatology-data/datasets/pollen)
6. Gather data on the increase of (pollen) allergy reports through the time period of 1950-present at Mount Sinai Hospital in NYC by receiving reports from Dr. Rosalia Ayuso.
7. Gather data on the increase of (pollen) allergy reports through the time period of 1950-present at Mount Sinai Hospital in Elmhurst, NY by receiving reports from Dr. Peter Gontzes

**The effect of pCO<sub>2</sub> on a developing Oyster reef**

Oyster reefs, and more generally bivalve organisms play a crucial role in estuarine ecosystems. They filter the water by introducing calcium carbonate through the decomposition of their shells, reducing the general alkalinity of the water. Estuarine systems are vulnerable to seasonal runoff, are shallower, and less saline, they run a higher risk to atmospheric change of pCO<sub>2</sub>. It is important to research the potential effects pCO<sub>2</sub> on bivalve organisms to protect the Oyster industry and Estuarine ecosystems. If more pCO<sub>2</sub> is introduced, then Oyster reefs will grow at a slower rate because of the high concentration of PH. Small chunks of newly developed oysters from the Chesapeake bay will be collected, (approximately 8-10 oysters 4-5 weeks old). They will be placed into a quarantine tank with similar properties to the Chesapeake bay in the summer. Various levels of pCO<sub>2</sub> will be introduced into the tank every day. Growth/ mortality rates will be recorded and analysed by measuring the oysters carefully with a metric ruler. I hope to find that oysters introduced to higher levels of pCO<sub>2</sub> will have reduced growth rates and higher mortality rates. I also expect there to be less calcium carbonate output from the decomposition of the shells. Bivalve organisms control a huge part of inshore fishing industry, and dominate the ecosystem of estuaries. A better understanding of the effects of pCO<sub>2</sub> on bivalve organisms is needed to save estuarine ecosystems.

**The Effect of Celastrol Treatment on Social Symptoms Associated With Autism Spectrum Disorder (ASD)**

Autism is a spectrum disorder that affects one in 88 children in the United States today. Autism impairs a child's ability to communicate and understand emotion, relate to others, and makes environments like school and family situations very difficult not only for the autistic child but for those who care for the child as well. Past research in this field has suggested that compounds with antioxidative properties that initiate the heat-shock response in humans, specifically sulforaphane, improve social symptoms in autistic children. If celastrol is administered to ASD patients with moderate to severe autism, then Social Responsiveness Scale (SRS) scores will be decreased as evidence of improved social skills in the patients. Celastrol treatment will be administered orally at a concentration of 2.5 uM/L, which is the active concentration of celastrol, to Caucasian autistic males with moderate to severe autism and no active seizures or gastrointestinal difficulties. This study will be double blind and placebo controlled. The effect of the treatment will be evaluated by the patient's caregivers and physicians using the SRS and ABC scales at checkpoints during and after the 18-week-treatment span and then again four weeks after discontinuation of the treatment. The expected outcome of this experiment is that there will be improved SRS and ABC scores, therefore showing improved social symptoms in the patients. Human connection is extremely important for children, and has a larger significance for those with autism. By understanding what medicinal treatments improve social functioning in autistic patients, there will be a better understanding of the autistic brain's functioning. This knowledge will also allow autistic children to live more fulfilling lives academically and socially.

## **Gowda, Jethin**

## **Project #84**

Physical Science, Completed Project

### **Effect of Extreme Temperatures on Discharge Rates of Multiple Types of Batteries**

Throughout the past few decades, the consumption of batteries throughout the world has grown through the use of technology. Because batteries are used at varying capacities in different areas on Earth, it is important to know how different types of batteries react to extreme temperatures while in storage. Of the five battery types being tested, Nickel Cadmium, Lithium Ion, Nickel Metal Hydride, Zinc Carbon, and Alkaline, Nickel Cadmium was expected to be the least affected by the extreme temperatures. This experiment will measure the change in output voltage the batteries give off. The batteries will be put in environments that replicate room temperature (23 °C), and extreme hot and cold temperatures, at 70 °C and -24 °C respectively, for 15 minutes so ambient temperatures can equilibrate with battery core temperatures. Battery efficiency will be determined by seeing which battery's output voltage has the minimum change from the initial voltage test to the post-temperature test. It was found that every type of battery, while tested in the temperature conditions, was not majorly affected by the temperature. This is due to the minute change in voltages in batteries after being introduced to the temperatures. The results disprove the hypothesis, in that Ni-Cd batteries did not perform any better than other battery types. The results show manufacturers that they can use the battery types tested, without the worry of the batteries' output voltage deteriorating from exposure to the extreme temperatures. In addition, manufacturers do not have to worry about which type of batteries perform the most efficiently in extreme temperatures, since each test showed no significant difference in change of output voltage.

## **Granath, Will**

## **Project #85**

Environmental, Research Proposal

### **Exploring the Underlying Causes of Long Island Sound's Lobster Scarcity**

Lobsters have been in Long Island Sound for thousands of years, but now that 90% of the lobster population in the sound have died, they are threatened by extinction. Scientists have found that an epizootic shell disease is a possible suspect in the deaths, but are not sure how the disease is able to get past the formidable shell on these crustaceans. 50 Maine-area lobsters will be collected, 25 placed in a tank mirroring affects of global warming on Long Island Sound, 25 placed in a tank mirroring the temperature of the Sound 50 years ago when lobsters were plentiful. The shell eating disease strain found in the Sound will be injected into the 2 tanks. Lobsters will be observed daily. When a lobster dies, its shell thickness will be measured and a cause of death determined. The expected outcome of this research is that more lobsters in the tank mirroring the effects of global warming in Long Island Sound than those reproducing conditions of the Sound 50 years ago will die due to a decrease in shell thickness which allows for the shell eating disease to eat its way through the weakened shell and kill the lobster. This project carries huge implications due to the fact that hundreds of lobstermen have lost their jobs because there are very few lobsters remaining in the Sound. If this research gives scientists an idea how the shell eating disease is killing the lobsters, than steps can be taken to prevent the deaths of these lobsters, saving them, and the jobs of the lobstermen.

**Accurate Maximum Heart Rate Prediction**

Maximum heart rate (HR<sub>max</sub>) is an important cardiovascular measurement, especially during exercise assessment. Two formulas for predicting HR<sub>max</sub> are 220-age and Inbar;  $HR_{max} = 205.8 - 0.685(\text{age})$ , but there is little data to support their validity. The purpose of this study is to examine the accuracy of the two formulas. It is hypothesized that the formulas will not be accurate due to the variability within age groups. The second purpose is to compare the formulas on the stationary cycle ergometer or treadmill. It is hypothesized that the formulas will not be more accurate on the bike machine because the variability will not change. This study will analyze data previously collected in the human performance laboratory at SCSU. Specifically, the results of VO<sub>2</sub> max tests on healthy subjects on the stationary bike and the treadmill, which include direct measurements of heart rate. The accuracy of each formula in predicting maximum heart will be determined with error calculations. Results thus far show that on the treadmill, the original 220-age formula had a mean error of 5.1% and a range from 0 to 31.6 and for the Inbar equation, it had a mean error of 3.9% and a range of 0.02 to 26.4. Also, the correlation between both of the formulas and the actual heart rate was 0.195, accounting for only 3.8% of the variants in the actual heart rate. The current trends show that, so far the hypothesis is being supported in that the Inbar prediction formula is performing better than the original 220-age prediction formula, however, they both have high percentages of error because the age of the participants is not the only factor affected the heart rate, which makes the prediction formulas less accurate.

**The Effects of SLES on the Percent of Growth of Mint Plants**

Sodium Laureth Sulfate (SLES) is one of the most common materials found in most shampoos. It is a known skin irritant and is clinically proven to cause mutagenic effects in mammals. But, it is unknown how this chemical affects the growth rate of plants. It is hypothesized that if a mint plant is watered with at least a 5% concentration of SLES, then the plants percent of height growth will decrease. In this experiment, mint plants will be watered concentrations of 5% and 10% SLES every other day after the seeds have germinated (the seeds will be germinated using distilled water). The seeds are currently germinating so no results have been discovered yet. If the mint plants do show signs of stunted growth percentage, then further research could be done on finding alternative substitutes that could be safer for the environment. The percentage of growth on the mint watered with the SLES solution will be compared to the percentage of growth on the control group (watered with distilled water). SLES is expected to decrease the percent of growth rate in mint plants because of its negative effects on mammals. Above a 5% concentration of SLES in animals caused many side effects and even death (Skyler White, Livestrong.com). If SLES is that harmful to mammals, then it has to have some effect on plants. Sodium Laureth Sulfate is a chemical that is in desperate need of more research because of its prominent role in everyday life. This experiment is testing on plants mainly because all research has been done on SLES effects on humans. If it is discovered that SLES is harmful to plant life, then measures can be taken to ensure SLES is not seen in household products. Also, more research can be done to find cheap, effective substitutes for SLES.

**Gross, Jacob****Project #88**

Behavioral, Research Proposal

**Effect of Hours of Social Media Usage on Susceptibility to Email-Based Phishing Scams**

Phishing, or obtaining valuable and personal information through illicit means, can result in dramatic and devastating consequences. Through online social media, people may come into contact with strangers more often and lower their guard around them. It is hypothesized that if one spends more time on social media weekly, they will be more susceptible to phishing scams and have lower inhibitions regarding contact with strangers over the Internet. To test this hypothesis, I sent out an email to everyone in the study. It was from email.department.support@gmail.com and contained a message saying that there was a problem with an email account and a link to a webpage where they could log in. Soon after this email was sent out, the participants received a survey which asked them how they responded and about their media usage. Data collection is ongoing. I expect the analysis to show that there is a correlation between hours of weekly social media usage and susceptibility to email-based phishing scams. So far, participants with low social media usage (0-2 hours a week) had a low susceptibility to phishing scams. Students with a higher amount of social media usage (more than 2 hours a week) were more likely to fall for these scams. This trend shows that the more one uses social media, the more likely they are to fall for phishing scams. People who do use social media more often should take care to educate themselves about the dangers of phishing and how best to recognize and be aware of it.

**Grusky, Alexandra****Project #89**

Environmental, Research Proposal

**The Resistance of *Mercenaria mercenaria* to Quahog Parasite Unknown**

Quahog Parasite Unknown (QPX) is a protist that causes a fatal disease in hard shelled clams, *Mercenaria mercenaria*, throughout the East Coast of North America. The purpose of this research is to identify specific stocks of *M. mercenaria* that are resistant to QPX. Using multiple known genes that lead to a higher resistance in hard clams, the DNA microarray technique will be used to test multiple stocks of *M. mercenaria*. Stocks that have the genes will be identified as more resistant to the Quahog Parasite Unknown. Based on prior research, it is expected that stocks from regions with colder temperatures, such as Massachusetts, Nova Scotia, and New Jersey versus clams from the Carolinas and Florida will be more resistant to the Quahog Parasite Unknown. The deficit of hard shelled clams caused by Quahog Parasite Unknown has been a major issue to the fishing and aquaculture industries since the 1990's. The reason why some clams are more resistant to the disease is still unknown. The identification of QPX-resistant stocks of clams would expand and develop the quahog aquaculturist industry as well as lead to an explanation of this mysterious disease.

**Bisphenol A induces retarded migration of mature granule neurons in fetuses**

Bisphenol A (BPA), a weak estrogen, is a monomer commonly found in many plastics and epoxy resins and has been linked to many reproductive and neuro-developmental issues. Bisphenol A can pass through the placenta and is easily shared from mother to fetus, so does the amount of BPA a mother consumes cause neuronal abnormalities in the vulnerable fetus' brain? To simulate different amounts of consumption in humans, five groups of healthy, pregnant mice would be fed water with increasing bisphenol A contamination levels. The first group would be fed water with no bisphenol A to act as the control. Fetuses from each group would be sacrificed at different time increments and the granule neurons in their cerebella stained, western blotted, and examined. Previous scientific studies suggest that there will be a lessening of mature granule neurons as the amount of BPA passed through the placenta increases, or that there will be fewer granule neurons in general. Should these results occur, this would further support the growing concern over bisphenol A's biotoxicity and could even be another step in getting its use permanently banned.

**To Identify Fundamental Processes That Regulate Astrocyte Function In Glial Scars To Understand Pathology In Diseases That Inhibit Neuron Regeneration**

This study aims to identify fundamental processes that regulate astrocyte function in glial scars to understand pathology in diseases that inhibit neuron regeneration. We hope to learn about factors that regulate astrocyte behavior in glial scars and how this relates to the inhibited axonal regeneration seen in disease and spinal cord injury. This could lead to treatments for diseases like MS by changing astrocyte behavior and preventing inhibited axonal regeneration. Neonatal mice cortices will be dissociated and incubated in a flask until the astrocyte monolayer forms. A scratch assay will be performed. Measurements of the width of the scratch will be collected during regrowth. Immunocytochemistry and immunohistochemistry will be used to mark specific proteins during regeneration. An imaging analysis program will be used to collect data on quantities and types of proteins in the monolayer. Statistical analysis will be done.

**Identification of Immunogenic Mutations From Tumor Cells For Cancer Immunotherapy (By ELISpot Assay)**

The aim of this study is to determine which tumor cell mutations elicit specific immune response by using predicted MHC class I peptides from those mutations in an IFN $\gamma$ -ELISpot assay. If a mutation is found that elicits a strong immune response, the mutation will be explored more. The significance of this study is to improve and advance immunotherapy by identifying a handful of tumor-specific peptide targets that elicit an immune response. The data to be collected from ELISpot are the spots on each plate. Each spot represents one CD8+ cell that released a cytokine. The protocol for ELISpot is done over three weeks. The plates are sent to our ELISpot consultant. There, the spots will be quantified on a counter and the results will be sent back along with images of the plates. The data will then be plotted and analyzed to see if the immune responses for each peptide were significant. If the immune response for specific mutations are statistically significant, then the mutation will be further explored. The results hopefully will point to further avenues of research it will help determine which mutations to further test. This will potentially advance immuotherapy.

**The Effect of FGF2 on Hypoxia in the Mouse Brain: A Model for Human Perinatal Hypoxia**

Each year in America, 40,000 babies are born with very low birth weight. The lungs of these premature infants lack surfactant, a key component for lung development, which allows for proper oxygen exchange. Hypoxia in the brain results, causing decreased neuronal volume, ventriculomegaly, cognitive impairment, and developmental delays. This study sought to ameliorate the neural detriments that result from hypoxia in premature babies by stimulating interneuron growth in the brain. Mouse models of perinatal hypoxia were injected with fibroblast growth factor-2 (FGF2), a neural growth factor that was hypothesized to increase neurogenesis. Densities of parvalbumin-tagged interneurons were then counted in the dentate gyrus and cortices of the brain. These data were compared with densities of interneurons in hypoxic control mice without FGF2, and normoxic controls with and without FGF2. After primary and secondary cell staining, a StereoInvestigator microscope was used to count interneurons. It was determined that FGF2 did not significantly increase interneuron counts in hypoxic mouse brains. Further research towards regenerating neural cells could help thousands of premature infants who suffer from the effects of hypoxia.

**Quantifying the Efficiency and Economics of Novel Capacitive Wireless Power Transmitter Topologies**

First proposed by Tesla over a century earlier, wireless power transfer has undergone newfound interest in the last decade. In 2014 alone, sixty smartphones were released with wireless charging capabilities. As such, the efficiency and production costs of wireless power transfer systems has become a great concern. Capacitively coupled systems potentially offer greater efficiency and cost reduction compared to conventional inductively coupled systems, however are still plagued by relatively limited efficiency and high production costs. The majority of these issues stem from the transmitter driving topology, the full bridge. Alternative driving topologies, such as the half bridge, class E amplifier, and Hartley Oscillator, may offer advantages over the full bridge in these areas. The researcher aims to contrast the production costs and efficiency of the proposed topologies with the conventional topology so that the commercial benefits of each can be qualified. Four wireless power transfer systems, each implementing one of the topologies, will be designed. Theoretical calculations, simulations in LTSPICE, and prototyping will be used to determine optimum values. Afterward, the optimized designs will be constructed and their efficiency and BOM cost will be determined. This will determine the benefits, if any, of the proposed topologies over the conventional topology. Final results have not been completed, however initial results using LTSPICE have been generated, which will aid in the further refinement of the designs. Only the simulation and experimental results of the finalized design will be used in the discussion. The results of this research will be used to determine if the proposed topologies offer any sizable benefits over the conventional full bridge, and the applications to which each would be most suitable.

**Temporal Changes in the Vertebrate Scavenger Community in Association with Wildebeest Carcasses**

Approximately 7,000 wildebeests per year die while crossing the Mara River. Understanding when each scavenger species feeds adds to knowledge of how nutrients contained in carcasses are recycled to aquatic and terrestrial ecosystems. This study broadens our understanding of scavenger characteristics that permit access to different parts of the carcass at different times during the carcass decomposition. I hypothesize that different characteristics will affect the stages when scavengers are present. Pictures taken every fifteen minutes during the month of November 2012, using an automated game camera, were analyzed. Research in the field presented the date of the drowning event (time=0) and the approximate number of carcasses at the beginning of the photo series. I collected data on number of carcasses; number and species of scavengers; temperature and time of day; and length of time carcasses were accessible. Data collection has been completed, and the data is currently being analyzed. Trends thus far show patterns within the scavenger community. Marabou Storks were the most common vertebrates at the site of the carcasses overall. Night activity was greatest after birds had scavenged the carcasses for several days. Further analysis is still being conducted. Results from this study will help determine the course of succession that occurs in a scavenger community. In the future, these data can contribute to the knowledge of what happens when an organism dies and how something that affects one ecosystem can also affect the surrounding ones. The conclusions drawn in this study can be further researched to investigate the recycling of nutrients between two ecosystems.

**He, James**

**Project #96**

Behavioral, Completed Project

### **The Correlation of Written and Spoken Language Development With Reading Cognition**

Written and spoken language skills are essential for acquiring new information. While spoken language skills are innate, written language skills require proficiency in spoken language and professional guidance to develop. This experiment investigates spoken and written language skills of phonological processing, picture vocabulary, word reading efficiency, and IQ through standardized assessments. To investigate this matter, scores on standard assessments involving phonological processing, picture vocabulary, word reading efficiency, and IQ from previously gathered random sample pools of children from the New Haven community, primarily those at the kindergarten and first grade level (ages 3-7), are observed and analyzed to evaluate their language abilities. From this, the data will be organized into tables and graphs, and analyzed through group means of the assessments. Ninety-two children ages 3-7 were given the Woodcock Johnson test, CTOPP 2, TOWRE, WPPSI-IV, and WASI. Each participant received a raw score that was converted to a standard score that reflects their capabilities in phonological processing, picture vocabulary, word reading efficiency, and IQ. Preliminary analysis indicates that older subjects are more proficient in phonological processing than younger subjects, meaning that they can process individual pieces of speech, known as phonemes. From the data, we can compare the reading cognition of older and younger age groups, informing us of the developmental process for written and spoken language skills. A correlation between the data will be analyzed using statistical methods. By determining skills that different age groups are more proficient in, the development of written and spoken language skills is made clear and should be further researched.

**Henrie, Madeline, Pura, Lillian & Siciliano, Katherine** **Project #97**

Environmental, Completed Project

### **Using DNA Barcoding to Study Invasive Species on a Suburban Campus**

Invasive species can be a threat to biodiversity and are important to study in many locations across the country. Invasive species are plants, animals, or other organisms that are introduced to an area outside of their original location. They can harm their new environment because they have no natural enemies to limit their reproduction. They therefore usually spread quickly and widely. This study seeks to determine the prevalence of invasive species on a suburban campus and whether the distance away from campus will produce a greater number of invasives. It is hypothesized that the greater the distance away from the main campus, the greater the number of invasive species. This is because the main campus is manicured while farther away from the campus there are more natural wilderness areas and wetlands. DNA will be extracted from plant samples from 4 locations on campus. Multiple samples will be tested from each location. After extraction, the DNA will be amplified and the amplification will be confirmed through gel electrophoresis. The samples will be sent for sequencing and the results will be analyzed using an online database. If invasive plant species are found, possible implications will be to determine whether these species flourish in land least affected by humans. Knowing the extent of the invasive species in communities can allow us to take action to eliminate them. The next step will be to discover ways to remove or limit the invasive species.

## Hornick, Kyle

## Project #98

Physical Science, Completed Project

### Size Variation in Ichthyornis From Humeral Articulation Facet Measurement

Ichthyornis dispar and Hesperornis regalis are prehistoric avians that are part of the group Ornithurae. This group means “Bird Tails” and encompasses all modern birds as well as their close ancestors. These two no longer living birds are crucial in understanding the evolutionary history of Aves because they possess a unique trait; teeth which are positioned in the center of the beak. The goal of the research was to document and measure all fossil specimens within the Peabody Museum’s collection that were filed under the genus of Ichthyornis, a prehistoric bird that lived during the Cretaceous era. For each specimen, if possible, element, species name, age, locality, collector, date, and specimen number were recorded in a data table using Microsoft Excel. An additional measurement was taken from all elements identified as coracoids, a bone crucial to shoulder assembly in birds and most mammals. This measurement was the humeral articulation facet (HAF) and was measured by a digital caliper. The 19 recorded HAF measurements were entered into the equation  $e^{[2.44(\ln \text{HAF}) + 2]} = \text{body mass}$ , (equation originally created in Daniel J Field’s paper: Skeletal Correlates for Body Mass Estimation in Modern and Fossil Flying Birds, Daniel J Field, Plos One (2013)). The body mass estimations ranged from 73.9grams to 458 grams, a range below the expected average mass of 1000 grams. This research will advance understanding of Ichthyornis’ metabolic rate and locomotor function.

## Hovstadius, Malin

## Project #99

Health and Medical, Completed Project

### Stabilization of CXCR4 for Crystallization by Tyrosine Sulfation of the N-Terminus

G-Protein Coupled Receptors (GPCRs) are of great interest to researchers because of their pharmaceutical potential. GPCRs are integral membrane proteins and their primary function is to transduce extracellular stimuli into intracellular signals to produce cellular responses. Chemokines are a family of small cytokines that have the ability to induce chemotaxis in cells, and their receptors are GPCRs. CXCR4, a chemokine receptor and GPCR, is unstable in the body and thus is incredibly challenging to crystallize. This project aims to stabilize CXCR4 by tyrosine sulfation, a post-translational modification that strengthens protein-protein interactions accomplished by tyrosylprotein sulfotransferases (TPST), in order to create a sample for x-ray crystallography. Prior research results from 2013 indicated that mutating the tyrosines on the N-terminus of CXCR4 to mimic a sulfotyrosine doesn’t increase the affinity of the ligand, SDF-1, for CXCR4. This project attempted to co-express the TPST and CXCR4 to ensure sulfation of the tyrosines on the N-terminus of CXCR4. This plasmid was created by the methods of ligation and creating a megaprimer. Both E. coli and S. cerevisiae were transformed with the plasmid. Once the sequences were verified, a bioassay would have been done to determine the amount of binding between CXCR4 and SDF-1, and thus the stability. Due to the difficulty in verifying the plasmid and growing the cell cultures, this data was not obtained. However, this lack of data raises questions about whether sulfation occurs on CXCR4 and if it could be done without TPST, as well as whether research done in CXCR3, a very similar GPCR, is accurate for other proteins of the same class.

## **Howard, Katia**

## **Project #100**

Behavioral, Research Proposal

### **The Effects of Visual Appeal on Decision Making**

Decisions are made based on factors including mood, pressure, and biases. This experiment looked at what effect visual appeal has on the decisions that people make. It was hypothesized that when someone makes a decision, they will choose the option that is most visually appealing to them. If findings suggest that visual appeal has substantial effect on decision making, then visual appeal can be used to help people make healthier decisions. Subjects were divided into groups. Groups was given the choice between one food in two different packages, two different foods in the same kind of package, or two different foods in different packages. When two variables are present, meaning both visual appeal and preference, the outcome will reflect that one, or possibly both, variables affected the decision. Subjects were given a survey with questions to help better analyze results. Results so far have suggested that more than 75% of subjects made their decision based on snack preference. For those that only had one type of snack but in two packages, all but one chose the snack in the package that they found more visually appealing. Thus far, the hypothesis has been disproven. It is believed that visual appeal may have a greater effect on subjects who are younger. If the results had proven that people's decisions were affected by visual appeal, it could next be used to look at how changing food packages might aid children in making healthier and better decisions on a larger scale.

## **Jain, Anisha**

## **Project #101**

Behavioral, Research Proposal

### **Role Of Education Level Of Parents In Their Children's Academic Performance**

Scientists have shown that the socioeconomic status of the parents affects eating habits of their children. Children who have parents who have received a college education tend to eat healthy i.e., eat more vegetables and drink less sugary beverages as shown in a study done at University of British Columbia by Naseam Ahmadi, Jennifer L Black, Cayley E Velazquez, Gwen E Chapman, and Gerry Veenstra in 2014. Although the relationships of parent's education level and their children's health have been studied, the direct effect on the education of their children hasn't been studied to date. It is hypothesized that if at least one of the parents has a college level or higher education then their children will have a higher GPA in school. A questionnaire was handed out, to willing students, inquiring the profession of the parents, their parent's education level, the number of siblings, the number of parents they live with, what child they are in relation to their siblings (first, second, etc.), and their GPA. Initial data hasn't shown a strong association between the education of the parent and the students GPA. There was only one outlier which suggested that the hypothesis was correct. As more data is gathered, there is yet a possibility that may emerge. Implications of this research may be that teachers or school's guidance counselor could identify students early on who may struggle in the school based on the educational background of the parents. This research may also be stimulating students to consider higher level education and a college degree in regard to their child's education.

**The Role of the Genetic Transfer of Mobile Genetic Elements in the Evolution of Microbial Populations**

Traditional understanding of phylogeny has its basis in vertical inheritance, or the transfer of genes from parent to offspring via reproduction. However, recently horizontal gene transfer (HGT), or the transfer of genes from a donor cell to a recipient cell by any mechanism other than traditional reproduction, has been shown to occur with significant frequency as well, especially within prokaryotic populations. The sequences of genes that are transferred are known as mobile genetic elements (MGEs). It is hypothesized that if microbial species are closely related, then they will have a larger amount of shared MGEs. A group of 9,250 genomes were collapsed into 291 groups of 90% sequence similarity of the 16s ribosomal gene. These 291 groups were then compared to each other using Basic Local Alignment Search Tool (BLAST) algorithms and Perl and Linux coding to determine the amount of shared MGEs in each group. These bioinformatics techniques produced sequences of MGEs, which were then sorted and aligned to make a phylogenetic tree based on sequence similarity to show evolutionary relationships. This tree showed strongly supported relationships between MGEs coming from several different clusters of genomes. Sequences of MGEs from a cluster containing streptomyces, corynebacterium, arthrobacter, and mycobacterium were particularly pervasive, as they appeared in several different places in the phylogenetic tree. The diversity of relationships between MGEs of different genome clusters shows significant levels of interaction and gene transfer between prokaryotic organisms. The development of a phylogenetic tree based on HGT rather than vertical inheritance shows substantial genetic interaction between prokaryotes. Further research could explore the concept of HGT, potentially by examining the types of genes the shared MGEs come from. Additionally, a network of genetic relationships can be developed to provide a more 3-dimensional understanding of the relationships.

**Endothelial Function in Female Patients Presenting With Chest Pain**

Cardiovascular disease (CVD) mortality rates have declined steadily over the past few decades yet gender, socioeconomic and ethnic/racial disparities have not. African American females with Coronary artery disease (CAD) have higher mortality and morbidity under the age of 55. Possible reasons for disproportionate CVD risk in African Americans include sex-specific factors, higher proportion of diabetes and hypertension, delays in identification of higher risk individuals and limited access to medical care. African American women are also thought to have higher incidence of microvascular dysfunction (MVD) which is primarily related to endothelial dysfunction rather than advanced atherosclerosis. Endothelial dysfunction is a surrogate marker of atherosclerosis and has been shown to precede both angiographic and ultrasonic evidence of atherosclerosis. Whether there are race-based differences in vascular endothelial dysfunction amongst women presenting with chest pain remains to be seen. It also remains to be seen whether measurement of endothelial function can serve as an inexpensive and convenient method to flag high-risk patients. We therefore propose this study to measure differences in vascular endothelial function via flow-mediated dilation of the brachial artery in African American and Caucasian females presenting with chest pain. Data is currently being collected, and has yet to be analyzed. However past studies strongly indicate that African American females should be expected to present the most endothelial dysfunction. The results of this study have the potential to prevent many cardiovascular diseases such as heart attacks from occurring. It will allow doctors the opportunity to diagnose an at-risk patient early on, and treat them with preventative medication. Thus reducing the risk for disease and subsequently death.

**Juan, Avery Katherine &  
Miller, Emily Ann**

**Project #104**

Environmental, Research Proposal

**Using Differences in Beetle Population Biodiversity in Urban, Rural, and Suburban Locations as an Indicator of Overall Biodiversity**

Studying beetle population biodiversity is important because beetles are decomposers, an important role in the environment. It is therefore necessary to know the effect of human activity on beetles. The hypothesis of this study is that the biodiversity of the *Nicrophorus* genus beetle will be lowest in fragmented areas. It is also hypothesized that in the areas of low beetle biodiversity, the environment in general will also have a low biodiversity. Two traps will be set out in each of three different locations (rural, suburban and urban). The traps will be left out for twenty-four hours and then the beetles in the traps will be counted and identified. Berlese funnels will also be used to count the number of microarthropods in the soil to help detect overall biodiversity. It is expected to find a differing biodiversity in the three locations. In rural locations, a high biodiversity of *Nicrophorus* genus will be found. In urban locations, a low biodiversity will be found. We also expect that where there is a high diversity of beetles, the environment as a whole will have high biodiversity. Future research includes comparing the beetles found in this study to the beetles stored in the affiliated research institution, in order to see how the population has changed over the years. Another experiment to test whether other insects could signal the biodiversity of its habitat will also be conducted.

**Kachru, Ananya**

**Project #105**

Behavioral, Completed Project

**Lifestyle Effect On GPA**

The objective of this research study was to prove that good diets influence grades. This experiment was done to inform students about the possibility of their daily lifestyle choices improving or deteriorating their GPA. The hypothesis was: If a good diet and healthy lifestyle is followed, then GPA will accelerate/ remain high. The independent variable is the type of lifestyle followed, and dependent variable is GPA obtained. This study was centered around analyzing results from two surveys: "Rate Your Diet" and "Healthy Life-Style Assessment" along with levels of students' classes and their GPA. Participants in this study were students from Amity High School, ranging in age, and of both genders in order to collect a variety of data. To establish a link between diet and GPA, the lifestyle and performance of various high school students was evaluated. The combined lifestyle score from Rate Your Diet Survey and Healthy Lifestyle Assessment, compared to each student's GPA. The classification of GPA level was done using the criteria for most public high school honor roll's, requiring a GPA of 3.5 or above to be classified as satisfactory. After analyzing the data collection, it was found that the majority of participants show a relationship between their daily lifestyle and GPA. The preliminary data is the first step in enforcing the ideal of healthy lifestyles leading to better academic performance. Further avenues of research can examine if certain aspects of a healthy lifestyle have greater influence on scholastic achievements. Future research can be done to prove whether exercise and prevention have a larger impact on school performance than diet. This should be pursued as it would open awareness to students.

**Engineering of ZnO Tapered Pillar Nanostructures as Antireflection Coatings on Silicon Solar Cells**

Reflection loss of light from solar cells is a major limiting factor of solar cell efficiency. Traditional quarter-wavelength transparent anti-reflection coatings (ARCs) are not always reliable over the whole solar spectrum or at high angles of incidence. A promising avenue of research is fabrication of moth-eye inspired nanostructures of tapered pillars. These structures gradually decrease the refractive index from the surrounding air to the solar cell material, minimizing reflection losses. Specifically, ZnO nanostructures (NS) can be used to provide a low-cost, low-temperature synthesis that can be easily scaled to industrial levels. The AR layer will be developed by varying the conditions of solution-based growth of the ZnO NS. From past simulations, it is expected that nanostructures of highly tapered shape will be most efficient for antireflection. Also, NS of length below 1  $\mu\text{m}$  are expected to have higher transmission than those of length above (absorption of light by the NS themselves). A pilot study has found that NS of length  $\sim 1\mu\text{m}$  can be grown on glass slides, forming an ARC, with decreased optical reflection from a polished silicon surface. This study aims to optimize the ZnO nanostructures (NS) for a broadband, omnidirectional antireflection (AR) scheme. The methods to be developed will easily scalable to commercial use, due to the relatively low temperatures and the solution based synthesis.

**Allergic Rhinitis: a Possible Way to Decrease its Symptoms**

This proposal is on creating a way to decrease or stop the effect of symptoms from pollen allergies, specifically ones that cause allergic rhinitis. Can there be a reactant that can cause the immune system to ignore the pollen allergen? Pollen allergies are caused by the seeds in any other botanic organism that reproduces through pollination. The body's immune system has many different cells that help fight diseases and bad bacteria (pathogenic) that makes you sick. The first time the body comes in contact with the allergen, the Th2 cell (a white blood cell that is a big part of the immune system) is given a copy of the allergen and IgE antibody cells will be made. The second time the allergen enters the body, the IgE antibodies bind to it and release histamine, the cause of allergic reactions. The closest variation to wiping out pollen allergies are vaccines that only act to make symptoms less worse, rather than totally getting rid of the allergy itself. Instead of a vaccine, there should be an easier, relaxed way to relieve allergy symptoms. This proposal is on creating a way to decrease or stop the effect of symptoms from pollen allergies, specifically ones that cause allergic rhinitis. Pollen allergies are caused by the seeds in any other botanic organism that reproduces through pollination. The body's immune system has many different cells that help fight diseases and bad bacteria (pathogenic) that makes you sick. The first time the body comes in contact with the allergen, the Th2 cell (a white blood cell that is a big part of the immune system) is given a copy of the allergen and IgE antibody cells will be made.

**Hand Exoskeleton for Osteogenesis Imperfecta**

Osteogenesis Imperfecta is a genetic disorder causing bones to break easily, often under little or no stress. This means that even the easiest tasks are hard for someone with this disease. Picking up a cup the wrong way could end in a bone fracture. My motivation for making an exoskeleton for a hand is to help participants specifically with Osteogenesis Imperfecta (Brittle Bone). My approach for making an exoskeleton for someone with Osteogenesis Imperfecta is to do tests to see what material would be the most useful for creating it. This material would need to be moveable and could not rub or irritate the patient. I hope to find that making an exoskeleton for someone who has Osteogenesis Imperfecta will help them do everyday activities without putting much strain on the bones causing them to fracture. By creating an exoskeleton for someone with this Osteogenesis Imperfecta It will be able to make everyday activities easier, because every day activities for someone with this disease is very hard. Doing what we think as easy activities like doing laundry or going grocery shopping is very difficult. This exoskeleton would make it easier.

**MLA Efficiency in P300-based BCI's**

Ever since I was little I have always wondered what we can do with computers, and how they help people. I had the same fascination with the human brain. My continued dual interest led me to current research being performed on Brain Computer Interfaces. How can newly developed machine learning algorithms be implemented to efficiently translate human brain waves into action by a P300 based BCI(prosthetic arms, legs, etc.)? A series of machine learning algorithms will be conducted by giving 5 amputee human test subjects a series of small tasks using a BCI(Brain Computer Interface) prosthetic arm. Each BCI will be running off a different programmed algorithm. The reaction time and overall efficiency of the BCI's will be recorded and compared for the most efficient BCI's. I predict that the with a most efficient machine learning algorithm, translation time between thought process and computer programming code can become minimized. I expect to learn which of the algorithms will be the most accurate and efficient, for future use in working BCI's that can be used for people of neurological impairment. The implications of this research can point towards how to create more efficient BCI's fit for use by neurologically impaired people, amputee victims, war veterans, etc. This research can help make the lives of people who suffer from neurological problems easier and make the understanding our knowledge of the human nervous system through the use of computer science.

**Effects of combined or individual expression of FOXO transcription factors to regulate cell cycle checkpoints by targetting genes in hematopoietic cells**

Cell multiplication that is not halted by the usual checkpoints on DNA-damaged cells is a hallmark of cancer. FOXO transcription factors increase apoptosis and cell cycle arrest, actions which increase in cells with damaged DNA. The purpose of this proposal is to identify which FOXO isoforms and their respective target genes work in conjunction or individually to enforce cell cycle arrest in hematopoietic cells. The PI3k/AKT pathway inhibits FOXO. PTEN forced expression will be used to suppress PI3K in hematopoietic cells, and the predicted enhancement of FOXO expression will be confirmed by immunoblot. The levels of proteins such as cyclins, that alter cell cycle progression and are predicted targets of FOXOs, will be assayed similarly before and after PI3K inhibition. Inhibition of specific FOXO isoforms will be done to test each individually. It is predicted that the combined effects of all three active FOXO transcription factors will greatly increase the cell cycle arrest in hematopoietic cells versus each transcription factor alone. These results should show an increase in p27 and Bim and a decrease in D-type cyclins. The reduced cell cycle activity will be shown in reduced cell proliferation levels measured by BrdU incorporation assays before and after changes in FOXO expression. The effects of FOXO1 and FOXO4 in combination with FOXO3a may regulate multiple targets in the cell cycle. Treatments currently exist that inhibit tumor growth by increasing Bim expression through upregulation of FOXO3. Findings from the proposed research could lead to the development of therapies that activate all three FOXO transcription factors to more effectively impose cell cycle checkpoints in cancer cells.

**The Relationship between Migraines and Dreams**

This study aims to investigate the effects different migraine headaches have on the dream content in diagnosed individuals. The pathophysiology of migraines is mostly unknown to neurologists in the field. By comparing the dream content of migraineurs vs. non-migraineurs a better understanding of migraines can be formulated. To test the dream content, a questionnaire was given to patients diagnosed with migraines and individuals who have not been medically diagnosed with any type of persistent headache. The questionnaire determined, age, sex, type of migraine and the presence of an aura. Additionally, the questionnaire determined the frequency of dreams, the most prominent emotions felt and a description of dream content on a night where the individual went to sleep or woke up with a headache versus a night without a headache. The data collected compared the dream content of migraineurs against the dreams of the control through means of statistical analysis. This determined if migraines have a major effect on dreams. Additionally, the study compares the dream content via age, gender and type of headache to create a broader understanding of migraines. A prevailing theory in the field of neurology regarding migraines is that the headaches originate from an imbalance of neurotransmitters in the same region of brain where dreams are thought to occur. If the results from this study show that the dream content of migraineurs is significantly different from the dream content of non-migraineurs, it would shed light on migraine pathophysiology and allow researchers in the future to pinpoint exactly why and how a migraine occurs.

**Khan, Owais &  
Golbazi, Arvene**

**Project #112**

Physical Science, Completed Project

**Exploring the Effects of Ammonia on the  
Electrical Resistivity of Graphene**

The problem being addressed is to find whether graphene has the ability to detect exceedingly low molecular concentrations of toxic chemicals like ammonia with a change in its resistance. Due to graphene's extreme electrical sensitivity when exposed to foreign molecules, we hypothesize that graphene will show a change in electrical resistivity when introduced to extremely low concentrations of liquid ammonia. To perform the experiment at an electrical engineering lab at the University of New Haven, the experimenters will expose individual, multilayered sheets of graphene (from the laboratory) to liquid ammonia concentrations (10 microliters, 15 microliters, 20 microliters) and measure the change in resistivity using attached electrodes from a digital multimeter. Afterwards, the sheets will be replaced, and at least 3 more trials will be conducted for each concentration. Additionally, the ammonia will be removed from the experiment for control trials. Projected results will most likely show that the ammonia will cause a change in the graphene's resistivity when compared to control trials. This change in resistance would most likely be due to graphene's extremely high sensitivity when exposed to foreign substances. Anticipated results show graphene's fluctuation in resistivity from the initial trials, indicating its use as an extremely efficient nanosensor capable of detecting toxic gases at concentrations where most conventional sensors fail. The detection of liquid ammonia could be applied to diagnose many gastrointestinal diseases which increase the presence of ammonia in the body.

**Khani, Nikzad**

**Project #113**

Health and Medical, Completed Project

**The Effect of Different Sandpaper Grits  
on Bacteria Colonization**

This experiment is based on Sharklet Technologies and their studies on shark skin and its anti-bacterial properties. Sharklet Technologies used different patterns at a nanoscale to find the most efficient pattern at sterilization. On a micro-scale, sandpaper can replicate the patterns tested, so experimenting the effect of different grits of sandpaper on bacteria growth will show which patterns will prevent the most bacteria colonization. The experiment calls for a control variable without sandpaper and two grits of sandpaper made by the company 3M, the P1500 and P2500. Bacteria will be swabbed off of the sandpaper and onto a petri dish after the sandpaper has been laid out on a flat surface for 24 hours. Three trials will be conducted to increase the accuracy of this experiment. For the control, bacteria will be swabbed off a smooth surface. The conclusion of this experiment will result in the finer grits of sandpaper having the most prevention of bacterial colonization while the control will have the most colonization of bacteria. The bacteria will be stuck in the sandpaper's valleys, so they won't be able to reproduce successfully which is optimal for bacteria colonization. This shows that technologies such as nanotechnology will be more effective in anti-bacterial patterns compared to patterns manufactured through microtechnology. Creating a sterile pattern will be highly beneficial to the world, the pattern that grew the fewest bacteria can be used to prevent bacteria-borne diseases in areas that have high amounts of bacteria such as phones, door handles and in hospitals. The pattern can also be adapted to fit on different materials such as glass, plastics and metals for further use on furniture and appliances.

**The Relationship Between Brain Dominance and Visual Information**

Whether left or right brain dominance and visual information are related has been an ongoing question for scientists and researchers alike. Does brain dominance affect the way an image is seen? In this project the independent variable would be the side of the brain more dominant in each participant. The dependent variable would be the first perception of the images the participant sees. It is hypothesized that brain dominance does have an effect on visual perceptions. Students in various classes took a questionnaire which was checked to figure out the brain dominance of the participant. After answering the questions the students looked at three different pictures and wrote down what image they saw first. The first is a picture of both a young girl and an old woman, the second is a saxophone player and a woman's face, and the last is a video of a cat turning in a circle. The primary results recorded show that most participants were right brain dominant. Those students had all answered "young woman" for number one; however, so did the other left dominant participants. Many had answered "both" for question two and the others said a woman's face or saxophone player. For the last question about the turning cat, the majority said counterclockwise and the remaining said clockwise, including a student who said they could control the direction immediately. In conclusion, the data this far shows no association between brain dominance and visual information. It opposes the hypothesis which states that there is a relationship. This information can be used to help teaching methods to advance. Many teachers may use brain dominance to help certain kids with their studies. Now school systems will be able to improve the way students learn with this knowledge.

**The Relationship of Major Vein Density on Leaf Size and Shape in the Plant Genus Pelargonium**

I will be researching how major vein density relates to leaf size and shape in the plant genus Pelargonium. It is known that major vein density decreases as leaf size increases but only for similarly shaped leaves. To see how different shaped leaves relate I will be working with the high diverse genus Pelargonium. This study is important because it can help explain biogeographical plant trends. I predict that leaf shape will effect the secondary major vein density at a different rate than the primary. I will be using photos of the leaves that were taken from South Africa. The major veins will be labeled in Photoshop and measured for length in ImageJ. The major vein density collected along with previously recorded data will be run in regression test and analyzed. Previously recorded data include leaf length and width, stomatal density and leaf dissection index. I have not finished my research yet, so I do not have any results. If there is indeed a correlation between the leaf traits then my next step will be to make leaf clearings. With the leaf clearings I can measure the third order major vein density. This can further support my previous findings and help explain evolutionary questions.

**A Method for Improved Gluten Extraction from Flour**

This experiment is being done as an attempt to find a more effective method of gluten extraction from wheat. With the rise in popularity of gluten-free foods, an improved method could be greatly helpful to companies who produce this kind of food. I will test the effectiveness of mixing the enzyme Pancreatin, due to the nature of an enzyme and the natural presence of Pancreatin in the body, in the with the flour before extraction to make the gluten extract more easily. I will test this by observing the flour on an SDS PAGE before and after extraction, to see if any gluten is present on the gel. If less gluten is present on the gel after extraction for the solution with the enzyme than is on the solution without the enzyme, then I will know this technique is effective. I hypothesize that this will be effective because of the enzyme acting on the flour.

**The Effect of Different Zirconium Isotopes Conjugated to Fresolimumab on Tumor Size**

Cancer tends to be extremely difficult to treat because it is a mutation in somatic cells that can keep mutating and multiplying while simultaneously managing to keep immune cells from fighting it. Immunotherapy is a treatment for cancer uses enhanced antibodies to specifically target cancerous cells. Chemotherapy is a treatment for cancer that introduces toxic substances into the body to eliminate cancer cells; although effective, chemotherapy is difficult to control. If chemotherapy and immunotherapy are combined into one treatment, will it be effective? Fresolimumab is a monoclonal antibody used against melanoma and kidney cancers. Benign melanoma and kidney cancer cells would need to be grafted into mice of the same gender, age, species, familial history, and medical phylogeny. Radioisotopes 86-89, 93, and 95-97 need to be separately conjugated to Fresolimumab, subsequently each conjugation would be injected into the mice. Each mouse would receive one form of the conjugation. PET scanners would monitor tumor size. Not Applicable. Almost everyone is affected by cancer in some way, either personally or by association. This experiment will determine if radioimmunotherapy is more effective than traditional treatments of cancer. A more effective treatment of cancer will produce higher survival rates among cancer patients.

**The effect of the winter drawdown on the fisheries of Candlewood Lake**

Every other year Candlewood Lake has a drawdown of 10 feet to kill off invasive species. Over winterization is when more of a species is killed in the drawdown than intended. My experiment is to test if the fisheries of Candlewood lake are being over winterized. Ideally the population would not be harmed but that is not possible. The ideal would be for the population to decrease as little as possible. I am planning on collecting data on the number of bigmouth bass before a large drawdown and after the large drawdown. I will then compare how many fish have survived the winter. I expect to find that the drawdown causes some population decline but not enough to cause a huge effect on the population number. I also think the fisheries will offset the difference. If too many fish are killed then the ecosystem of Candlewood Lake will be disrupted and damaged.

**Honey as an Alternative to Antibiotics**

Antibiotic resistant bacteria is becoming a growing concern. Superbugs are becoming more common due to the overuse of antibiotics. This poses a serious health threat to the public. This has led scientists to look for alternatives. Honey offers an alternative to antibiotics. Honey has three components that allow it to kill the bacteria. The three components are its low ph, high osmolarity, and the production of hydrogen peroxide. In the experiment I will be comparing the antibacterial activity of multiple types of honey against *Staphylococcus aureus*. I will measure the inhibition zone of the bacteria in order to compare the effectiveness of each type of honey. It is expected that Manuka honey will have the largest inhibition zone. Many studies point to Manuka honey consistently having high antibacterial activity. If the most effective type of honey is found, then more research can be done specifically with that type of honey. If honey is accepted by more of the medical field, it could become a powerful alternative to antibiotics. Honey could kill bacteria that had previously been resistant to antibiotics.

**Lucid Dreaming**

I predict that the majority of people cannot lucid dream, but will be able to do so if they are given the proper training. I've always been interested in lucid dreaming since I have done it a few times. It is very intriguing way to dream and I want to understand it better. I also want to know if there are many real world applications of lucid dreaming. Since I cannot use human test subjects, I will send out a survey to ask if people can lucid dream. I expect to get the majority of results being that most people can not naturally lucid dream. I then want to send the people who cannot lucid dream various techniques in which to induce lucid dreaming. I then want to send out a second survey to see how many more people can lucid dream now. This is to test the effectiveness of the lucid dream induction techniques. The techniques used in my experiment have been approved by various researchers in the field, as well as the researcher I hope to make my mentor. I expect to see a noticeable increase in the number of people who can lucid dream after training. The lucid dream induction techniques have been proven to work on handpicked subjects with high IQ's or other specialities concerning intelligence or overall cognitive capability. I will be testing the general public, to see if the same results are yielded. If this experiment indeed proves that people with average intelligence are able to lucid dream by using the mind techniques, then the subject pool for further experiments can be broadened. As it is now, experiments concerning lucid dreaming have around thirty participants, and this could increase the subject pool. A larger subject pool can add to the accuracy of the findings.

**The Synthesis of Copper Aerogels Using the Nano-smelting Process for use in Electrical Wiring**

The purpose of this experiment would be to design a highly conductive metal aerogel for use in electrical appliances and wiring. I believe that a copper aerogel would be a very effective conductor thanks to the metals high conductivity and the high surface area of aerogels. My motivation for this experiment is my interest in aerogels and applying them to the real world. The first step in the experiment is to design a copper oxide aerogel using sol gel chemistry. The gel would contain a Carbon based polymer and Copper Oxide. Then the gel would need to be supercritically dried to form a Copper Oxide aerogel. This Copper Oxide aerogel would then need to have the Oxygen taken out of it to leave just the Copper behind. To do this, the aerogel would be subjected to extreme heat, forcing the polymer to burn away, just leaving the Carbon which would bond with the Oxygen in the aerogel, separating it from the aerogel. The new Copper aerogel would then need to be formed into a wire. The use of the nano-smelting technique to create metal aerogels has been successful. Iron aerogels are the most notable type made in this fashion. Also, the synthesis of copper aerogels has been successful when using copper nanowires. Although, the process to make the aerogel applied in this experiment is different and the structure of the gel is also unique. There are multiple implications of this research. First of all, it would help to make electronics more effective. Also, copper aerogel would be a lighter form of wiring than traditional materials, lowering weight of any thing it is applied to. This would give it a large advantage over other materials in objects being sent into space, as it is very expensive and lower weight means lower fuel usage, thus, lower costs. Finally, research into how to develop copper aerogel could potentially improve the current knowledge on how to synthesize metal aerogels, which could be used in countless other possible applications.

**Selecting for Roundup Resistance in Wisconsin Fast Plants**

This experimental proposal seeks to study the growing number of herbicide resistant plants by attempting to demonstrate that resistances can arise in populations within 3 generations of plant growth. If Wisconsin Fast Plants are grown in the presence of Roundup then the population will gain a resistance to it over the course of 3 generations. It will be attempted to grow Wisconsin Fast Plants with and without the presence of the Roundup herbicide, cross-pollinating within the experimental and control groups in order to simulate enclosed populations. Once 3 generations have been grown in both groups, offspring from both groups will be grown in Roundup in order to prove that any survivors from the experimental group survived due to their resistant genes. The data will consist of the average number of petals, average height at pollination, and number of offspring for each pod during the experiment. The data between the experimental and control groups will then be compared in order to identify whether or not the experimental group is becoming more stable as time goes on. Should the results show that a population of plants can generate a resistance and spread within 3 generations, farmers will have to either increase their application size or look into alternative methods of pest control since resistant groups are appearing within a short time. These results can then be used to examine whether environmental factors such as soil pH could contribute to the rate of resistant gene adoption.

**Effects of Iron, pH, Sunlight, and Mixing on the Growth of Algae**

Finding which factors between Iron, Sunlight, pH of solution, and mixing the solution effect the growth of algae the most in order to increase the intake of CO<sub>2</sub> by the algae to reduce the levels of CO<sub>2</sub> in the atmosphere. Conduct an experiment using both some and none of a factor, effectively deciding whether or not it increases the growth of the algae. Also, measure the physical growth of the algae to see which factor effects it the most. I have not started my research as of now. I will use my findings in order to determine which factor should be added to the ocean in areas of high concentration in order to get the most productive growth.

**Effect Of Using A Computer On Memorization**

More technology is being used in the world. Much of it has practical uses which benefit everyday people. Students are one affected group. With the plethora of new technologies available, it is becoming significantly easier and more common for students to use their computers to study, rather than using paper. This experiment studies whether or not using a computer to study helps students memorize more material compared to paper. The experiment has participants memorize one-word definitions for 15 made-up words on a piece of paper. After 5 minutes of studying, the students are asked to fill in definitions for the words, which would be written in a different order. The above process is then repeated with a different set of words written on the computer. A third quiz is given without prior definitions as a control. Early trends in results show that using a computer does have an effect on how much information a person retains, nor does it detract from it. The number of words memorized for both were around the same number. Whether or not paper or a computer was used to study, the participant retained the same amount of information. At this time the data shows that using a computer to study is not detrimental, nor is it beneficial. Technology does, however, have the advantage to be readily accessible in many locations. While it does not improve how effective studying is, I'm interested in researching how it may affect other things people often do.

**Deciphering the effects of aerobic glycolysis of tumor cells on host anti-tumor immunity**

In the presence of sufficient oxygen (normoxia), normal cells consume glucose by engaging oxidative phosphorylation (OXPHOS) a highly efficient metabolic pathway that produces 36 ATP. In contrast, normal cells produce only 2 ATP and Lactate through the inefficient metabolic pathway of glycolysis in the oxygen-deficient condition. Interestingly, despite aerobic conditions, cancer cells engage a similar glycolysis pathway (aerobic glycolysis) to maintain their energy demand and proliferation. The goal of this study is to determine examine whether tumor cells possess distinct metabolic features (aerobic glycolysis-dependent vs. oxidative phosphorylation-dependent) that have different effects on suppressing anti-tumor responses. To do so, we will use tumor cell engraftment to compare the immune response of tumors that possess different reliance on aerobic glycolysis and oxidative phosphorylation. qPCR has been conducted and results are currently being analyzed. Seahorse analysis and FACS analysis will be conducted. Data are anticipated to show a strong correlation between higher levels of aerobic glycolysis and suppressed host antitumor immunity. The information gained from this study may lead to a new venue of therapies combining drugs to target cancer metabolism and boost host anti-tumor immunity. If this metabolic activity is identified, then it could be targeted to boost antitumor response.

**Li, Catherine**

**Project #126**

Health and Medical, Research Proposal

**Combination of alpha-mangostin and piperine inhibits intracellular fatty acid synthase, modulates NF-kB and P13K/AKT, and induces apoptosis in breast cancer cells**

Breast cancer is the most common cancer in women worldwide. The human body rapidly develops resistance to multiple cancer drugs, and such treatments also have high toxicity and unwanted side effects. The purpose of this experiment is to co-administer phytochemicals to enhance their bioavailability, to inhibit certain pathways significant in the development of cancer (NF-kB and P13/AKT) and to develop an improved or alternative treatment for the disease. Alpha-mangostin will be coadministered with piperine and treated on human breast cancer cells to enhance its bioavailability in the human body and apoptotic effects on carcinogenic cells. The cancer cells will be incubated in varying concentrations of the solution for 24 and 48 hour periods. Immunoblot analysis will monitor cell signaling pathways, FAS expression level, intracellular fatty acid accumulation, and apoptotic effects by also using a CCK and FFAQ. Alpha-mangostin will exhibit cytotoxic effects on MDA-MB-231 breast cancer cells, and the addition of piperine is expected to increase its bioavailability. This will be shown through elevated levels of PARP protein expression and an increase in the Bax/Bcl-2 ratio, which will favor apoptosis. Growth will be suppressed, and apoptosis will be induced due to a decrease in intracellular fatty acid, silence of FAS, and modulation of P13K/AKT. Alpha-mangostin and piperine are promising agents for chemoprevention/chemotherapy of cancers because they are dietary components, relatively non-toxic, inexpensive, and consumption of them can easily be adopted into lifestyles. The results will show their inhibitory effect on carcinogenic cells to have a therapeutic potential, and demonstrate that they have the novel means of controlling breast cancer. Thus, these compounds can be further explored for prevention and treatment for breast cancer.

**Liang, Kimberly &**

**Zhao, Kevin**

**Project #127**

Physical Science, Research Proposal

**Unmanned Aerial System Challenge: Precision Pesticide Application**

Within 40 years, approximately 9 billion people will be on Earth. Thus, it is vital to provide a sufficient quantity of high quality food. The team, Amity Aviation 1, will use unmanned aircraft systems (UAS) or UAS paired with unmanned ground vehicles (UGV) to apply a fluid pesticide, SOLVITOL, across 1 square mile to eliminate a target pest. Over the course of five months, the team will create a novel solution that significantly reduces the volume of pesticide and application cost with an improved productivity, while also demonstrating the end profitability of the business concept. To accomplish this solution, the team will designate a target crop, location, and application method based on the proposed system design. Since this is an engineering project, the team will follow an engineering process. The six-step cycle is as follows: analyze needs and requirements, brainstorm, analyze alternatives and down select options, create a detailed design, validation and testing of the system, and life cycle support. Thus far, the team is nearing the end of the brainstorm phase and preparing to analyze and alternatives and down select options. The final solution will be presented for a panel of judges and conveyed through an engineering notebook in March, 2015. The final solution will be capable of aiding in maintaining a healthy and growing population on the Earth. The solution will augment crop yield while reducing the cost and resources necessary. Amity Aviation 1's solution will take part in the strong future of precision agriculture.

**Liang, Jingzhao**

**Project #128**

Behavioral, Completed Project

### **The Effect of Stress on Mental Math Skills**

This experiment places the subjects under simulated stress to test whether or not their test taking skills will be affected. This should show how stress impacts the result of a test, such as a basic addition and subtraction test. The results of this study may help students learn why they should control their stress in test taking environments in order to obtain better results and grades. A group of people were told they would be given 2 minutes to complete a set of 100 addition and subtraction problems. They were also told they would be graded out of the total problems on the sheet. After the first test, the same set of students were given another 2 minutes to complete a separate sheet of only 25 of the same kind of problems. After both tests were taken, the tests were graded based on how many problems were correct out of problems attempted. The scores were then averaged. So far, the results show no relationship between stress and scores. The minimal amount of stress from the first test does not affect the scores in a negative way.

**Lingareddy, Harika, Hague, Theodore,  
Lingareddy, Harsha &**

**Teepireddy, Vimratha**

**Project #129**

Physical Science, Research Proposal

### **Sikorsky STEM Challenge**

Using the engineering design process, students will reconfigure the Corsair aircraft to deliver as much potable water as possible in a 72 hour period from Beaumont, TX to Wichita Falls, TX. The purpose of this project addresses the annual droughts in Wichita Falls, an inland region of Texas; our task is to design a transport system most efficient for delivering water to this area. The engineering design process is a series of steps that is followed to solve a problem and design a solution for a real world problem; it is a methodical approach to problem solving for engineers. The process begins with defining the problem and ends with communication of results. In between, the team must research, develop, choose, create, and test possible solutions, by completing a research report, planning report, trade study, free body diagram problem set, and a final challenge. The team will be using Connecticut Innovations (CT iHUB), a website where the team will submit assignments and communicate with their mentors. Thus far, the team has completed three modules of the challenge: the research report, the project planning report, and the trade study. The team is currently finishing up the free body diagrams problem set, the fourth and final module. Once all four of these are complete, final challenge is released by the project administrators. The students will complete this before April 9th, as their final solution to the given problem. Our findings will possibly help solve the drought issue in Wichita Falls. If engineered efficiently enough, water transport with the Corsair could be a major alternative to fixing the annual drought issue.

**Studying the Possible Side Effects of Hydroxytyrosol, a Potential New Weapon in the Fight against Breast Cancer**

Breast cancer can be a deadly disease and 1 in 8 women will be diagnosed at some point in her life. Traditional breast cancer treatments, like chemotherapy and radiation, are not always effective. Researchers are currently working on targeted and more effective breast cancer treatments. Some treatments may even be available in our own homes. One of the main components of olive oil, hydroxytyrosol, has recently been the subject of research for women who are at increased risk of developing breast cancer. One current study focuses on the role that hydroxytyrosol plays in reducing breast density and therefore the incidence of breast cancer. This study will look at the possible side effects of this chemical at different doses, in order to add to the body of research that currently exists. Different doses of hydroxytyrosol will be administered to mice, and their overall health and behavior will be studied for possible side effects. The control group will receive a placebo. It is expected that only the mice receiving high doses will be affected by the hydroxytyrosol. Changes in health at the high dosage may include weight loss and allergic reactions. Since studies have shown that olive oil may reduce the risk of several diseases such as cancer and heart disease, it makes sense to further explore its benefits. Along with the benefits, however, may come risks and those potential risks are the focus of this study. This research hopes to confirm that the benefits of using hydroxytyrosol will outweigh the possible risks and side effects.

**Soot Formation in Diesel Surrogate Fuels**

Often in combustion, emissions are formed from incomplete burning of hydrocarbons, known as soot. Soot is the second leading cause for global warming and also directly harms human health. Diesel engines produce soot in large concentrations but are difficult to analyze given its large number of components. It was hypothesized that the sooting tendencies of the surrogate fuels will depend on the structure and bonding of the hydrocarbons. The way soot emissions will be reduced is by improving engine design and computational simulation through surrogate fuels, mixtures with fewer components, intended as models to be more efficient in optimizing low soot emissions. I created thirty-two dopant solutions (surrogates) from nine different hydrocarbons, selected by a literature study done by Charles Mueller at Sandia National Laboratory (2012). I added each solution to a methane/nitrogen flame. The soot concentration was measured with laser-induced incandescence (LII). By measuring sooting tendencies of mixtures, the individual hydrocarbon components' sooting tendencies were also derived. The data agreed with the mixing rule, that there is a relationship between the sooting tendency of the entire mixture and the mass fraction of its components. The total soot concentration of the fuel is dependent upon the sum of the soot concentrations of the hydrocarbon components. This experiment supports a hydrocarbon bonding on soot formation. For future research, the surrogate mixture that had the most similar sooting tendency to the target diesel fuel will be used in testing with diesel engine designs in order to optimize low soot emissions.

**Determination of Illicit Drug Residues on Currency Using LC-MS/MS**

This research will determine a variety of drug analytes on currency from Macao, whose economy is based on gambling, using a technique novel for this usage called liquid chromatography-tandem mass spectrometry (or LC-MS/MS). Though this is more of a methodology experiment, it was hypothesized that this LC-MS/MS method would be more effective at accurately and efficiently detecting these illicit drug residues than GC-MS (gas chromatography mass spectroscopy). Macau Pataca currency bills were collected from four major metropolitan areas. Analytes were extracted from the banknote by methanol, concentrated by solid-phase extraction (SPE) evaporation, followed by reconstitution in the mobile phase. Analytes were analyzed by LC in conjunction with triple quadrupole MS operated in the electrospray ionization (ESI) mode. Each of the banknotes contained at least one of the following drugs, with four or more drugs on a majority: cocaine (95%), benzoylecgonine (87%), methamphetamine (96%), MDMA (20%), "Magu" (75%), and ketamine (98%). The technique was very sensitive in detecting these analytes, but still needs to be tested in various matrices for accuracy and precision, and compared to GC-MS. It is anticipated that the percent recovery and sensitivity of the analytes will still be relatively high through these matrices. As a non-destructive drug-detecting technique, LC-MS/MS has great potential. Not only can it quickly detect drugs so accurately, but also help get results that can ultimately be used find the patterns between drug residues on bills and the socio-geographical and drug trafficking correlations from that area.

**Influence of Global Temperature Changes on Arability of Soils, as Measured through Level of Soil Organic Matter (SOM).**

When I started this project, I was focused on what effect rising global temperatures might have on soil, which has the potential to affect the agricultural output of farmers worldwide. I am heating soil to simulate rising global temperatures, and comparing this soil's organic matter (an important indicator of how arable it is) to unheated soil by using the Weight Loss on Ignition method. When I get my results, I expect to learn whether increased temperatures has a significant effect on the level of soil organic matter -- and by extension, arability -- of soil. I will analyze my results to find whether they are statistically significant or not. The implications of my research could include further issues we must concern ourselves with in reaction to climate change. If there is a significant negative affect on soil arability as a result of increased temperatures, then it would imply the need for counteraction of this problem.

**Altering Cancer Cells Growth with Caffeine**

Caffeine has shown to be the most highly used drug in the world, while cancer proves to be one of the most deadliest diseases. Exposure to caffeine and the effects it may have on cancer cells may prove to inhibit these cells growth. In some cases, caffeine has proved to change cell cycle function, and this proposal aims to find out how caffeine may affect the growth of cancer cells. The proposal for this experiment would be to test cancer cells with doses of caffeine to determine if it either promotes or inhibits growth of the cells. This would discover valuable information in order to learn more about how these cells work, and in what ways we can alter their growth speed. This experiment would be conducted in a certified research facility, while following all testing procedures that abide by ethical and safety guidelines. In order to determine the effects of caffeine on cancer cells, data would be recorded and analyzed from multiple trials.

**Exploring the Environmental Benefits of the Symbiotic Relationship of Azolla and Anabaena azollae**

A major contributor to increasing global temperatures is the rising level of carbon dioxide in the Earth's atmosphere. Azolla ferns have the potential to significantly reduce carbon dioxide in the atmosphere through its unique symbiotic relationship with the nitrogen fixing cyanobacteria, Anabaena azollae, within its leaves. The photosynthetic complementary pigments of the Azolla and Anabaena azollae cause greater absorption of the solar energy spectrum, which the fern harvests for photosynthesis. New ways to utilize the effects of Azolla should be explored to benefit the environment. By increasing the density of Anabaena azollae in the leaves of Azolla, the cyanobacteria will be able to fixate nitrogen faster and thus Azolla reduces more carbon dioxide. In the experiment, the ferns with both natural and altered densities of cyanobacteria will be exposed to controlled amounts of carbon dioxide for 90 minutes and then boiled in ethanol. The rate of carbon fixation and photosynthesis of the ferns will be evaluated using radioautography. This method will detect the position and progress of carbon in photosynthesis. The experiment will determine that the rate of photosynthesis, determined by the position of carbon, will be the lowest within the Azolla containing no cyanobacteria. The most rapid rate will be of the Azolla with the highest density of Anabaena azollae. This experiment will demonstrate the significance of the symbiotic relationship of Azolla and Anabaena azollae and how it can be altered to become more beneficial for the environment.

**Accelerated Detection of Salmonella within Fresh Produce using Type 3 Secretion Systems**

This proposal aspires to accelerate detection of Salmonella contamination within fresh produce. Within the United States, The FDA processes 80% of the fresh produce for Salmonella; however, their methods (mainly forms of PCR and colony counting) prove to be time consuming; taking a few days to process a sample, which is not acceptable for a bacterial infection that is so widespread. In order to expedite detection of Salmonella and its different serovars, or its different subspecies, it is important to look at its type three secretion systems (T3SS). T3SSs are protein attachments that deliver effector proteins to the host cell and are potentially excellent targets for detection due to the fact that their structures differ between contrasting serovars of Salmonella. By using specific proteins associated or within the T3SS (such as SpaO located within Salmonella typhimurium), potentially, there can be a differentiation of contrasting serovars of Salmonella. Methods and techniques that will be used includes isolation of T3SS and identification of specific proteins of T3SS through immunoprecipitation. The findings from this research could possibly give an expedited detection method for Salmonella within fresh produce and an accelerated detection method is needed for a bacterial infection like Salmonella that is so widespread, and has 40,000 cases of it each year, however, it may be thirty or more times greater, due to the fact that milder cases may not be reported.

**Significance of nuclear pores and nuclear pore complexes in Huntington's Disease**

This study is important because Huntington's Disease is an autosomal dominant disorder that affects hundreds of thousands of people in the US alone. It usually leads to death, and has no cure yet. My research may lead to finding a target for therapeutic treatment of Huntington's, which would benefit many people, both nationally and globally. My hypothesis is that in stem cells positive for Huntington's Disease, there will be more nuclear pore complexes, and they will be longer than those in normal stem cells. I will review a collection of TEM pictures of 2 stem cell lines, the normal stem cell line (control) and the HD positive stem cell line, in a single blinded manner. I will enlarge the pictures using zoom functions on the computer and systematically scan them to search for nuclear pores and pore complexes. Once identified, position coordinates will be documented, counts will be performed, as described above, and the results will be tabulated after analyzing 25 to 50 cells of each stem cell line. I will determine statistical significance using a students' t-test. I have not completed my research yet, but I have started collecting data, and I will analyze the data by testing for statistical significance afterwards. After this research has been completed, I will find whether my results are significant. If they are significant, I will research possible ways to target nuclear pores and complexes in HD positive cells. These ways will need to be tested in further research.

**Infrared Body Tracking**

The field of human to computer interaction is one of the fastest growing fields right now. Humans are coming closer and closer to adapting technologies that allow them to mimic real actions in virtual space. This research project was formulated around making that interaction easier for all using parts found around ones house. This project started with the gathering of all household items that might be useful to its completion. This included tv remotes, stray wiring, plastic clothing hooks, a video camera and an old 9 volt battery pack. Using these pieces and the research of current infrared tracking designs, a tracking device was made that allows for three-dimensional position tracking. Currently, a computer program is being designed that allows the user to set proper tracking values for any body part that an individual finds necessary to track. With all of my research, a fully functional model and computer program pairing should be done by early spring. My finding rely on the design of working software to go along with the hardware that has been competed. This project started on the basis of recreating a \$120 consumer head tracking device for free with homemade parts. With the research that has been done, this can be expanded to other parts of the body as well. This includes hand, arm, leg and full body tracking.

**The effects of radial water maze training and chronic ketamine administration on parvalbumin expression in the rat hippocampus**

Recent studies have found that in animal models, parvalbumin expressions are lowered when given ketamine and when animal models were trained, parvalbumin expressions were increased. By combining these two inferences into one study, researchers will gain crucial insight to schizophrenia. It is hypothesized that saline treated water maze-trained rats will have higher amounts of parvalbumin expression in the hippocampus than the ketamine treated trained rats and the untrained and untreated rats. Histological data was collected by taking photomicrographs of stained hippocampal slides and parvalbumin expressing cells were counted through a computer programming system ImageJ (free image analysis software provided by the National Institute of Health (NIH)). This histological data was then compared between the three groups of rats. There is the group of trained and ketamine treated rats, the group of trained and saline treated rats, and the “naïve” or untrained and untreated rats. Data thus far has shown parvalbumin expressions highest in rats treated with the 30 mg/kg of saline and trained in the radial water maze. It is expected that the naive rats will have a parvalbumin expression higher than or equal to the trained rats treated with the 30 mg/kg of ketamine, depending on the section of the hippocampus (CA3,CA1,etc.). Parvalbumin expression has been found to be decreased in schizophrenic humans, and in ketamine-treated rat models of the disorder, similar decreases in parvalbumin have been found. In order to better understand the relationship between parvalbumin expression and schizophrenic memory impairment, it is important to research the impact that this drug has on parvalbumin expression and its relationship to memory performance. With the results found from this study, specific areas of the hippocampus can be looked at when training schizophrenic animal models.

**Massello, Alexandra &**

**Dushyanth, Deah**

**Project #140**

Health and Medical, Research Proposal

### **Examining REM Sleep to Diagnose Mental Disorders**

It is predicted that the use of the Jawbone wristband and app will allow for a more focused area of research regarding the analyzation of the brain during REM sleep. This will enable doctors to better understand and prevent the misdiagnosis of many brain disorders. Through this study we hope to find distinguishing factors such as disturbed or enhanced sensory during REM sleep. This could help define characteristics of certain diseases in order to help doctors find a possible cure. Control and experimental group subjects will wear the Jawbone wristband and sleep characteristics will be recorded. These characteristics will be transferred into an app and will be saved for analysis. The methodology therefore includes a comparison between REM sleep of the control subjects with those diagnosed with an affliction such as Autism or Schizophrenia. In observing the differences between the test subjects, we hope to come to a conclusion that will support the hypothesis that there will be differing sensory characteristics during REM sleep in individuals with disorders such as Autism and Schizophrenia. This difference should help create a concrete area of diagnosis for doctors who will use the Jawbone wristband and app with their patients. We believe that this product will reduce the risk of misdiagnosis and provide patients with afflictions with the most appropriate treatment available.

**Mathur, Anubhuti**

**Project #141**

Health and Medical, Research Proposal

### **Designing an EGCG-PLGA Drug Delivery System for Osteoarthritis Treatment**

Osteoarthritis affects more than 27 million Americans and is a leading cause of pain and disability. There is currently no cure for OA. The optimal treatment would be an OA disease-modifying therapy that can arrest the progressive degradation and eventual loss of articular cartilage in OA and improve symptomatic relief. My project goal is to design and develop a drug delivery system that administers the antioxidant EGCG to damaged articular tissue to serve as a treatment to this disabling disease. My design consists EGCG-encapsulated PLGA nanoparticles. The use of nanoparticles allows for a slower delivery necessary for long-term therapeutic treatment. Thus this system represents an ideal localized treatment for cartilage degeneration. The characterization of the delivery system includes an analysis of drug release from the nanoparticles, FTIR spectral scanning, mechanical testing, and examining cellular response. The data from these analysis techniques will be valuable in performing a meaningful comparison of my design. I hypothesize that the optimization of EGCG concentration in PLGA nanoparticles will lead to an effective scaffold with IL-1 $\beta$ -inhibiting activity that promotes chondrocyte growth and proliferation. In this study I will create EGCG-PLGA nanoparticles for EGCG release to prevent cartilage degradation and promote regeneration. Osteoarthritis is a disease that leads to the degradation of protective joint cartilage. Though the disease affects millions worldwide, its etiology is unknown and there is no standard treatment. However, sustained chronic production of inflammatory mediators is an important characteristic of the disease. The proinflammatory cytokine Interleukin-1 $\beta$  (IL-1 $\beta$ ), produced in an arthritic joint, is considered to be one of the most potent catabolic factors in arthritis (Kraan and van den Berg, 2000). IL-1 $\beta$ -induced inflammatory response in arthritis joints includes the enhanced expression and activity of matrix metalloproteinases (MMPs), and their matrix degrading activity contribute to the irreversible loss of cartilage.

**The Effects of Footwear on Lower Extremity Kinetics During Running**

There is an extremely high injury rate for distance runners; as many as 50% of runners are injured every year and another 50% of those runners will be re-injured. Problems in running form can lead to a greater likelihood of injury. The purpose of this study is to determine which type of footwear (regular shoes, minimalist shoes, and barefoot) will lead to reductions in peak forces and rate of force development and better dynamic balance, thus resulting in a running form that makes runners less prone to injury. It is hypothesized that runners will have the smallest peak forces, the lowest rate of force development, and the best dynamics balance when running without shoes. The materials needed for this study are an instrumented treadmill and human participants with different types of running shoes, as well as biomechanical software to record and analyze the data. First, a consent form would be made and distributed. Once participants have returned the consent form, they will be tested on an instrumented treadmill under three different conditions: either no shoes, minimalist shoes, or regular running shoes. A survey will be given to record past experience of runners, how much they run, and which types of footwear they normally use. Following data collection, the kinetic variables will be analyzed with specialized biomechanical software. It is predicted that barefoot runners will have reduced peak forces and rate of force development, as well as better dynamic balance. This study will determine which footwear leads to the safest running form. This can help to reduce the extremely high injury rate in runners.

**The Effect of Cold Stress on the Frequency of CD8+ T Cells in Mice**

Does thermoneutrality affect the immune system's ability to fight off cancer? Cancer research has always been very important to me and this summer I had the opportunity to conduct a cancer research project. I was able to direct some of the research that I conducted at Roswell Park Cancer Institute. Our laboratory has set up an experiment to test the impact of mild cold stress on both young and old mice. CD8+ T cells are cytotoxic cells of the adaptive immune system, which have been seen to be affected by the cold stress. We predict that the old mice will have a lower frequency of CD8+ T cells in tumors compared to younger mice and the cold stress on some of the old mice will only serve to amplify this lower frequency. For the experiment, young mice (4-6 weeks) were separated into chambers at standard temperature (22-23 °C) and thermoneutral temperature (30-31 °C); old mice were also separated into chambers at standard temperature (22-23 °C) and thermoneutral temperature (30-31 °C). The mice were acclimated for two weeks, then implanted with tumors and tumor growth was recorded periodically. The tumors were then dissected, made into frozen blocks and then sectioned in the cryostat. The slides were then stained using immunohistochemistry and viewed under light microscopy to determine the frequency of CD8+ T cells. The young thermoneutral mice had an average of 9 CD8+ T cells per 450µm, while the young standard temperature mice has an average of 6.5 CD8+ T cells per 450µm. The old thermoneutral mice had an average of 5.6 CD8+ T cells per 450µm, while the old standard temperature mice had an average of 4.4 CD8+ T cells per 450µm.

**McGowan, Andrea**

**Project #144**

Health and Medical, Completed Project

**The Development of an Immunosorbant Assay (ELISA) for Detection of IgG and IgA Antibodies against Tissue Transglutaminase for the diagnosis of Celiac Sprue.**

It is estimated that 83 percent of Americans who have Celiac Disease are undiagnosed or misdiagnosed with other conditions (National Foundation for Celiac Disease Awareness). With this staggering amount of undiagnosed celiac patients, it is necessary that a simple method of testing is standardized/developed to assist physicians in the diagnosis of Celiac disease. Using an ELISA method, IgG and IgA Antibodies were quantified in response to Tissue Transglutaminase. Optimization Vary the concentration of tTG per ELISA well, the dilution factor of serum samples, and the dilution factor of the anti human IgG/IgG ALP conjugates. Concentrations were optimized (negative samples produced a low Optical Density and positive samples produced a high OD). Calibration 25 positive samples were used, assigning an arbitrary unit (AU) to the pool. Diluting this, AU's were assigned degrees of positivity. A calibration curve allows samples to be assigned AU/mL when optical density is measured. Optimal concentrations: 1000ng tTG/ per well Sample Dilution 1/100 1/500 dilution of anti human IgG ALP Conjugate Following the creation of the calibration curve, four positive and 21 negative serum samples were tested using the calibration curve. All serum samples were properly diagnosed. Each sample in the ELISA well was measured for optical density. Using the calibration curve, a value of 300 AU/mL suggests positive samples. In conclusion, the ELISA test developed is a simple manual method to detect IgG and IgA antibodies for the diagnosis of Celiac Disease. These implications suggest that the ELISA test is an appropriate method for diagnosing celiac serum samples. In the future, known serum samples need to be classified in order to fully measure the accuracy of the test and calibration curve.

**McKenna, Matthew &**

**Santos, Levi**

**Project #145**

Physical Science, Completed Project

**Real World Design Challenge for Precision Agriculture, National Challenge**

Precision agriculture (PA) is a method of farming whose purpose is to optimize crop yield, protect the environment, improve agricultural profitability, sustainability, and augment product quality. In a world with a rapidly growing population, it is important to have a steady, reliable food supply. With technology quickly advancing, it seems practical to design and implement an Unmanned Aircraft System (UAS) to support precision agriculture. The team used a 6-step process which was provided by the team's mentors from Pratt and Whitney. The process involved analyzing needs and requirements, brainstorming, down selecting options, creating a detailed design, testing the system, and providing life cycle support, to discover the optimal solution to efficiently survey the plot and identify the pest in order to increase the crop yield for the farmer. After a thorough down selection process, the team decided what needed to be changed. The team kept the fixed wing pusher propeller design for the airframe, and the final design still included one thermal and one electro optical sensor. However, the team changed the design to gas power to cover the entire field without needing to land, and implemented a second UAV into the mission for speed and cost effectiveness. The team's final UAS has the potential to change farming for the better. By detecting pests in a cornfield, the UAS would help farmers treat their crops more effectively. Overall crop production would then increase, and the agricultural industry would be able to expand to feed the growing population. The UAS would also have several practical applications outside of agriculture. The thermal sensor, for example, would help in search and rescue missions in mountains and rough terrain.

**The Effect of Aeration on the Rate of Growth in Water Wisteria (*Hydrophilia Difformis*)**

By increasing the rate of cellular advancement to increase rate of growth of organisms, unlimited biological potential would result. The main reason for experimenting with the rate of cellular development would be to repair damaged or infected parts of the body in shorter periods of time. The hypothesis of this experiment is, if specimen are exposed to aeration, then the rate of the specimens' growth will increase due to the enhanced aeration and the higher its adenosine triphosphate (ATP) level, theoretically increasing its cell energy and development, depending on the specimen. But because plants do the opposite in photosynthesis, a decrease in rate of growth is expected. In this study, the following procedure was followed: Every two days the growth of the specimen was measured. Growth was measured by a submerged ruler next to the specimen. As for current results, after four days of experimentation (eight days of growth): plant one's height and width grew 0.5 cm; plant two's height grew 0.2 cm while its width grew 1.0 cm; plant three's height grew 0.3 cm, while its width grew 0.7 cm; plant four's height grew 0.5 cm, while its width grew 0.6 cm. In conclusion, the somewhat sporadic growth can be due to the fact that these aquatic specimen grow independent of oxygen exposure, as they do not draw on it for any source of energy. In conclusion, the somewhat sporadic growth can be due to the fact that these aquatic specimen grow independent of oxygen exposure, as they do not draw on it for any source of energy. As for implications, this research can hopefully enable an increase in the growth rate of specimen, especially in sources of food. Another would be allowing specific areas on a live specimen (like cuts) to heal faster.

**Effects of Global Warming on Invasive Species**

With global warming changing environments across the world, many species must find a new area to live because their old habitat has been destroyed. These species become invasive, and take over these environments, killing other species within it by eating their food, and taking up too much space. Without these original species, these habitats are ruined, as well as human cities and industries around them. This is a huge problem on the planet, and it must be stopped. What I am trying to do with this experiment is change the environments that have been hurt by invasive species. So, what I will do in this experiment is reconstruct the conditions of an area such as the Great Lakes region in a lab. Then, I will take a certain amount of this invasive species and put them in the conditions, changing one part of the conditions, such as water salinity, or streamflow quickness, to see which most greatly effects the population of invasive fish. At the end of this experiment, I hope to find a result that shows that one of the environmental problems such as high salinity has been changed, and then has effected the population of invasive species in the area. This in turn, would be able to kick them out of the habitat and hopefully bring original species back to the area they once called home. This of course, would take time, but hopefully is an obtainable goal. This experiment can help to provide new methods of the evacuation of invasive species in habitats that have been overrun by them. If the experiment is successful, it can be implied in areas such as the Great Lakes to keep invasive fish out, and original fish in. The experiment could also help to re-create industries that have been ruined by the destruction of these habitats.

**Effects of Interests on Creativity**

It's common knowledge that creativity is a great quality to have, and contributes to many of the inventions and innovations we have today, but its causes are not quite as well known. The objective of this research is to determine the impact of various hobbies/interests/activities on creativity in individuals. I hypothesize that if humans participate in scientific activities or have scientific interests, then they will be more creative. To test this hypothesis, each subject was administered a creativity test to test how many uses of a brick they could think of. Afterwards, a hobby/interest survey was administered, where subjects will be asked what activities they participate in regularly, and what interests they have. In order to complete this experiment, I created and utilized hobby/interest surveys and creativity tests. Some constants in this experiment were the assessments, surveys, and time spent on the creativity test. Data collection is currently in its infancy. At this time, results are inconclusive. After results have been collected, they may be used to improve creativity in individuals through the alteration of school curricula and in one's lifestyle, for example. After all, creativity is not only a fundamental of many, if not all, disciplines, but a mysterious topic among the scientific community. This data may lead to new studies in other factors of creativity, and how to incorporate them into everyday life, in order to create more creative individuals.

**How Antibody Responses Change Throughout Treatment for *Borrelia burgdorferi***

*Borrelia burgdorferi* is the bacterial species that exists in North America and Europe and is the main causative agent of Lyme disease. Lyme disease can be very detrimental to one's health and thus early diagnosis and treatment are important. In the United States, 300,000 people a year contract Lyme disease. This project will look at antibody responses to *Borrelia burgdorferi* in newly diagnosed Lyme disease patients and how the antibody responses change over time and after treatment. This project will be conducted by first obtaining sera samples from newly diagnosed patients. Subsequent sera samples will be obtained about 2 months after diagnosis corresponding to approximately 4-6 weeks after the completion of antibiotic therapy. Sera samples will be tested for the presence of antibodies to *B. burgdorferi* proteins. ELISA and Western blot assays will be performed using lysates of cultured *B. burgdorferi*. I will be performing these tests and analyzing the data. The results from the tests will show what antibodies are present and quantify the amount of antibodies present. It is hypothesized that if treatment is initiated very early after infection, before antibody responses are allowed to develop, no antibodies may be detected before, during, or after. Alternatively if treatment is started later during the course of infection, after antibody responses have already been generated by the immune system, then antibodies to *B. burgdorferi* will be present at the time of diagnosis. The results of this project can be used to aid in the development of new ways to test for Lyme disease and design a new way to determine when someone is "cured" of Lyme disease.

**The Examination of Second-Impact Syndrome Concussions Using CT Scans**

Studying Second-Impact Syndrome is important because it will help protect the health of athletes. It's also important because if this syndrome is better understood, then athletes will better understand the severity of concussions, and pull themselves out when they may have suffered a head trauma. If the CT scans of athlete's brains after their first impact and after their second impact are examined, then after the second impact, the brain swelled and experienced internal bleeding and damage which would confirm the origin of the Second-Impact Syndrome. Techniques in this experiment are CT scans from a wide variety of cases of concussions after their first impact and CT scans after a second impact. Since it is very rare to have a CT scan of one athlete after their first and second impact without actually asking the athlete to risk their safety, the CT scans will be of different athletes in different situations. Variables are the CT scans will be from teenage athletes who have received a concussion from their sport. From this experiment, the exact origin and cause of the second impact syndrome can be discovered, since the current cause of this syndrome is a theory, and not written in stone. The data will be analyzed by comparing both results from the CT scans of the concussion after the first and the second impact. The results from this research could possibly lead to further avenues of research because in cases where Second-Impact Syndrome is not fatal, the long-term effects are similar to those of severe traumatic brain injury. Since they are similar, if there is progress with the treatment of one condition, it should benefit the other.

**Gender-Specific Copepod Susceptibility to Phytoplanktonic Neurotoxins at Various Concentrations**

Copepods are used as bio indicators to relate information about water quality and bacteria back to scientists. Copepods vary in susceptibility by gender to toxins, which can affect the food chain overall due to the decrease in nutrition being transferred through the trophic system. This experiment was done to measure how gender affected susceptibility to these toxins when presented in varying concentrations. 10 male or female copepods were placed in half liter bottles with basic food preparation and varying concentrations of toxic algae. Concentrations of algae were measured before experimentation. The bottles were placed on a rotating plankton wheel overnight. The water was then measured for a decrease in toxic content, which was attributed to digestion by the copepods. Ingestion rates were then calculated. The results indicated that female copepods underwent the process of selectivity, meaning that they purposefully ingested less of the toxic material than nontoxic material. The male copepods were found to ingest less food particles in general, but more toxic content, meaning they did not undergo selectivity. The ingestion rates of the male copepods slowed over time, while the females remained constant. These findings indicate that female copepods are less impaired by toxicity than males. This can result in an eventual decrease in male copepods, and therefore copepods in general, in highly toxic areas. Scientists can now check for a low copepod population when looking for reasons for energy deficiency in ecosystems. This can save abundant time and resources in the field.

**The Quantitation of the Rate of Regeneration in Planaria**

Planarians are a type of small flatworms that have a large population of adult stem cells. This allows them to regenerate at extremely fast rates. Planarians have sensory detectors that can perceive light, magnetic fields, chemical gradients, and vibrations. Planaria are ideal model organisms because of their ability to regenerate so quickly. Although they are used so often in experiments, there is not a universally known way to care for the organism. In this project, planarians were cut horizontally and measured under a microscope to view the rate of regeneration. This project offers solutions on the best ways to take care of the animals and a way to measure their growth after they are cut. If this project is successful in finding efficient ways to maintain these organisms, this can have beneficial effects for anyone who wants to experiment with planaria in the future and make them easier to use.

**The Effect of pH of Vegetables or Fruits on the Voltage of the Resulting Voltaic Cell**

I studied this topic for two reasons: it was interesting, and it could potentially help us build better chemical batteries in the future. I am investigating the effect of the pH, of a certain part of a voltaic cell, the bridge. I am using variations on the classic potato battery to investigate this. I hypothesize that if the bridge is more basic than the battery will have a higher voltage. I used 4 different fruits of different pH, as well as distilled water for a control, and blended them into a paste. Then I put 250 mL of each fruit into a cup measure, and put a zinc and copper strip in it in the same locations for every trial. Then, I measured the voltage between the two strips and the pH of the fruit. In my experiment I discovered that lemons, potatoes, and kiwis all produce roughly the same voltage, 0.9 to 1 volts, even though they have different pH. I further discovered that black olives, the most basic of the experimental groups, produced a voltage of 0.7 volts. Also, distilled water, which has a pH of exactly 7, produced no voltage at all. My results tell us that it is not pH that makes the bridge substance function the way it does, because if that was true, then there would be a strong correlation in the experimental groups, and the water would produce some voltage, due to its low but equal concentration of hydrogen and hydroxide ions. More research is necessary to determine what will help this part of the battery function best.

**Exploring the Tunicate *Ascidia callosa* and its Associated Bacteria for Antimicrobial Compounds and other Marine Natural Products**

Tunicates are marine invertebrates that live on the ocean floor and grow on rocks and the hulls of ships. A mutualistic relationship with unicellular marine bacteria helps tunicates survive. These bacteria produce secondary metabolites that the tunicates utilize to protect themselves from pathogens. There is potential for these marine bacterial compounds to be used in treatment of human pathogens through antimicrobial pharmaceuticals. An invasive Alaskan tunicate species, *Ascidia callosa*, was sampled and its associated bacteria was isolated, extracted, and observed. The sample was fractionated using solvents such as methanol, dichloromethane, and ethyl acetate. It was tested for activity using the LC-MS and proton NMR machines. Sample E, which had 100% ethyl acetate, was found to have the most recorded activity based on data results from the LC-MS and NMR. It was then tested through a series of bioassays on the bacterial strain, methicillin-susceptible *Staphylococcus aureus* (MSSA). No antibacterial activity was detected. The control antibiotic, Vancomycin, showed a 12-mm ZOI (zone of inhibition), while the fractions of Sample E showed 0-mm zones after 24 and 48 hours. The hypothesis that a useful compound would be discovered was refuted. Gram-positive bacteria, which are typically more susceptible to antibiotics, may yield different results than gram-negative bacteria, which tend to be more difficult to inhibit due to the additional outer membrane that is composed of lipids. For this reason, the sample will be retested on methicillin-resistant *Staphylococcus aureus* (MRSA), a gram-positive bacterium such as *Bacillus subtilis*, and one fungal cell line, *Candida albican*, in the future.

**The Effects of Different Music Learning Strategies on Playing Accuracy**

The problem being analyzed is: which practice strategy is the most effective: reading the music, hearing it, or both? The hypothesis this: students will play the highest percentage of correct notes when they are allowed to see the music and hear it, and then continue to have the music in front of them while they play. The purpose of this study is to learn the effectiveness of different practice strategies. The IV is the way the music is presented, and the DV is the accuracy of notes. When conducting these tests, the participants would play on the instrument of their choice, then play three rhythms. For the first, they would only read the sheet music. Next, they would listen to the music twice, then play. Finally, they would listen to the music with the sheet music, then play with the music still with them. The three rhythms are equal in difficulty, and length. All tested students have been trained in Concert Band. The preliminary trends suggest that the students were most accurate in the trial when presented with the audio and sheet music, then continued to see the music, and were the least accurate when presented with only audio. The data was analyzed by comparing the number of notes played correctly, over the total notes in the rhythm, and written as a percentage. This process was repeated for each of the three trials. The preliminary trends that my data show correlate with the hypothesis, but leave questions, specifically, why? Why did the participants do the worst when just given the audio, and the best when given the audio and the music? This can be solved by collecting more data, testing different instruments other than trumpet and piano, and analyzing other studies done on this topic.

**Effects of Dance and Dance Experience on Balance**

The purpose of this study was to see if dancers were able to balance longer after turning than non-dancers, and if people with more years of dance experience could balance for longer than those with less. The hypothesis was that participants with more years of dance would be able to balance longer. The independent variable is number of years danced, and the dependent variable was balancing time. Participants were asked to turn for 10 seconds, then attempt to balance on one foot for as long as possible. Balance time and the number of years each participant danced, if any, was recorded. Some participants were dancers and others were not dancers. The amount of time it took each participant to regain control of their balance was also recorded. The balance time was capped at 3 minutes. Preliminary data shows that dancers are able to regain control of their balance faster and balance longer than non-dancers. Participants who danced longer were able to regain control of their balance faster. However results may change after collecting more data. Results show that dancers are used to turning and therefore can adapt faster. They take less time to find their center of balance. Non-dancers were not able to adapt to the situation as quickly as the dancers. The data can also be used to say that dancers are able to change movements faster than non-dancers. Future studies could be done to look at how quickly dancers can change tasks.

**The Effect of Social Media on Loneliness**

Ph.D. Christopher Lane's article, "Social Media and Loneliness," says although social networking sites (SNS) were designed to facilitate communication, SNS usage can lead to loneliness. Ph.D. Guy Winch claims loneliness can increase risk for or exacerbate depression. Therefore, it is hypothesized if SNS are frequently used, then one would become lonelier. The purpose of the study is to examine the association between SNS usage and loneliness. High school participants complete a two-part survey. Using the Likert Scale, the first part assesses whether users are active (frequent posting, sharing, etc.) or passive (simply viewing others' posts but rarely posting). The social media inquired about include Facebook, Twitter, Instagram, Tumblr, and Pinterest. The second part of the survey is the UCLA Loneliness Scale. The study is a correlation study and will be analyzed by a linear regression. Past research and data collected so far show that people who use SNS more will receive higher scores of loneliness on the UCLA Loneliness Scale. This study will contribute to the growing amount of research on whether or not social media causes loneliness in users. Since past studies concluded that more social media usage will increase loneliness, trends show that refraining from using social media will decrease loneliness in general. An implication is that people will have more knowledge about the relationship between social media and loneliness. Past research showed that social media does cause loneliness; if trends continue as seen so far, this study will agree with the past data.

**Moran, Kristen****Project #158**

Behavioral, Research Proposal

**Don't Touch Me: Using Osteoarchaeological Methods to Determine Medieval Practices of Disease Classification**

Leprosy is the least communicable of all contagious diseases, according to the World Health Organization. However, its reputation for disfiguration precedes it, and many who have no scientific understanding of infectious disease fear contact with lepers. This fear can be traced back into pre-history, and remains problematic today. Leper hospitals and colonies have been created around the world in the past to separate the victims of the disease from the healthy. During the Middle Ages, doctors did not have the methods necessary to distinguish leprosy from other disfiguring, scale-inducing diseases, and so leper hospitals came to be filled with victims of various diseases that were mistaken for leprosy. This project will seek to examine the osteoarchaeological evidence of a medieval leper hospital in order to determine what diseases were present, using skeletal remains from the Castleton Hospital Project in Castleton, England, as a proxy for medieval leper hospitals. The markers of paleopathology on the bones will be examined and analyzed to determine the array of represented infectious disease. The analysis should lead to the identification of multiple diseases other than leprosy such as Lupus vulgaris, sarcoidosis, and actinomycosis, all commonly conflated with leprosy. This project will offer insight into the treatment of those with highly visible diseases and the grouping of such diseases, which will help to understand how some areas of the world, such as India and Brazil, continue to make use of leper colonies.

**Morgan, Catharine****Project #159**

Environmental, Research Proposal

**The reversible castes of *Pheidole birainata* soldier ants and *Pheidole birainata* major working ants using differentially methylated regions.**

The ability for an animal to revert between different castes is important because this way the number of ants per caste can be regulated. Different species may have predators and are in need of soldiers while others need more workers to collect food. If all the major ant were removed from an ant hill, then the soldier ants would revert to being major working ants in a *Pheidole birainata* hill. I would preform this similar to the article, Reversible switching between epigenetic states in honeybee behavioral subcastes by Brian R Herb. The DNA would be extracted and the differentially methylated regions (DMRs) would be compared in soldiers, major workers, and reverted soldiers. I would expect the soldier ants to revert to major, working ants. I would support this with data similar to Reversible switching between epigenetic states in honeybee behavioral subcastes. There would be less DMRs between reverted soldiers and major workers than between soldiers and major workers. Ants provide nutrients and oxygen to the roots of plants by digging tunnels near the plants. This helps the ecosystem flourish.

**The Practicality and Effectiveness of Nitrification Inhibitor in Mitigating Nitrogen Runoff From Tomato Plants into Groundwater**

The waste from plants' eating nitrogen based foods, containing nitrate, oxide, and/or ammonium, runs off into groundwater and contaminates natural water reserves that are used for drinking and survival. This drastically impacts a given ecosystem and must be mitigated. The motivation that I have for this comes from my interest in pollutants other than the main greenhouse gases. I know that there are others that are just as bad or worse and they need to be focused on too. Plant a tomato plant in Plant-Prod 28-14-14 High N soil Obtain a small fish tank filled with water from the Saugatuck Reservoir in Redding underneath. Model the setup after reality, with the plant in soil on top of a permeable barrier that supports the soil while still allowing elements and water to pass through into the groundwater. Measure the Nitrogen level of the water before the experiment to have a basis for change Now repeat steps 1-3 with the two other fertilizers, Plant-Prod 15-15-18 Pioneer Feed and Potassium Nitrate Multi K. These are the control groups. After 2-3 days, measure the level of Nitrogen in each sample of water under the plants with Nitrogen test strips. After 1 week, measure the level of Nitrogen in each sample of water with test strips. Now you have a baseline for the transmission of Nitrogen in the form of Nitrate, Nitrous Oxide, and other compounds to compare the test groups to. Plant a new batch of seeds in the various fertilizers and add the correct amount of Lovibond - 2418642 - Bod Meter Nitrification Inhibitor as stated on the bottle. After 2-3 days, measure the level of Nitrogen in each sample of water under the plants with Nitrogen test strips.

**Remission of Diabetes Induced by Injections of Antibodies and Beta Cells**

Type 1 diabetes, an autoimmune disease that is currently incurable, is a result of T-cells of the immune system attacking and destroying insulin-producing beta cells in the pancreas. This process prevents the body from producing sufficient amounts of insulin. Diabetes is diagnosed when glucose level in the blood increases significantly. Research is currently being done in non-obese diabetic mice. This research involves antibodies that eliminate these T-cells, suppressing diabetes in the mice. This method has proved to be successful. However, it only works in recent-onset diabetic mice that still have a significant amount of beta cells in their bodies. Diabetes can be reversed by injecting stem cells into the body. Research involving implanted stem cells has been conducted and proven to suppress the effects of diabetes. These cells will be programmed to mature into insulin-producing beta cells. Antibodies will also be injected into the mice, specifically targeting and eliminating the T-cells of the pancreas. These combined methods will effectively restore the beta cells in the body and eliminate the T-cells that cause diabetes. The treatment will be shown to be effective when the level of glucose in the blood decreases to a normal range. It is expected that the number of beta cells in the mice will increase while the number of T-cells in the pancreas will decrease and no longer attack the beta cells. This method of treating type 1 diabetes is important to develop since there is no current cure, and new research could lead to other methods of reversing type 1 diabetes through the use of stem cells and varying antibodies.

**Mulcahy, Jack**

**Project #162**

Environmental, Research Proposal

**Impact on the Viscosity of Ethanol on Particulate Matter Output and Enthalpy of Combustion**

For this experiment, I first looked into how outside conditions can impact how a fuel worked. I had seen that some similar research had been done with diesel fuel, and the experimentation on more environmentally friendly fuels seemed interesting to me. The examination of ethanol fuels and how the environment, particularly cold conditions, seemed like an experiment that would yield interesting results. In order to determine the viscosity of the ethanol, I used a system of ice and salt to cool the mixture. Once cooled, I tested the viscosity by determining the time it took for a ball to travel through the liquid. From there, tests to determine the mass of the particulate matter on piece of filter paper and the enthalpy of reaction by using water were done. This experiment will likely find that the cooling of ethanol fuels, like what is done in nature, will increase the particulate matter created as well as lower the enthalpy of the reaction. This would also impact the efficiency of how ethanol is as a fuel, and it would show the various implications of how the fuel responds to various weather conditions. The largest implication that could stem from this experiment would be suggestions into methods that would increase the viscosity of an ethanol fuel before it is combusted, in order to decrease the particulate matter and increase the energy output. It would also suggest to what climates ethanol would work best in, particularly those that avoid steady periods of cold.

**Murphy, Marion & Paletta, Grace**

**Project #163**

Health and Medical, Research Proposal

**Determining the Health Effects of the Asian Kratom Leaf**

Kratom is an opiate-like leaf from Southeast Asia that is being used as an alternative medicine, drug substitute and for drug withdrawal. Companies that sell kratom claim that it can be used for fatigue, pain and depression but research has not been conducted to back up these claims. Research is also needed to determine its safety as many people who use the plant end up in the emergency room. This study will test different doses of kratom on mice, and the behavior and health of the mice will be recorded and analyzed. The experimental mice group will be administered a normal diet with kratom and the control mice will only receive the normal diet. Different doses will also be given to the experimental group to see the effects of daily high dose use. It is expected that long-term daily high dose kratom consumption will cause nervous behavior, tremors, and aggression in the experimental mice group. Mice administered low doses and the control mice will likely not exhibit these behaviors. This research is important because although kratom is legal in the United States, it is unregulated and its use is growing. Future work could include studying the effects of kratom withdrawal.

**Analyzing lesion location in grey matter in comparison to the type of multiple sclerosis and neurological disability**

Multiple sclerosis is a demyelinating disease in the central nervous system. When demyelination occurs it causes scar tissue, and depending on where these lesions are people could have a range of symptoms. In my experiment, I will be studying if lesion location in grey matter has an affect the type of MS, neurological disability and other symptoms. Brain samples from people with MS will be used along with samples from people without MS to be used as controls. The symptoms of the brain samples will need to be available. Myelin basic protein and primary and secondary antibodies will be used to locate the lesions. The expanded disability scale will be used to see how the lesion locations correlate to the reported symptoms. I hope to find that there is clear relation between the lesion location in grey matter and cognitive disability. I also expect to see a correlation between the type of multiple sclerosis and where the lesions are located in the grey matter. My experiment will help people because it is collecting data. This data can be used to help further understand the disease. It can also help with treatments because if there is a clear connection between lesions location in grey matter and cognitive disability it can be easier to prescribe treatments.

**Applying the Friendship Paradox to Trends in a High School Population**

This study aims to utilize the friendship paradox, a basic property of social networks, that one's friends have more friends than they do, on average, and thus a higher than average centrality within the social network, to predict which potential trends may spread through a high school population. It is hypothesized that the nominated friends of random individuals will be familiar with more potential trends, such as viral videos, than randomly selected individuals within the network. First, 50 high school students were interviewed on what new videos and trends they thought could be potentially popular within the high school. From the interviews, 12 potential trends were selected in which 60 random high school students assessed their familiarity with these trends, and then nominated 3 of their friends within the school. The same survey was then given to a group of the nominated friends. The number of trends and particular trends which the group of friends was aware of was then compared with that of the group of random participants. While data is still being analyzed and collected, the results thus far suggest to support the hypothesis, and overall the nominated friends are aware of more trends than the randomly nominated individuals. Current methods for predicting trends of social contagion, as well as other contagious outbreaks are rather ineffective. It is known that such "trends" spread through centrally located individuals earlier than those in the periphery of the social network, on average. However, given the intricacy, it is incredibly difficult to map social networks and determine which individuals are located in the center. If the hypothesis is supported, utilizing the friendship paradox, provides a new, simpler, more effective method to predict trends, as well as other contagious outbreaks.

**The cognitive advantage of fluent bilingualism in lingual task-switching**

Multilingualism has become more common in today's society, but recent studies demonstrate that it may actually improve executive functions such as cognitive inhibition and mental flexibility. After all, knowing multiple languages requires one to switch between different grammar concepts, as well as recognize and use distinct vocabularies. The present study seeks to bring light to a novel method of measuring the benefits of bilingualism by testing lingual task switching. Two groups of 20 people will be required to take a timed test where a subject must alternate between reading Spanish and English words (one word at a time on a screen). The control is the fluent English group, the independent variable is the fluent Spanish-English group, and the dependent variable is average accuracy and time of reading an English word that was preceded by a Spanish word. It is expected that when an English word appears after a Spanish word, the Spanish-English bilingual group will be quicker and more accurate in reading it. If this were to happen, it bears significance because one would expect both groups (both fluent in English) to have similar times. The data will be analyzed using a T-test to determine whether the two tested groups show a significant difference. The implication of the present study is that it attempts to reveal bilinguals' cognitive advantage in task-switching, an important executive function. Future research should explore what kind of brain site is responsible for the neurological difference between mono- and multilingual speakers using a neuroimaging technique (e.g. functional magnetic resonance imaging).

**Habitat of Asian Shore Crab (*Hemigrapsus sanguineus*) May Determine Next Regions of Migration**

The invasive Asian Shore Crab indigenous to the East Asian Coast has spread rapidly across America's Eastern shoreline. With a strong presence lasting all the way from Maine to South Carolina, the crab has decimated aquatic populations. Due to an abundance of resources and a lack of predation, the Asian Shore Crab population is growing exponentially. If the crab continues to migrate further south, it will continue to destroy fish inhabitants. It is thought that the species prefer rocky habitats. Evidence suggests that the Asian Shore Crab will continue to migrate further south, which allow future crab destinations to be predicted. Therefore further action can be taken to prevent the crabs from occupying these regions. In order to ensure that this is a viable solution to preventing further spread, it must be shown that the species generally live in rocky habitats along the shore line. The number of individual crabs will be counted in different locations on different coastal areas in several rocky and non-rocky habitats. It is hypothesized that an abundance of individuals will occupy rocky habitats, and little few reside in external ecosystems. The crabs that occupy the rocky habitats will be more fit than the crabs in other locations. This will be tested through the crabs size. Southern ecosystems that may provide an environment for the crab to flourish in can be predicted and determined. Therefore, regions at threat can work to prevent Asian Shore Crab populations from moving into the area.

**A Novel Method of Controlling Size of Carbon Nanotubes**

Carbon nanotubes and the many applications that come with are hindered by the large variation in size present. It is extremely difficult to control this aspect of nanotubes because of the high count per a given volume and their high strength. The purpose of this study is to try to use sonication as a means of shortening large batches of carbon nanotubes. It is hypothesized that sonication will shorten large batches of nanotubes, and that it will also have a minimum nanotube length, as determined by the frequency of the sound waves. In the study, the carbon nanotubes were prepared in a controlled mixture containing 2 mg carbon nanotubes (either functionalized or pristine nanotubes). Next, the nanotubes were sonicated in a given amount of time (0, 0.5, 2, and 8 hours have been tested thus far) before being evaporated onto a glass slide. Afterwards, the slides were placed under an optical microscope and were measured for length and area using imaging analysis software. The findings suggest that sonication for higher periods of time yield a lower median nanotube length, as well as a smaller standard deviation. The idea of a “size floor” is supported by the data gathered as well; there were relatively discrete range of nanotubes present for each recorded time interval. The results gathered carry significant implications regarding the feasibility of sonication as a means of manipulating the size of carbon nanotubes. In the future, more time different frequencies for sonication may be tested.

**The genetic and morphological differentiation and possible speciation of the slender mola, *Ranzania laevis*.**

The *Ranzania laevis*, or slender mola, is a relatively unstudied fish species of the family Molidae. Previously known as a strictly tropical fish, many *R. laevis* specimens have recently washed up on beaches with latitudinal coordinates ranging from 33.30N down to 34.394S. These outlier sightings and wash-up events have been attributed to the recent increase in oceanic temperature, although the overall effect is unknown due to the species' elusive nature. Because so little is known on its population size, the most effective way to monitor behavior is through citizen sightings ([www.oceansunfish.org](http://www.oceansunfish.org)). A mapping program produced by utilizing citizen sightings around the world (location, date, fish size, S.S.T., behavior) will be made to analyze the *R. laevis* population. Citizen sightings as well as select preserved specimens (Smithsonian M.S.C., California Academy of Sciences) will provide meristic data and morphological measurements. In addition to this data, genetic analysis will be conducted on washup specimens from the Catalina Islands, CA. After comparing the genetic and morphological characters of *R. laevis* from varying locations and sources, the characteristics will be quantitatively compared to as a whole, to support the subspeciation of the *R. laevis* population, and to learn more about the species' population dynamics as a whole. This research will be used to better educate the scientific community of the *R. laevis* population status. Since so little is known about the species and its population dynamics, more research needs to be conducted in order to fully assess the dangers associated with their recent spatial shift, the purpose being to not allow the species to reach the threatened/endangered threshold, or, go extinct without awareness.

**The Effect of Galaxy Density on Galaxy Cluster Mass-Luminosity Relationships**

The light emitted by galaxies clustered through gravity can be studied to understand the nature of galaxies and the larger structures formed by them. A method of analyzing galaxy groups is determining the luminosity of galaxies and clusters based on their other characteristics, such as their mass or the number of member galaxies. Trends in this data can be used to establish an understanding of both galaxies and the Universe. In order to bring information together to determine the effect of galaxy abundance in a cluster on a cluster's unique galactic mass-luminosity relationship, information will be collected from astronomical databases for each example cluster member's individual masses and luminosities. The galactic mass-luminosity relationship of each cluster can be plotted, and then compared between clusters based on the number of member galaxies to determine trends in brightness caused by other galaxies. Through the observation and comparison of different clusters, it is predicted that as the the number of galaxies within them increases, each galaxy's luminosity-mass ratio will decrease. It may be possible that an increased number of galaxies in close proximity can have detrimental effects on brightness, such as impacting its supply of star-forming gas, to cause lower levels of brightness. However the possibility of the opposite cannot be ignored. A discovery of a trend in brightness based on the presence of other galaxies could be used to further refine our understanding of star formation and brightness, as well as the structure of galaxies and the interactions that occur between them throughout the universe.

**Genetic Disorders and Learning Styles**

Genetic disorders can range from minor to severe. For example an anxiety disorders are very common and can be handled without medication and not have an extreme impact on a person's life. However, a disorder such as Down Syndrome can greatly affect an individuals daily life. By studying the effect of genetic disorders on learning abilities we can find a better way to teach students struggling with these genetic disorders. I hypothesize that the students with Down syndrome will struggle with learning more than the students with anxiety because down syndrome causes cognitive delays. I will gather 3 groups of 5 high schooll students. One group of students that have down syndrome. Another group of students that have anxiety disorders. Finally a group of students that have dyslexia. I will give the students a passage to read and give them around 20 minutes to process the information that they learned and repeat it back to me. Then I will read aloud a different passage without them being allowed to see it. I will give them 20 minutes to process the information and ask them to me what I said. The enviornments will be the same for both groups. I hope to find the best way for students with genetic dieases to learn. I hope to find the worst ways that the students learn as well. By finding the best and worst ways the a student with a genetic disorder learns then schools can specialize their special education programs to best fit the disorder the most. This also can be used to help teachers learn how to help a special ed student succeed. This can be used in my further reasearch with genetic disorders by helping explain to a patient the best way how their genetic disorder effects their body.

**The Contribution of Tfh and Th1 Cells to the Pathogenic Development of Systemic Autoimmunity**

Systemic Lupus Erythematosus (SLE) is a disease that causes chronic inflammation. The Tfh cell-driven cytokines IL-21 and IFN- contribute to the pathogenesis of lupus, which is presumably due to effects on B-cell maturation. The hypothesis of this study was that the ANA and ELISA results would support the idea that the B6.Sle1.Yaa murine lupus model will have a more pathogenic development than B6.Sle1.Yaa.ICOS-/- because of the contribution of the Tfh and Th1 cells to systemic autoimmunity. The experiment was performed twice but with two different techniques, ANA and ELISA. ANA is a technique that focuses on staining the nucleus of a cell with antibodies to visualize any traces of Lupus using Confocal Microscopy. Anti-dsDNA ELISA is best known as an Enzyme-linked immunosorbent assay that uses an enzyme linked to an antibody or antigen as a marker for the detection of a specific protein, in this case, an antibody. The results of this study supported the hypothesis since the B6.Sle1.Yaa murine lupus model had a more pathogenic development than B6.Sle1.Yaa.ICOS-/- due to the contribution of the Tfh and Th1 cells to systemic autoimmunity. This study, as well as future research regarding the abrogation of Tfh cell function, could hold therapeutic promise for SLE.

**Tommy John in Professional Baseball**

In recent years, the number of ulnar collateral ligament (UCL) injuries of professional baseball players in the MLB has seemed to skyrocket. Since 2012, 53 pitchers undergone Tommy John surgery in order to repair their UCL. With big-name pitchers under contract for millions of dollars every year, this injury which typically benches a player for at least an entire season is costly for everyone involved. The first step is to compile a complete list of players who have had a UCL injury, and see to what extent, if any, that the number of injuries has increased over time. The next step will be to analyze how different variables, such as pitches thrown, pitches thrown per game, average pitch speed, and pitch type impact injuries in pitchers. The resulting data hopefully will paint a clearer picture on what is the greatest risk factor for a UCL injury. While most variables will have some impact, there will likely be one that is far more important in regards to causing injuries. While a UCL injury is rarely the career-ender it once was, it is still a very serious injury that takes a great deal of time and effort to fully recover from. Losing even one player to Tommy John surgery can dash a team's hopes of making the playoffs. With a clearer risk factor identified, teams will be able to prevent at least some future injuries to their players.

**Offir, Jacob****Project #174**

Physical Science, Research Proposal

**Determining the Optimal Orbit for a Spacebased Laser for Space Debris Removal**

Earth's orbits are filling up fast, which could have a detrimental effect on the future of space travel. Most objects in orbit, specifically low Earth orbit (LEO), are space debris. Space debris can mainly be credited to a cascading effect known as Kepler Syndrome. If nothing is done to remove space debris, humanity's space prospects will be put on a long hiatus. In this project, an orbital simulator will test different orbits for a spacebased laser to find the optimal orbit to deorbit small (1-10 cm) space debris in LEO. Also, different angles to shoot the space debris will be tested with different laser strengths. In my findings, it is expected that a polar orbit will be most effective as it gets a sampling of the most amount of other orbits. It is also predicted that shooting the debris at a perpendicular angle will be most effective in deorbiting. The implications of this project are vast and very important for the future of space travel. Space debris must be deorbited in order to avoid major, life threatening disasters.

**Oleynik, Ryan****Project #175**

Physical Science, Completed Project

**Using Igor Pro to Analyze the Effectiveness of Fabricating Core Shell Cylinder Nanoparticles**

The motivation of this study is to learn more about the effectiveness of fabricating core shell cylinders. Targeted drug delivery has been a major advancement in cancer research. Nanoparticles are used to help guide anti-cancer drugs to the desired tumor area. Prior to the discovery of these Nano-scale particles, cancer patients faced multiple intravenous treatments of very potent anti-cancer drugs. This would cause the patient internal damage to healthy cells as well as external side effects such as hair loss and tiredness. All of these side effects are due to the drug being dispersed throughout the body. With nanoparticles, anti-cancer drugs are able to deliver the medicine directly to the area of the malignant cells. This study will be conducted in two phases. The first phase will be a data analysis phase. This will be conducted during this year. In the future, the nanoparticles may be fabricated at the Self-Assembled Functional Nanomaterials (SAFN) UCONN lab and an in vivo test may be conducted. Dr. Nieh's graduate students will train the researcher on how to use Igor Pro. The data will consist of the nanoparticles produced in different dilutions. The results of this study could provide a more effective way of nanoparticle drug delivery. The results of this study could provide a more effective way of nanoparticle drug delivery. This study in particular, will utilize the data analysis software, Igor Pro, in order to analyze previous collected data and understand more about the fabrication of core shell cylinders for drug delivery. Results thus far show that the type of dilution in which the nanoparticles are created can affect the amount of nanoparticles created.

Environmental, Completed Project

**Is it Possible to Graft the Scion of a Non-Leguminous Plant (tomato) to the Root Stock of a Leguminous Plant (soybeans)?**

Determining the optimum growing conditions for plants and crops is a daily challenge for farmers, scientists, and homeowners. One common problem is over fertilization, which causes negative effects on the environment. Not only does over fertilization have detrimental effects on the environment, but it is also costly. However, some plants do not need as much fertilizer as others. These types of plants are called leguminous plants. Leguminous plants are utilized in a variety of ways, including crop rotation. In an effort to replenish fields, farmers' plant legumes so the next set of crops are able to grow with fertile soil. By using this grafting technique farmers would: potentially eliminate crop rotation and decrease their annual fertilizer usage shrinking the effects of excess nitrogen such as eutrophication. Other techniques that increase crop production are grafting. Grafting leguminous and non-leguminous plants is optimal because it incorporates many benefits that grafting already entails: more efficient plants that need less irrigation, fertilization, increased productivity, higher resistance to pest and disease, stress tolerance withstanding higher temperatures for longer, and an efficient alternative source of useable nitrogen, as well as annual and long-term economic stability. After several trials were conducted, the data was statistically analyzed via bootstrapping. The results showed no statistical difference in terms of survival of the grafted soybean-soybeans plants and the grafted tomato-soybean plants. These results could cause a major transformation to this immense and growing industry, and ultimately help farmers create crops more efficiently, while helping to preserve the environment. Furthermore, this idea can be expanded and improved by combining different leguminous and non-leguminous plants and characteristics together.

Environmental, Completed Project

**Antimicrobial Activity of Lichens**

A lichen is considered one organism, although it is composed of two components, a mycobiont and a phycobiont. Since ancient times, lichens have been used for medicinal purposes. Lichens are helpful in stopping the growth of several cell types. Since it has been shown that lichens have antimicrobial activity, the aim of this study is to further investigate antimicrobial activity of several different types of lichens. The antimicrobial substance was soaked with acetone to yield a crude extract. This extract was assayed against the bacteria, *Bacillus subtilis*. The antimicrobial activities of the extracts were estimated by the inhibition of the bacteria growth when treated with the lichen extracts using the cylinder plate procedure. Several species of lichens were used to determine if there are any differences in antimicrobial activity between species and growth forms. Thus far, positive results have been obtained with one species of lichen, and the experiment is going to be repeated to verify the findings. This experiment is important because positive results may lead to the use of lichen extract as an antioxidant, antifungal, or anticancer medicine. Current antibiotics that are being used in the medical field are becoming less effective due to antibiotic resistant pathogens. If a natural substance was discovered or created to have antimicrobial activity, such as a lichen extract, it could alleviate the problem of antibiotic resistance in certain bacteria.

**The Synchronous Rotation of the Eris/Dysnomia Binary System**

The discovery of Eris, orbiting outside of Neptune's orbit, (in 2003) prompted a reevaluation of Pluto's status as a planet and the creation of a new category of orbiting objects known as "dwarf planets." These planets are large enough to maintain a spherical shape but are too small to dominate their orbiting regions. Dysnomia, Eris' satellite, takes 15.772 days to orbit around Eris. However, the rotation period of Eris, the time taken to rotate on its axis, remains uncertain. This research intends to determine Eris' rotation period using data from the ESO Schmidt Telescope with Yale University's own "QUEST" camera. To detect brightness variability, telescopes measure small changes in the intensity of light reflected off the object. Surface color or composition variations may contribute to a variation in the brightness of the light reflected off Eris. Plotting magnitude versus time can show a pattern, namely the rotation period of the dwarf planet. The data shows that the Eris/Dysnomia binary system is synchronously rotating since Eris' rotation period matches Dysnomia's orbit time around Eris (15.774 days). Synchronous rotation, or tidal locking, occurs between the Moon and Earth as well. The process is known as tidal evolution, when the satellite's (Dysnomia/ Moon) gravity gradually slows down the larger body's rotation (Eris/ Earth). This is surprising given that Eris is 500 times brighter than Dysnomia, and likely to be 100 to 10,000 times more massive. The time it would have taken for Eris' rotation to slow down to a synchronous one is longer than the age of the solar system. Additional research regarding Eris' orbital properties will further our knowledge of the evolution of our solar system.

**Role Of Interleukin-8 In Cancer Cell Survival During Drug Treatment**

Non-small cell lung cancer (NSCLC) is a particular variant of lung cancer that equally affects smokers and non-smokers. Typical treatment of NSCLC involves the use of tyrosine kinase inhibitors. Whilst initial treatment is successful, in around the majority of the cases, drug resistance is inevitable. Several studies have implicated elevated levels of Interleukin-8 to be linked to cancer. This project investigated whether or not Interleukin-8 could be instigating drug resistance in NSCLC cell lines. The data gathered showed evidence that Interleukin-8 was linked to greater cell viability and health, as well as showed higher levels of Interleukin-8 in drug treated cell lines. In conclusion, Interleukin-8 is most likely a factor in inducing drug resistance, by promoting cell survival, enabling the cells to develop mutations or become resilient to chemotherapeutic agents.

**The effects of highly reflective material to be use for housing and their ability to mitigate global climate change.**

I was motivated to do this project because this summer I attended an energy summit held at Columbia university where I learned a lot about the effects of global warming. So after that I began doing a lot of research into this field and discovered information about how increasing urban albedo would be able to mitigate global warming. If using Si for roofing and TiO<sub>2</sub> for road coverage, then you will be able to increase urban surface albedo by .5 Mw-2 because of their highly increased reflection levels. This experiment is going to compare Si versus roofing shingles and TiO<sub>2</sub> versus Asphalt to see what combination will provide the greatest increase in urban albedo. These variables will be tested on a 1ft x 1ft board that will have a small road going around two sides and in the middle there will be 4 small elevated boards angled in similar ways to that of a house. The road surface and the small elevated boards will be equipped with a vernier sensor to measure and graph change in temperature. The sensor will be mounted on the boards and 4mm above the board to detect heat being absorbed and the heat being reflected by the different materials. The board will be put in contact with a light source angled at a 45 degree angle to the surface of the board. Not Applicable This research has the ability to both save the physical environment and give the world a chance to catch up and save the atmosphere. This research would prove the feasibility of this type of modification so that it can extend the life of the damage that we are doing now. This research will help to show that this can work and potential effect implication of such plans. My research deserves funding because it is opening the gates to a world dominated by green power, and low carbon emissions.

**The Relationship between Entertainment Purpose Screen-time and GPA**

As the technology and electronic devices are improving, there are many problems arising among people, especially in young teens involving screen-time. According to the two studies conducted in 2011 by Yan Zhou and Kai Yuan, excessive screen-time can have negative effects on teenagers' developing brain, such as atrophy of gray matter and weakening of cognitive functions. The hypothesis is that if students spend more than 2 hours(recommended) on screen for entertainment, then their GPA will be lower than those who do not because of negative effects of excessive screen-time. The participants of the experiment were high school students of Amity High School, varying in levels and grades. During the experiment, a survey was given to the students. The survey asked for how much entertainment screen-time the students got in each of the past 3 days and their GPA, as well as their grade and level of classes which are shown on Powerschool. Then the data was collected and analyzed. The data was analyzed through comparison of the independent variable and dependent variable; entertainment purpose screen-time per day and GPA. In this experiment, screen-time is defined as time spent going on internet, social media, watching TV, but excludes the time used to do homework on computers. So far, the data trend shows no apparent relationship between the amount of entertainment screen-time and the GPAs of the students. From the preliminary data, it is suggested that there are no direct relationship between the two variables and does not support that students who spend more than 2 hours for entertainment purpose screen-time do not get lower grades than those who do not. As the technology advances, the screen-time a person gets will increase as well, and further research could be done to discover more on the topic.

**Differences in Neurocognitive Function between Patients with Bipolar Disorder and Healthy Controls**

Studies show that patients with Bipolar Disorder (BD) have neurocognitive deficits, including executive dysfunction. Executive functioning is a cognitive domain encompassing the capacity to organize, establish priorities, and implement and monitor tasks. This study determines differences in executive control between BD patients (euthymic (BD-Euth) and depressed (BD-Dep)) and healthy controls (HC). We also examined differences between groups on other cognitive domains that may be associated with poorer outcome in BD. To test the domains, this study assessed tests of frontal executive control (Groton Maze Learning task, GML; and One Back task, ONB), psychomotor function (Detection, DET), short and long-term verbal memory (international shopping list, ISL and ISLR respectively), attention (Identification task, IDN) and memory (One Card Learning task; OCL). Results of testing were compared between HC, BD-Dep, and BD-Euth groups. Data was analyzed using analysis of variance (ANOVA) for continuous variables and Chi square test for categorical variables. We found significant differences between groups on the GML Test ( $F= 4.905, p= 0.0185$ ). When we conducted a post hoc examination, we observed that the strongest differences between HC and BD-Dep groups. Further, we observed a trend toward significance on the ISL task ( $p=0.06$ ), but more recruitment is needed to confirm significance. Neurocognitive deficits affect psychosocial and occupational functioning for patients recovering from bipolar disorder. The continuation of this study can add to existing data and help create rehabilitation programs to help regain premorbid neurocognitive performance. Doing so would make for an easy recovery into the social, occupational, and emotional aspects of patients' lives.

**The Effect of Zoo Visitors on the Behavior and Stereotypies of Gorillas in Captivity**

Stereotypic behavior is a repetitive self-destructive behavior seen in captive primates. This behavior includes over grooming, chewing cage bars, head banging, and pacing. The purpose of this study is to determine if the number and behavior of zoo visitors affects the intensity and number of stereotypies exhibited by gorillas at the Bronx Zoo. This is important to study because enrichment and stereotypy research is lacking for most zoo species. The first hypothesis is that an increase in the number of visitors increases the number and severity of the stereotypies exhibited by the gorillas. Secondly, it is hypothesized that certain visitor behaviors (ex. banging on glass or loud speech) will increase the number and severity of stereotypies exhibited. Over the course of several weeks, the number of visitors visiting the same gorilla exhibit will be counted using a clicker. The visitors' behaviors will be noted. During this time, the behavior of the gorillas will be recorded using an ethogram, keeping note of the intensity and number of stereotypies exhibited. During non-visiting hours, the behavior of the gorillas will be recorded for control purposes. It is expected to see a direct correlation between the number of visitors and intensity and number of the gorillas' stereotypies and between bothersome visitor behavior and intensity and number of the gorillas' stereotypies. By recognizing that the number of visitors and their behaviors may cause stereotypies, zoos may be able to limit the number and restrict the behavior of visitors allowed in an exhibit at a time.

**Neurochemical Signature of Cerebral Vasospasm in Patients with Subarachnoid Hemorrhage**

Cerebral vasospasm is a serious complication of vasoconstriction in subarachnoid hemorrhage (SAH) patients. There is a varied onset of the condition, and there is no known cure. The process of metabolomics profiling allows us to identify amino acids that have the potential of breaking down essential vasodilators. We propose that this amino acid profile, which is mechanistically linked to vasomotor tone via nitric oxide metabolism, represents a candidate chemical signature that may be used for early diagnosis and development of improved treatments of vasospasm. To begin the project, samples of cerebrospinal fluid (CSF) were drawn from patients during each stage of vasospasm. Two metabolomics approaches, LC-MS and GC-MS, were used to screen the chemical and level changes in the CSF before, during, and after vasospasm. A concentration change  $>1.5$  fold and  $p$  value  $<0.01$  were used to classify changes as significant. Five significant amino acids were identified. Two metabolites were identified by both LC-MS and GC-MS, while the other three were identified by only GC-MS. Four of these amino acids are linked to the nitric oxide (NO) pathway, which is essential for vasodilation. The approaches were very specific, having the ability to identify over 200 chemicals at a time. This pathway has been studied for the first time in post-SAH patients. These discovered biomarkers can lead to the development of tests for the early detection of vasospasm. Further studies will establish the role of these biomarkers during clinical diagnostics and treatments of vasospasm in patients with SAH.

**The Effects of Atypical PH on Bay Scallops (*Argopecten irradians*)**

The purpose of this project was to study the effects of low pH on bay scallops, *Argopecten irradians*. A drop in ocean pH is expected due to acidification, so it is necessary to understand how this can affect wildlife such as bay scallops. The hypothesis was that a decrease in pH will cause an increase in mortality and a lesser growth rate for the height, width, length, and mass of the scallops. Three salt water tanks were set up to contain 10 or 11 scallops each. The pH of the first tank was 8.1, the natural pH. The other two had pHs of 7.8 and 7.5. The pHs were lowered daily with a CO<sub>2</sub> pump that operated on sodium bicarbonate and HCl. The scallops were fed 60 ml of algae daily and measurements were recorded with a caliper and a mass scale. The results show that pH does affect scallop mortality. The tank with a pH of 7.5 experienced a mortality rate of 100% in the time the experiment was run. From the tank with a pH of 7.8, the mortality rate was 18%. All survived in the tank with a pH of 8.1. The results from measurements of mass, length, width, and height have not yet been statistically analysed. It can be tentatively concluded that pH affects scallop mortality. This information is vital to know for scallop farmers and environmentalists alike, to protect bay scallops in captivity and in the wild. In ecosystems, a reduction of living scallops similar to what has been demonstrated by the experiment would be detrimental to many rungs of ocean life.

**Practical Robotic Control Systems with Servos**

Biped locomotion is a rapidly evolving field with many aspects and approaches. In much of literature published in this area, joint torques are provided as the output of the control algorithm. However, this practice creates a hardware limitation for researchers/hobbyists who cannot afford more than simple servos, which can only be controlled by setting the angular velocity. This research proposal attempts to develop a relationship between desired torque and servo velocity to bridge this gap. Multiple approaches are possible to accomplish this research goal. A theoretical solution would involve constructing a kinematic model of the robot and deriving the torque/velocity relationship. Another approach would be a hardware-oriented solution using a microcontroller and establishing a correlation between servo current and output torque. After the experiments have taken place, a procedure will be established for controlling servos to produce a desired torque. In addition, practical and effective schemes will be developed for precise control of robot joints. This experiment will allow for the implementation of advanced robot control algorithms with off-the-shelf hardware. Other areas of interest include examining the force/velocity relationship with other types of joints, such as those that are pneumatic or hydraulically actuated.

**How understanding the nesting patterns of the green sea turtle will save our ocean ecosystem**

Each year the health of our oceans decreases due to the depletion of seagrass beds which are home to numerous organisms. The green sea turtle, or the *Chelonia mydas* plays an enormous part in maintaining the health of the seagrass and improving the condition of the oceans. Thousands of green turtle nests are destroyed each year due to lack of knowledge about their nesting habits, deteriorating their population. If more can be understood about the nesting patterns of the *Chelonia mydas*, then their population will increase and the condition of our oceans will improve. To conduct this experiment, over the course of ten years nesting *Chelonia mydas* on Wabasso Beach in Florida will be tagged fitted with satellite tags that will track each turtle's travels. The migration data will be stored in the Argos system. It is expected that most of the green turtles will return to Wabasso beach to nest, with some stray turtles that have never nested there before. In addition, ocean water samples will be taken from the water around Wabasso Beach once a week to be analyzed for the pregnancy hormone estrogen. During the nesting offseason (September-February) the levels of estrogen in the water will be low and there will be no stray turtles. During peak season for nesting (March-August), the estrogen levels in the water will be high as well as the amount of stray turtles nesting on Wabasso Beach. This data will illustrate how stray *Chelonia mydas* determine where to nest, based on turtle estrogen levels in the water. If people can understand the nesting habits of *Chelonia mydas* then their population will be saved and the health of our ocean ecosystem will improve.

**Effects of drinking-water treatment residuals on nitrate solutions from vegetated buffer strips**

The problem statement for this experiment will be, how industrial by-products will affect the nitrate sorption of buffer strips. After reading previous journals I realized the implications of different industrial-by products on buffer strips and proposed the implications of this experiment on other chemicals involved in water runoff. Because buffer strips have many implications in nutrient and pesticide sorption, nitrate absorbing properties could purify runoff housing a functioning buffer strip. Industrial by-products would be applied to the buffer strip previously mentioned for every 1-120 minutes. After 30 minutes and 60 minutes, water passing through the buffer strip would be acidified then frozen until analyzed at a reputable testing laboratory. From research that has been conducted previously, it can be expected that the solubility of nitrogen in the form of nitrate will increase when the ibp is introduced to the buffer strip. Other sorption rates could be tested upon using various methods, however that much remains undetermined. Although P is a useful element focused on in buffer strip testing, nitrate is a major component and should also be focused on. The results of this experiment will allow researchers to understand the effects of industrial by-products and open up areas for testing other applicants. Because only one specific type of product will be tested and only nitrogen levels are specifically being tested, much can be built off of this research. However, buffer strips already filter nitrogen, and if the ibp does increase nitrate sorption, it will not have as great effects.

**Gold Nano-particle and Radiation Therapy**

Nanoparticles, especially gold nanoparticles, have been seen to benefit the medical field. Nanoparticles are being used as a way to deliver drugs, as well as react with tumor cells within the body to cause apoptosis. Gold nanoparticles in particular, have been seen to have increasing effects on these tumor cells especially when applied with radiation therapy. The use of nanoparticles allows for a noninvasive treatment of cancer. For this research a technique will be applied which uses gold nanoparticles and radiation therapy. It will be performed in vivo with the use of rodents and a specific type of cancerous tumor. First the gold nanoparticles will be injected into the subject in the lab intravenously. Then radiation therapy will be applied to the area of interest. Radiation therapy with gold nanoparticles can help apoptosis in tumorous cells. Gold nanoparticles offer a noninvasive form of cancer treatment. The data from experiments which have been performed was collected and showed the amount of nanoparticles dispersed within the tumor. A trade off of this research, is that it has not yet been tested on humans and gold nanoparticles have been found in the liver which may cause unknown side-effects. With this research and analysis, further advances may be made with cancer treatment. With the use of gold nanoparticles and radiation therapy, a new form of treatment can be made. It offers an alternative to current cancer therapies. Gold nanoparticles offers a noninvasive form of treatment, that is in some ways more efficient and effective than current treatments. This may lead to new forms of nanoparticles and advancements in nanotechnology.

**The effect of snow and ice thickness on the winter respiration Carbon Dioxide output**

The issue behind Global Climate Change can most accurately be seen through the Carbon Dioxide output by humanity and nature. Nature naturally releases Carbon Dioxide through the ground, especially in frozen ground, every year. If the snow thickness is increased, then the frozen ground decrease underneath will result in greater winter respiration rates and a higher concentration of Carbon Dioxide. Using areas in the ground, nitrogen gas will be pumped down one tube into the ground in order to stimulate the gases underneath out of another adjacent tube. The exit tube is inserted in a solution of Calcium Hydroxide, where Carbon Dioxide gas will react and form a precipitate. The precipitate will be analyzed underneath a geometrical analysis and the Spectronic 20 in order to find the concentrations of Carbon Dioxide. The way that the data will be analyzed will be through a statistical analysis where points will be plotted on a graph with the snow levels as the x-axis and with the Carbon Dioxide concentrations on the y-axis. The findings that will be produced by this experiment are directed towards the adding to the data that displays the effect of nature itself on Global Climate Change. With how humanity's effects causes changes that further amplify effects or decrease effects of nature naturally interacting with the environment.

**Autologous Bone Marrow-Derived Cell Therapy with Physical Therapy**

Motor paralysis is an issue that affects many spinal cord injury (SCI) patients. Traditional treatment has primarily included physical therapy. Recently, however, scientists have attempted to use bone-marrow and stem cells to aid in the recovery of the lost movement in SCI patients. While these methods have been observed as helpful in the reversal of paralysis, the most effective dosages have yet to be studied. This work will address the increase of cell dosage as well as the risks that might come from this treatment by using a larger pool of SCI patients. It is hypothesized that higher cell dosage will increase the mobility of SCI and paralyzed patients with minimal risks. This study will focus on bone-marrow cells and will test a high cell dosage compared to a lower cell dosage on SCI patients aged from eighteen to thirty. The control group will be made up of 100 SCI patients treated with physical therapy alone. The first experimental group will be 100 patients treated with a lower dosage of bone-marrow cells ( $2 \times 10^6$  cells/kg) and paired with physical therapy. The second experimental group will be 100 patients treated with a higher dosage of bone-marrow cells ( $4 \times 10^6$  cells/kg) and also will be paired with physical therapy. The study will show an increase of success rate going from the low to high dose. With a higher pool of patients, the study will see almost double the mobility in SCI patients. When the dosage is doubled, it will be more effective for the patients when paired with physical therapy. This study could advance the treatment of SCI patients. Continued study could focus on any negative effects of this method as well as the effects bone-marrow therapy would have on a younger (teenage) patient pool.

**How Body Size Perception Affects Portion Size Perception**

Obesity seems to be a serious problem, which could be because people have skewed perceptions of portion sizes since perceptions can be altered with illusions (Koert Van Ittersum/Brian Wansink, 2012, Cornell University). The body swap illusion can make people perceive body size and surroundings differently (Björn van der Hoort, Arvid Guterstam, Henrik Ehrsson, 2011, Karolinska Institutet). It is hypothesized that by using the body swap illusion with a smaller body, a person will perceive portion sizes as larger. This could satiate people with smaller portions than they would normally have chosen. Participants were shown six photos of foods, two smaller than correct portion sizes, two correct portion sizes, and two larger than correct portion sizes. The participants characterized the food as small, good, or big. They went through the body swap illusion by having synchronous touch to a video of a small mannequin. Finally, they looked at six more photos of foods, pairings in portion sizes to the first six and took a survey to determine the success of the illusion. It was found that the body swap illusion into a small body did make some participants perceive food portions as larger than without the illusion, which supported the hypothesis. For others, portion sizes were similar before and after the illusion, and for still others, portion sizes were perceived in no pattern. Implications for this could be for doctors to employ the body swap illusion with sufferers of eating disorders. This could steer their unhealthy perception of food portions to the correct size, either larger for sufferers of anorexia or bulimia or smaller for sufferers of compulsive eating or obesity.

**The Effect of Hormones on Cattle Behavior and Growth**

The use of multiple hormones in cattle behavior and food production. I feel that it is important to study this field of research because it can drastically improve our understanding of hormones and how they relate to different behaviors, as well as improve food production and quality. It could also improve our understanding of certain hormones and how they can be used to treat a multitude of disorders. During this experiment, various cattle would be supplemented with small amounts of varying hormones (independent variable). These hormones could include cortisol, dopamine, trenbolone, etc). and would be administered in varying amounts according to each hormone in order to maintain a respectable level of safety for the animals. The animals' consequent change in growth and behavior in response to stimuli would then be recorded (dependent variables). If a hormone were to be found to inhibit the panic attacks that fainting goats experience in response to stimuli, this could lead to further research that could lead to this hormone being used to treat humans with panic attacks or other similar disorders. Certain growth hormones have been found to increase appetite, and hormones similar to these could be used to treat humans suffering from a loss of appetite. The data collected in this experiment could be beneficial to the economy and the general public. The research of more hormones (specifically growth-enhancing hormones) and their effects on cattle could drastically improve food production. The data recorded regarding the animals' behavior when implanted with specific hormones could lead to further research that would benefit humans suffering from certain disorders (such as epilepsy or panic attacks).

**Rogoff, Nicholas****Project #194**

Environmental, Complete

**Analysis of the Effectiveness of the North American Emissions Control Area**

The purpose of this research was to analyze the effectiveness of the North American Emissions Control Area. Pollution from ships is a much larger phenomena than most people expect, resulting in large oceangoing ships to be one of the top ten producers of CO<sub>2</sub> in the world. The study looked at determining the effectiveness of the North American ECA and its effectiveness of reducing pollutants from shipping. To obtain the data for this research publicly available pollutant averages from the Environmental Protection Agency were used. These measurements were made from numerous monitoring stations located within 6 different regions of the United States. From this data a statistical analysis was performed, pollutant readings were extrapolated and used to analyze the effectiveness of the regulation. This experiment concluded that there was indeed a decrease in pollutant levels since the onset of the North American Emissions Control Area. This conclusion was made through comparing levels of pollutants from before the Emissions Control Area to afterwards, as well as comparing them to the desired level set by the implementers of the Emissions Control Area. As a result of this research, researchers can now know the true effectiveness of the ECA on pollution. Since the North American ECA appears to be working it can be used to help establish further ECA's in other countries in order to reduce pollution and increase overall health. As a result, pollution related illnesses like asthma should start to decrease in the coming years due to the time it takes for pollution levels to reduce.

**Ross, Julian****Project #195**

Behavioral, Research Proposal

**The Application of Lotka-Volterra Population Interactions to Modern Day Economic and Political Trends**

The ability to forecast economic trends and outcomes has and will remain one of the most sought after skills in human history. The way goods and services are exchanged plays an enormous role in human life. Equations developed by Alfred J. Lotka and Vito Volterra in the 1900's are a pair of first-order, non-linear, differential equations frequently used to describe the dynamics of biological systems in which two species interact. These equations describe the population interaction between predator and prey. Is there anyway that the Lotka-Volterra interaction model could describe the past, future, and present relationship between two economic and/or political variables. The project will investigate a create a computer simulation that would model selected political and economic data sets, and associate the data sets with parameters and "populations." It will determine the realistic applicability of the model into real-world scenarios. This has rather obvious implications into economic predictions and forecasting.

**Optimal Fresnel Lens Configuration for SunLight Redirection**

Changing the angles and design of a fresnel lens, can positively effect the efficiencies of photovoltaic solar panels, by providing the panel with a larger range of sunlight throughout the day and at the same time produce more energy than a regular solar panel would. Fresnel lenses are clear, thin pieces of plastic that have a flat side and a side with a pattern on the bottom. When these lenses are placed over solar panels, they concentrate the light and make the panels produce more energy because they are receiving more light than usual. The only problem with these lenses is that they only produce this high amount of energy when the sun is directly above the panels. They have a limited amount of time during the day that the solar panel is producing this extra energy. Changing the design of the lens from a sawtooth pattern to semicircles, allows light to be taken at any angle and redirected to a 90 ° angle. This fixes the low efficiency during certain times of days. The lens was designed using a computer program called Optimal Ray Tracer. Then using an online program called 123D Design, the a mold can be created for this lens. Having the mold the lens can be created by pouring special liquid hardening plastic into it. This fresnel lens application would be beneficial because it's cost effective, easy to make once mold is created, and they extend the period of time during the day that solar panels have high efficiency. This will allow solar panels to be more efficient for a longer period of time.

**Introspection by the Tursiops truncatus through Altruistic Behaviors**

The Tursiops truncatus, or the common bottlenose dolphin species has proven to be among the most intelligent mammals to date along with the Homo sapiens (humans) and the Gorilla gorilla (gorillas) as a result of their demonstrated complex forms of self-awareness. All three species can display mirror-self recognition, or the ability to differentiate between another organism of its species and themselves in a mirror. However, only the human has been able to display introspection and mental state attribution. To determine whether or not the bottlenose dolphin is capable of introspection, the ability to consider one's own internal state or feelings, a controlled experiment will be conducted testing for altruism, the behavior of selfless concern for the well-being of another individual: a trait very distinctive to a group of observers/data collectors. To carry out the experiment, a trainer will hold out two toys towards one dolphin that is within 5 meters of another individual: a noodle and ball. If the dolphin choses the noodle, then the noodle and one fish head will be thrown at the individual while the other dolphin isn't given anything and is put in a 30 minute isolation chamber. If the dolphin chooses the ball, then both are given a fish head and ball to play with: if the dolphins display this choice, it will support the dolphins ability to demonstrate introspection. It is expected that the individual will pick the ball, and thus, demonstrating introspection, a form of self-awareness that only humans have proven to be capable of. If the species can demonstrate such advanced behavior, then conservation efforts can then be modified to better help the species.

**Short-term Time Perception Accuracy in “Morning People” and “Evening People” in Adolescents**

Short-term Time Perception is a person’s ability to estimate any length of time under a minute in length. Past studies have shown that Short-term Time Perception is related to Circadian Rhythm. A person’s sleep-wake cycle is dependent on Circadian Rhythm. This study will help to determine whether Time Perception has any relation with a person’s sleep wake cycle (in this case, whether a person is a “Morning” or “Evening” person). In order to test the proposed question, participants were given a survey to determine whether they are a morning, or evening person, as well as instructions to a self-administered time-perception task, in which they were asked to use a stopwatch, press start, and then stop after they felt a period of ten seconds had passed. They repeated this task in both the morning and evening on three different days. From the error in their estimates, it can be found how being a “morning” or “evening” person affected people’s Time Perception accuracy. Data is still being analyzed, however a past study conducted by Vercruyssen and Rodenburg in 1992 found that day oriented people tended to have more accurate estimates earlier in the day, as opposed to night active individuals. Because of this, anticipated results are that “morning people” will have more accurate Short-term Time Perception in the morning and “evening people” will have more accurate Short-term Time Perception at night. Results from this study will allow people to know in what way being a morning or evening person affects their time-perception. Knowing this will allow people to make planning decisions at the optimal time for them, which is import in everyone’s lives, especially that of a highschooler.

**Chef NAO: The Humanoid Cooking Robot**

Can the NAO humanoid robot be programmed to cook toast?

The NAO humanoid robot built by the Aldebaran-robotics company has the characteristics that makes it suitable to be a service robot. (Ramirez-Hernandez, 2011). My research focuses on: enhancing NAO’s capabilities as well as adding to the study of human-robot interaction and service robots. Current research with the NAO robot present findings with human robot interaction with the elderly and the autistic, but there are few pieces of literature focused on service robots performing tasks such as cooking.

In order to test the question, NAO needs to recognize objects and move towards them and then use the objects correctly. It is necessary to build up NAO’s capabilities of using objects in order to complete tasks. Step 1: make a list of object needed to be recognized along with the list of steps in correct order (COMPLETED). Step 2: make series of programs made by storing motions needed To program I will be using Choregraphe, a computer application that allows you to work with the robot virtually and in real life. To analyze results, programs that use all the steps to make toast will be carried out and the most successful product will be the final program. Once there is a final program, it will be distributed to the NAO community so that other researchers can continue to enhance NAO’s capabilities.

**Telomerase Activity in Squamous Cell Carcinoma Patients and the Potential Reduction of Telomerase Levels by Usage of Intensive Meditation Training and Psychological Mediators**

If a cell is cancerous then its telomerase levels will be increased significantly. If telomerase activity is increased significantly in cancerous cells then relaxation techniques cannot prove enough to lower the levels, only true genetic inhibition can lower such levels. Since 1990 there have been over 5 million deaths due to cancer, and more than one and three people will be diagnosed at some point in their life time. There is no known cure for the disease, and it is pertinent to the health of society that cancer research is continued. Data will be collected from a number of qualified previous outside tests on telomerase activity in various patients with squamous cell carcinoma. Then statistical tests will be used to compare the telomerase activity with patient's age and stage of cancer diagnosis. These results will be compared with those from telomerase levels in non-cancerous tissue. Statistical analysis similar to above will be conducted on research done on telomerase reduction due to stress relieving activities. A third test will be run to see possible correlation between reduction of telomerase levels in relaxation patients and cancer patients with increased levels of telomerase activity. From previous research that I have looked over I can closely predict my results. Based on many studies I have looked over and will be using in my research I can see that it looks as though telomerase levels do increase in cancerous cells, however relaxation seems to bring the levels down. I do not however think that relaxation will be a powerful enough tool to use alone to rid cells of cancer. As an aid to other methods I think that it could have potential.

**Point of care diagnostics using magnetic iron oxide nanoworms**

Nanotechnology is a growing field, which shows a lot of promise in its application with many fields of science, highlighted in my proposed research experiment is its application in cancer diagnostics. Detecting cancer in its early stages is crucial in effective treatment of cancer. I aimed to develop a urinary diagnostics system using enzymes, which play a role in the progression of disease. Matrix metalloproteinase-9 is a protease present in both colorectal and breast cancer. Using a magnetic iron oxide nanoworm conjugated with a sandwich immunoassay and polyethylene glycol. Then with mice models with xenograft colorectal and breast tumors, protease activity will clip the peptides off the nanoworm and will then be filtered into urine. The presence of the peptides in the urine will be determined by lateral flow assay. The protease activity in the xenograft tumors will clip the peptide substrates off the nanoworms. Matrix metalloproteinase-9 is known to do this. Then, the peptide substrates will be filtered into urine with the help of glutamatedibrinopeptide B, which is the linker in the sandwich immunoassay. Lateral flow assay (LFA) will then detect the peptide substrates using paper microfluidic technology and gold nanospheres for the color change, indicating presence of a tumor. Not only would a simplified diagnostics system be more efficient to identify cancer at an early stage, but it also has possible implications in developing countries. It has an extremely low cost compared to CT Scans and MRI's of conventional cancer diagnostics. Therefore this nanoworm diagnostic system can be used in developing nations as well as be used in primary physician's office.

**Slim soft robotic glove**

Millions of people each year suffer from stroke each year. These people suffer from not being able to move their hand. During rehabilitation, they need others to move their fingers for them. While a soft robotic glove has been made for rehabilitation, the glove is inconvenient and bulky. The reason for this study is to create a soft robotic glove that provides the same force and curvature for the user to go through rehabilitation. The glove would be half the size and more convenient for travel. First the actuator needs to be created. After this it needs to be programmed to bend in the form of each finger. Each actuator programmed for a specific finger. The ring finger and the index finger require the same curvature, so in total 4 actuators created for each hand. Weight <1kg

Waist pack weight <2kg, Profile of glove <1m, DOFs 3 per finger, DOFs for thumb 2 bending, 1 rotating, Bending angle (thumb) 160°, Bending angle (middle) 250°, Speed of actuation (closed loop bandwidth) 0.5 Hz, Force range Adequate to enable ADL, Hours of autonomy 4 h continuous, 6–8 h intermittent, Controller frequency >10 Hz If all is successful, this would be the next step to having a glove the size of a winter glove. In time, it could become a skin tight glove that helps rehabilitate people. This is very convenient and can be used by anyone. Additionally, this type of slim, soft robotic material can be used for the rehabilitation of any body part.

**Robots in the Classroom: The Effect of Social Robots on Student Memorization and Participation**

According to USA News 25% of American students failed to reach a level 2 Math benchmark, far below the international average. Discovering a method to improve student memorization of concepts could possibly improve scores. It is hypothesized that if students participate in an interactive story being conducted by either a social robot or human, then the group instructed by the robot will have a higher memory-recall ability about the material and participate more frequently. First, the social robot, NAO, was programmed to tell a story in which it would stop and ask the audience questions that could be answered by touching the robot's feet. A memory quiz about material from the story was created. A survey about the lesson was also created. During experimentation, 50 students were split into two groups: NAO recited to 27 students, and a human recited to 23 students. Participation frequency was also observed. The questionnaires were distributed immediately after the presentation. Two weeks later, an identical quiz was distributed to compare short and long term memory retention. On the short-term memory recall quiz, the robot-taught group scored an average of 99.27% while the human-taught group scored 95.33%. On the long-term memory recall quiz, the robot-taught group scored an average of 94.8% while the human-taught group scored 83.8%. On average, 34.66% of the robot group volunteered to answer each question while 11.33% of the human group did. NAO's beneficial impact on student memorization and participation is invaluable to the development of a better educational experience.

**Measuring the Feasibility of an In-Home In Situ Carbonation Device Utilizing Calcium Rich Basalt**

In this modern age, populations are burgeoning and so is Global Climate Change. One source of the issue, Global Climate Change, is green-house gases in our atmosphere such as carbon dioxide. CO<sub>2</sub> is the most abundantly emitted greenhouse gas, and reduction of its anthropogenic emissions is among the great challenges of this century (e.g., Broecker, 2007; Oelkers and Cole, 2008). It is possible to capture this gas permanently in calcium-rich minerals underground in places such as Iceland at the Hellishei Geothermal Plant. Currently, this process is large scale and is capturing CO<sub>2</sub> from mass emission sources, thus not accounting for the sources such as the home and city environments. So, the problem is that currently there is not a way to capture carbon permanently in a home environment. Still in experimentation. I expect that my device will be able to capture carbon dioxide permanently with perhaps promising results that could lead to mass carbon sequestration if used on a large scale. My findings will be able to show that no matter how perilous our situation may be on Earth, there is some light to extend the time we have by reducing the effects of global climate change with the reduction of a large greenhouse gas. This research is some of the first of its kind and will shed light of in-home sequestration of greenhouse gases and reduction of the effects of global climate change created in our homes.

**toxic halogens in lithium ion batteries**

Currently the electrolyte in lithium ion batteries contain very toxic halogens which are bad for the environment and people. These halogen when not disposed of carefully can leak into the environment and cause harm to many organisms. I plan to find a new electrolyte that is safe for the environment and people. This electrolyte will not affect the performance of the battery. I am going to test the conductivity of an electrolyte that is used today in batteries for my control. Then I am going to choose or create 5 other chemicals that can be tested to see their conductivity. To test to see if it could be a useful electrolyte. What I hope to find is an electrolyte that does not lower the performance of the battery but is environmentally friendly. Some implications will be, the lack of background research with chemicals that have the right characteristics for electrolytes. Knowing how to make certain compound that are similar to current electrolytes.

**Analysis of Transport of Nitrogen Species through Right-of-way-Bioswales**

Urban stormwater runoff has become an increasingly major source of nitrogen (N) contamination to near-by water systems. An increase of nitrogen levels can cause serious environmental damage to surrounding ecosystems of coastal cities. Sewage overflow into coastal waters is a growing problem caused by the impervious nature of urban settings. A solution to this imperviousness is green infrastructure (GI). In the coastal urban settings, GI has two major purposes: (1) to decrease the rate and amount at which stormwater enters the sewage system and (2) to filter the stormwater that enters the system. In general, stormwater control systems (SCMs) have been good at reducing the speed at which stormwater enters the sewage system. This project consisted of running soil column experiments with multiple nitrogen tests to determine total nitrogen and field samples from current bioretention cells. This project focuses on testing the effectiveness of a certain SCM called bioretention cells (street gardens). It was found that the current design of bioretention cells is no effective in filtering out nitrogen from the stormwater and that design changes are required to improve efficiency.

**The Effects of Mcl-1 Down-Regulation Using Maritoclax on Acute Myeloid and Acute Lymphoblastic Leukemia as well as on Wild Type Lymphocyte Mitochondrial Function**

Patients with Acute Myeloid Leukemia, who have just a 25% 5-year survival rate, rarely go into remission after receiving cytotoxic chemotherapy. Mitochondrial protein inhibitors have the capability to make cancer treatments less damaging, so testing mitochondrial function can confirm that Mcl-1 antagonists will have fewer side effects. This will ensure that Mcl-1 antagonism will selectively induce apoptosis at a higher efficacy than today's damaging cytotoxic chemotherapy. To compare resistant and less resistant cancers, AML and ALL will be plated with and without Maritoclax, an Mcl-1 antagonist. Next, wild-type cells will be plated with and without the drug. Ultrasound imaging can show the physiological changes in the mitochondria, which is determinant of its function. Flow cytometry will be performed on all cultures to test survival in the cancer cell lines as well as in the healthy cells. Maritoclax has been proven effective at inducing apoptosis in AML before, however, few other tests have been run with this new drug. To enhance the possibility of this drug becoming a new treatment option for resistance cancers, it would have to demonstrate an ability to kill the cancer cells as well as keep the healthy cells functioning properly. With almost 1 in 4 dying of cancer, cytotoxic methods have not proven effective enough at targeting resistant cell lines. While successful in some instances, more specific inhibitors are necessary to enhance treatment for cancer patients. Less damaging treatments have been developed, and now it is time to confirm their worth in the pharmaceutical industry as they become treatment options for patients.

**Determining the Number of Concussions That Occur in Order to Induce Stage I Chronic Traumatic Encephalopathy**

Chronic Traumatic Encephalopathy (CTE) is a rare neurodegenerative disease with symptoms that parallel those of Alzheimer's. It is the entanglement of p-tau proteins within crevices of the brain, occurring mostly in athletes who have sustained numerous concussions. To understand more about this debilitating condition, it is necessary to determine the number of concussions in which it begins. By doing so, professional football player's lives could potentially be prolonged. PET (positron emission tomography) brain scans of high-school, collegiate, and professional level football athlete in addition to a retired player, all demonstrating Stage I severity of CTE will be compared to each other and a control to examine p-tau build up patterns. Concussion history of each player will also be observed to determine correlations between brain pathology and sustained injuries in the subject's life. Expected results should show similarities of entanglement concentrated mostly around vessels or at the depths of the sulci in the cerebral cortex. Limited p-tau concentrations may be found in the locus coeruleus. In addition to the similarities of tau pathology in the Stage I samples, the demographic factors of concussion history should point to be closely similar despite age of player or mean numbers of years playing football. These findings could be implicated for safety of all athletes no matter their level of ability, age, or years participating in sport. By determining the number of concussions that induce Stage I of Chronic Traumatic Encephalopathy, regulations can be set to limit participation when an athlete has sustained a set number of concussions. This would overall benefit their health and prevent CTE from worsening before it becomes fatal.

**An investigation of the growth effect of Vitamin B12 on freshwater Chlorella**

Because of increasing population growth, research regarding the process of aquaculture is becoming increasingly widespread. Currently, rotifers are fed to fish larvae, and algae are fed to the rotifers. There are many species of algae, but the most common one is marine Chlorella. However, for the purpose of this experiment, the effects of Vitamin B12 (cobalamin) will be tested on freshwater Chlorella. The Chlorella will be grown with and without the cobalamin. A control group will be grown, as well as a group grown with 50 micrograms per liter of the cobalamin. An initial count will be taken of the algae, and then it will be split into two different flasks. The cells will be counted every two days, using a hemocytometer. If the Vitamin B12 has a positive effect on the growth of the freshwater Chlorella, then scientists may be able to supplement rotifer feed with it, and it would increase the efficiency and speed of aquaculture.

**The Effect of Predator Presence on Primate Behavior**

It is vital to understand the behavior of the ancient hominids in order to understand how the modern human has evolved, and predict how it will change. The question my research will attempt to answer is how does the presence of a tiger affect the behavior of different primates? If primates are presented with a predator, then the chimpanzee will react the most similarly to a human by shouting for help and exhibiting humanlike fear. This is because the chimpanzee is the primate that diverged most recently from the human. This experiment will involve monkeys, gorillas, chimpanzees, and orangutans, and a tiger as the predator. The subject will be recorded and observed multiple times to find tendencies and similarities in the reactions. The tiger will be presented in multiple ways, involving the presence or lack of a cage. The expected results will be that as the evolutionary divergence from humans becomes more recent to humans, then the reaction will be more human-like, which involves behavior such as vocalization, grouping, or hiding and escaping. The brain activity will be examined for patterns similar to human anxiety or fear. In other words, the chimpanzee is expected to react with a more cognitive approach. As a result, it should be clear that the behavior of humans evolved throughout the primate order. This study of primate behavior could lead to implications of which primates shared most of their characteristics with the extinct human ancestors. By understanding the behavior of the species before and after these hominids, the missing part of man's ancestors will become clearer, and it will shed light onto the future of human evolution. Are we completely separate from all mammals?

**A Statistical Analysis on the Effects of Volcanic Sulfate Emissions on Precipitation Patterns as an Analogue for Geoengineering**

Sulfur emissions released by volcanic eruptions have been proven to largely counteract the Greenhouse Effect by forming sulfate aerosols in the Stratosphere that reflect solar radiation back into space while also absorbing ultraviolet radiation, thus changing the planetary albedo and cooling the Earth's temperature (the Whitehouse Effect). An intentional injection of sulfur species into the Stratosphere would mitigate many devastating effects of global warming such as melting of the polar ice caps and increased acidity of oceans. However, geoengineering is a largely unexplored science and there are many resting concerns including the unknown impact weather patterns. Using various volcanoes as an analogue for geoengineering, this project intends to assess the following: Do the sulfate emissions released during volcanism have a statistically significant impact on precipitation patterns? Volcanoes to be studied: Precipitation records (optimally daily data, but monthly if daily data is not available) beginning approximately ten years before the major eruption of study until present for each volcano (optimally data should range from ten years before and after the eruption, but use whatever data is available because catalogues are limited). The WeatherUnderground Historic Precipitation Almanac will be the primary source for this data collection. Eruption histories of each volcano to be studied (year by year volcanic activity). Volcano profiles on each volcanic region (coordinates, weather zones, seasons, temperature and precipitation patterns on an annual cycle, volcano type-height, typical eruption style). Volcanodiscovery.Com will be the primary source for volcano profiles.

Data on the percent composition of sulfur in the typical emissions of each volcano. Excel spreadsheet for data collection and calculations. Procedures: 1. Select major volcanoes to be studied and their locations and record in the Volcano Profile Data Table.

**Silliman, Jacob****Project #212**

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Behavioral, Completed Project

**The Effect of Temperature on Reading Comprehension**

This experiment is being conducted to better understand what environmental conditions allows a reader to perform at their best. The motivation behind this study is to make the temperature of classrooms best suit the overall student population in level of comfort while test taking and also to enhance one's test taking experience so that the student can perform to his or her best. Each participant will be given an exam that tests the ability to comprehend what one is reading. Students will have a maximum of ten minutes to complete said exam and hand it in to the head scientist. Once this is completed the participants will be given a survey to assess their level of intellect. The participants will then hand said survey to the head scientist for later examination. Questions on the test were multiple choice with only one possible answer. Preliminary data trends show that students in the colder room scored lower on the reading comprehension test than students in the warmer rooms. Surveys so far show that every participant is around the same level of intellect therefore test results will not be skewed due to varying levels of intelligence. These results will encourage schools to change the temperatures of their classrooms if needed in order to provide the best environment for the student population. Testing other environmental factors in a classroom to see what will help the student population optimize their performance could possibly stem from this research.

**Silverman, Vinnie & Dardik, Kevin****Project #213**

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Physical Science, Completed Project

**Validating the Effectiveness of Biosensor Imaging of Redundant Deviation in Shifts**

Medications used in treating potentially cancerous tumors vary based on the environment of these tumors. Current magnetic resonance or MR methods measure important characteristics like temperature and pH, but are also sensitive to other parameters. However, the new MR method known as BIRDS measures chemical shifts and is thus less sensitive than previous methods. This project is designed to validate the accuracy of the results acquired by this method. Data collection is done by inserting model tissue samples containing TmDOTP (the BIRDS contrast agent) at varying pH into a 500 Megahertz magnet used to model a practical MRI machine. After the experiment is completed, each of four peaks is measured in ppm and intensity. This process is repeated for multiple temperatures and pH values; the data is then graphed to determine the sensitivity of the agent to these parameters. Data thus far includes two samples that show trends that very closely resemble the expected trends. More samples will be analyzed in the future, and trends show that they will follow the same pattern as the previously collected data. The current data set only includes samples that have already have been tested, while future data collection will involve the analysis of new samples. The data collected from this project will enable researchers in the future to design contrast agents that are more effective than the current process. The contrast agents that show minimal sensitivity will be tested in more practical settings, while future experiments could be conducted on samples that show weaker sensitivity trends in order to improve them.

**Effect of MEK and PI3K inhibitors on the proteins in the KRAS signaling Pathway**

The motivation for this experiment is that there has been little progress in the treatment of KRAS mutated cancers in the past 30 years. Pancreatic Cancer was chosen specifically because of its especially high mortality rate and low response rates. The hypothesis of this experiment was if PDAC cells are treated with a MEK inhibitor then irregularities in levels of phosphorylated proteins in the KRAS signaling pathway will be found. The levels of protein in the Pancreatic cancer cell lysate samples were optimized to make sure that the results would be as good as possible. After that 10 Western Blots were performed to see the different levels of the proteins in the KRAS signaling pathway. After each western blot the membrane was run through a licor machine to measure the level of the different proteins (including MEK, ERK, AKT, RAF). After many Western Blots it was found that the MEK protein was hyperphosphorylated when treated with the MEK inhibitor. This was very unexpected because it is the opposite of the expected result. The result meant that there was a compensatory signal that was causing the MEK protein to be hyperphosphorylated which is either due to autophosphorylation or another protein in the pathway phosphorylating it. The implications of this experiment are that if the mutation that caused this unusual result is discovered, then it could help cancer treatment in the future. This is because in the future doctors could sequence the genomes of their patients and see if they have the mutation. Then, if they do the doctors would treat them with a different medicine since the aforementioned medicine would be ineffective.

**Investigating the catalytic effects of mutating nonstructural conserved residues on the EcMcrBC Restriction System**

Antibiotics are increasingly becoming ineffective against bacteria due to evolution of antibiotic resistant strains. Amongst several alternatives that are currently being pursued to provide a robust solution to this problem, bacteriophage viruses, used to lyse antibiotic resistant bacteria, are a promising one. In response to bacteriophage DNA modifications such as hm5C, gh5C, and hm5U, however, bacteria have evolved restriction systems such as McrBC to recognize and cleave these modified phage DNAs. Previous biochemical studies have shown that McrC stimulates McrB's GTPase activity and that this function is a necessary prerequisite for DNA translocation and cleavage activities within the bacteria. This study sought to identify the catalytic machinery responsible for the stimulation by McrC. The methodology for studying the stimulation was to examine the effects of mutating the surmised interaction domain of McrC on GTP hydrolysis. A series of highly conserved amino acids, predicted to reside in non-structural portions of the protein, were selected for mutagenesis to identify the McrC's catalytic machinery. Each mutant protein was then expressed in *E. coli* BL21(DE3) cells, and the effect of the Y62F mutation on EcMcrC's ability to stimulate EcMcrB's GTPase activity was examined. Wildtype EcMcrC stimulates the basal GTPase activity of McrB by ~20 fold. The magnitude of this increase did not change with different molar ratios of McrC and McrB. No significant change in the stimulation was observed with the Y62F mutation. Since the Y62F mutation shows no observable phenotype with regard to stimulation by McrC, examination of other mutations in the N-terminal domain, like Y62A, will have to be considered. It is expected that one of these candidate mutations will substantially inhibit the functionality of the surmised interaction domain of McrC...

**Levitating through Sound Waves**

Levitating through sound waves it can revolutionize the world. This is interesting to me because it amazes me how you can revolutionize materials with sound waves. An experiment could be done to see if weight, mass, or volume affects the acoustics needed to make levitate. The variables for each experiment would be the effect weight, mass, or volume on the height of the object levitated. And find weight, mass or volume to acoustic levels. This has many applications like holding high strength acids that would dissolve a container; it cannot dissolve something that is untouchable. It could also be used in chemistry experiments in single drops. It is able to be controlled a lot easier and easier to manage. It would also be safer, so that if there is a violent reaction it will be much smaller than if they used a beaker filled.

**The Effect of Gut Microbiota Composition on Obesity in Rodent Model**

Previously, the effect of the gut microbiota - the aggregate sum of symbiotic microbes in the alimentary tract - on obesity has been highlighted. Recent studies have determined that mutualistic bacteria - through a process of converting polysaccharides into digestible substrates in the small intestine - may have an effect on energy absorption, and therefore caloric intake. Additional research has also revealed that obese mice have significantly elevated levels of the phylum Firmicutes, specifically class Clostridiales, Actinobacteria, and Deltaproteobacteria bacteria in the gut, and reduced levels of class Bacteroidetes. The present study aims to connect these two observed phenomena by proposing that a direct relationship between the relative abundance of Firmicutes and Bacteroidetes in the gut and energy absorption exists. To ascertain the efficacy of this assertion, 2 groups of germ-mice will be tested. The first group of mice will be lean and receive a capsulized microbiota transplant consisting of Firmicutes bacteria isolated from healthy mice donors. The second group of mice will be obese and receive a similar treatment consisting of Bacteroidetes bacteria instead. Following the colonization of the mice cohorts, each group should be tested for changes in energy absorption - as achieved through a process of comparing the calories in diet and in subsequent feces - and Body Mass Index. On the basis of prior experimentation, we believe that the first group will manifest increases in energy absorption and weight, whereas the second group will manifest decreases in both variables, thus indicating that the abundances of both bacterial phyla yield a significant effect on energy absorption. Given the current crisis of obesity, this study may provide insights into potential, non-cognitive therapies which address obesity by modulating the gut microbiota.

**The Effect of Gut Denitrification of *Dreissena polymorpha* on the Nitrate and Nitrite Availability in the Freshwater System of Eichler's Cove, Newtown**

The recent increases in the non-native, invasive *Dreissena polymorpha* population have disrupted the nutrient flow of freshwater systems. If the nitrate and nitrite levels in water samples from 3 tanks containing: fresh water, fresh water with zebra mussels, and freshwater with native freshwater Corbiculidae mussels, are measured, the levels of these pollutants will be greater in the tank with *Dreissena polymorpha* due to their high overpopulation and gut denitrification. Three tanks are used each with five gallons of distilled water, one with *Dreissena polymorpha*, one with Corbiculidae clams, and one with just water as a constant. After acclimation process and set up, tanks are monitored with testing strips for the levels of nitrates, nitrites, chlorine, hardness, pH, and alkalinity; for consistency and nitrates and nitrites will be compared between the three tanks. This was done for 40 days and statistical analysis is gone through with. I analyzed the data through a comparative graph system and independence statistical test. From these findings I concluded that the nitrates were at much higher and dangerous levels in an overpopulation of *Dreissena polymorpha* than with Corbiculidae, and this can be inferred that *Dreissena polymorpha* disrupt the freshwater nutrient cycle on a larger scale. Yet, the Corbiculidae had an unexpected greater rise in a shorter period of time of nitrites, which I propose is resulted from a less complete process of gut denitrification. Still the *Dreissena polymorpha* by the last day of data collection, had the same amount of nitrites with much greater nitrates, supporting that overtime *Dreissena polymorpha* cause a greater abiotic and biotic change in freshwater environment. As described above, all in all it can be supported that *Dreissena polymorpha* have a greater long term negative effect of pollutant effects in the freshwater column of where they are colonized than native species and have a more complete gut denitrification process.

**The Effects of Melatonin on Cortical Spreading Depression and Inflammation of the Trigeminal Nerve**

The purpose of this experiment is to see how Melatonin effects Cortical Spreading Depression (CSD) and Trigeminal Nerve (nerve in face) Inflammation in mice, to further the understanding of migraines headache attacks and migraine treatment in hopes that this disorder will eventually be cured. Related Articles: [www.ncbi.nlm.nih.gov/pubmed/16412149](http://www.ncbi.nlm.nih.gov/pubmed/16412149), [www.thejournalofheadacheandpain.com/content/14/1/62](http://www.thejournalofheadacheandpain.com/content/14/1/62), [www.nbneuro.com/calciumchannelblkers.shtml](http://www.nbneuro.com/calciumchannelblkers.shtml) 100 mice per group. Two control group, Group A would be given a Tryptophan Hydroxylase (THI) inhibitor (THI) and group B is unaltered. Groups D and C are given THI. C is fed one Melatonin tablet for three weeks each day, and D is fed Melatonin the day of the experiment. Experiment day, all groups given KCl on the parietal cortex to induce CDS. The brain activity monitored 2 hours. THI have been shown to increase CSD in mice because serotonin inhibits CSD and melatonin metabolizes from serotonin. Melatonin has been shown in some studies, decrease the pain and duration of Migraines. I think CDS/Inflammation of the Nerve would be highest in A, then D, C, and then B has the lowest. It's hard to say if melatonin decreases Trigeminal Nerve inflammation, or if the melatonin decreases CSD. this Study is important because it would increase the understanding of the role of both the hormone melatonin, as well as increase understanding of migraine headaches which effects about 25% of the population. Migraines depression and Sleep disorders seem to have similar pathology. This study could also open up new ideas for solving these other problems. All research would be done in an institution, and follow guidelines for animal testing.

**Sugarmann, Joseph****Project #220**

Behavioral, Completed Project

**The Affect of Chewing Gum on Memory Retention**

This experiment could forever give students a way to recall more accurately when studying. The independent variable is the activity in the student's mouth, and the dependent variable is the accuracy of what they recall. It is hypothesized that if a student chews gum while memorizing a series of digits, then they will recall that series more accurately. This study will determine how the chewing motion affects memory recall accuracy. Students will have 2 minutes to memorize a series of 9 digits in order. They will each read the same article for 5 minutes. They will try to correctly recall the series in order. The students will chew Double Bubble gum during the first trial, but they will not chew gum during the second. They will also rate how often they chew gum. 1 means seldom, and 10 means often. Although data collection is not complete, preliminary data trends show that chewing does indeed improve the accuracy of memory recall. Although some recalled the series less accurately while they chewed gum, they rated themselves 1 for chewing gum. This means they had to focus on actually chewing the gum rather than memorizing. However, everyone who participated that rated themselves 2 or higher averaged 1/9 more digits correct while chewing. These results conclude that chewing gum while studying for an exam is beneficial. The hypothesis was proven mostly correct by those rated 2 or higher recalling the series more accurately while chewing on average. However, those rated 1 partially proved the hypothesis wrong. They focused on chewing the gum, causing a worse performance. Conducting this experiment in the future, those rated 1 should learn how to chew gum before experimentation.

**Sutherland, Grace****Project #221**

Health and Medical, Research Proposal

**The Effectiveness of Different Hand Sanitizers on Bacterial Growth**

This project involves finding a hand sanitizer that best stops the spread of germs and will help prevent hospital infections. Hospital infections kill more people than AIDS, breast cancer, and auto accidents combined. More than 1.7 million Americans will contract a hospital infection, and more than 10% of these people will die. It is hypothesized that the more alcohol present in a hand sanitizer, the more effective it will be on bacterial growth. The effectiveness of multiple hand sanitizers will be tested in this study. I will see which will best combat the growth of bacteria, such as E.coli, that will be grown in test tubes. A spectrophotometer will be used to determine the growth of bacteria. A new hospital grade hand sanitizer will be included in the samples. Bacteria without sanitizer will be used as a control. Multiple doses will also be tested to determine if the number of applications plays an important role. It is expected that the sanitizer with the highest level of alcohol will prevent the growth of the bacteria the most. In addition, multiple doses will be needed to be the most effective. The results of this study may lead to changes in hospital policy and may help find a better way to stop the spread of infection. This research will continue to include additional sanitizers beyond those tested in this study.

**The Impacts of Stress on the Marine Mammal Immune System**

This field is important to study so that people may have a better understanding of how stress impacts the marine mammals in our world. It is believed that environmental stressors may have a greater negative effect on the immune system, than psychological stressors. Marine mammals specifically beluga whales will be exposed to small stressors both psychological and environmental. The impacts that these stressors have on the immune system will be observed and recorded. It is hoped that the experiment will show that stress is bad for the health of marine mammals. If it is found that certain stressors effect the immune system more so than others, this experiment can lead to future experiments in how to eradicate stressors in the lives of wild marine mammals.

**Household Consumption of Various Peanut Allergen Containing Foods as a Risk Factor for Adaptation of Allergy**

Six million children are affected by food allergy. 39% of allergic reactions are severe or life threatening. Specifically, peanut allergy causes severe anaphylactic reactions. Serious food hypersensitivities are generally adapted due to early exposure and consumption of allergens. The purpose of this experiment is to investigate the comparable levels of peanut exposure from various allergen-containing food substances in order to prevent allergy adaptations at a young age. In order to prevent further adaptations of peanut allergy an experiment could be conducted with different types of peanut containing foods. This study will gain its results from a questionnaire. Answers will be gathered from mothers during pregnancy and lactation as well as young children. Families will be asked questions regarding the amounts of peanut containing foods consumed, how often they were consumed and the types of foods consumed. After multiple families complete the questionnaire it is expected that different peanut containing foods have different effects on the subjects. According to a previous study peanut butter, when exposed to pregnant mothers and infants, created a higher chance of developing a peanut allergy than two other peanut containing foods. For this experiment it is hypothesized that exposure of peanut butter may lead to the further development of peanut allergy. By investigating the comparable levels of peanut exposure from allergen-containing foods in order to prevent allergy adaptations, one will be able to conclude that exposure of peanut allergens from peanut containing foods leave different impacts on subjects. However, this study showed that the consumption of peanut butter lead to adaptation of allergy. Because of this research children everywhere will have the opportunity of being peanut allergy-free.

**Investigating Inhibitors of Dihydrofolate Reductase Enzyme in *S. pyogenes* and *S. Aureus***

Upon testing numerous propargyl-linked antifolates (compounds) which ones will be most effective in inhibiting the enzyme Dihydrofolate Reductase in *Streptococcus pyogenes* and *Staphylococcus Aureus*? Currently there is no drug that will treat a combined infection of the two bacterial strains. The enzyme DHFR will be used as drug target as numerous newly synthesized compounds will be tested to see which ones will best inhibit the activity of the enzyme as well as kill the microorganism as a whole. To find effective inhibitors of the enzyme DHFR, Half maximal Concentration values will be used as indicators. These numbers represent the the minimum concentration of a drug that is required to effectively inhibit fifty percent of the enzyme's activity. This will be accomplished through performing enzymatic assays using a photo spectrometer. The effect of the compound on the microorganism as a whole will be evaluated using minimum inhibitory concentration values (MIC). Currently five of the twenty compounds have been tested for their IC50 values. Many compounds are left to be tested. Therefore there are no results or data to analyze just yet. Once all the data is collected, I will be looking for low IC50 values. This means that the compound is a potent inhibitor. I will also be looking for low MIC values as these are the compounds that are able to kill the microorganism as a whole. Compounds that accomplish both criteria for both bacterial strains will be deemed most effective.

**Ricocheting Sound Waves at High Frequency to Transfer Information**

Sound will exist forever, and is always active in people's lives, so furthering the study of sound can only be of benefit. The motivation of this project was due to interest in music and the physics of sound/acoustics. This project will consist of a speaker playing very high frequencies, that are not audible by the human ear. These sound waves will then ricochet off a surface, in turn slowing the wave, and ultimately decreasing the frequency to something that the human ear can pick up on. Methods of approaching this study would likely consist of a speaker that can produce very high frequencies, facing toward a wall. A person, or sound capturing device will then be placed in between the speaker and the wall. The speaker would then emit waves past the person/device that can not be heard, hit off of the wall, than back toward the person/device now at a lower frequency that can be interpreted by the human ear. The expected results will be to find a usable frequency that the sound waves can travel at, but it will only be audible once the frequency is decreased after ricocheting off of a surface. The then lower frequency that the human ear can intercept would be a comprehensible/decode-able message. Future aspirations would include uses such as projecting messages in a confined space (A Grocery Store Isle)for people to hear, or on a large scale to broadcast a message to a mass of people(Crowd Control). This research is relevant, because it offers a new step forward in the sound industry, and can be a building block for future sound aspirations.

**The Development of Cognitive Abilities, Decision Making Styles, and Personality Types in Adolescents**

The brain undergoes rapid changes throughout adolescence (14-18 years), which may explain why views, behaviors, and preferences evolve drastically. The study aims to track changes in cognitive abilities, decision making styles, and personality types, as well as relationships among them. Being able to understand a comprehensive picture of transition through adolescence will provide additional insights into brain development, but also provide practical advice to educational and psychological programs targeting adolescents. The 44 participants were recruited through a suburban Connecticut school in spring 2014. All participants and their parents provided written informed consent and completed an anonymous online survey, which took about an hour. The survey consisted of three sections each specific to the three variables being tested; one measured their cognitive abilities, another measured their decision making styles, and the final captured their personality types. The collected data is currently still being cleaned and analyzed. It is anticipated that the analyses will reveal that based off of the adolescents, their relationships between cognitive abilities, decision making styles, and personality types will be significantly affected by the age of the participants. The results of the analysis will provide a hypothesis for any further neurobiological research which will be aimed to understand the human brain development. For instance, it may inform on age-specific heterogeneities in individual differences in adolescents. It may also inform educators working with high school students on how to individualize study plans during this complicated period of brain development.

**From Land to Sea: Using DNA Barcoding to Detect Food Mislabeling**

Food mislabeling may lead to health problems and may result in the shortchanging of consumers by corporations. Mislabeling is a highly prevalent issue amid the world of processed food. Fish sticks and health bars are two under-tested food items and will therefore be tested for ingredient mislabeling through the process of DNA Barcoding. DNA will be extracted from fish samples and health bars. The DNA, including controls, will be amplified using PCR, and the amplification will be confirmed through gel electrophoresis. The samples will then be sent out for sequencing, and the results will be analyzed in an online database. This study will evaluate ingredients present in products from both commercial stores and school settings. It is proposed to use standard barcoding techniques in order to decipher the quality and legitimacy of ingredients in both health bars and fish sticks. It is expected that the fish species will vary in quality, with some fish products using low grade fish rather than the high-quality fish they claim to contain. It is also expected that various ingredients in the health bars will be identified as fraudulent (not as labeled). In conclusion, DNA barcoding will be utilized to extract and analyze DNA from fish in fish sticks and grains, chocolate, and nuts in various health bar samples. These results will help determine whether or not corporations are deceiving consumers, and will expose consumers to what they are really consuming when they purchase fish sticks and health bars at supermarkets or at schools.

**Dextran hydrogel scaffolds promote collagen formation and angiogenic responses after burn wounds**

Burn injuries are a problem worldwide. According to the University of Miami two million Americans suffer from burn injuries a year. Third degree burns usually do not heal well. Dextran hydrogels have shown to be able to promote regeneration after a burn. This research will find the effectiveness of a dextran based hydrogel with a basic fibroblast growth factor on the healthy regeneration of vascular networks after a third degree burn. To create the Dex-Ae/PEGDA hydrogel, the properties of the dextran hydrogel would be modified by reducing the degree of substitution of cross linking groups. After creating the hydrogel, an aqueous solution of bFGF would be absorbed in the hydrogel. The hydrogel would be applied to a mouse by covering the wound with the hydrogel and layering it with DuoDerm to keep the hydrogel in place and protect from infection. After one week of application the wound would have completely healed with minimal scarring. Angiogenesis and neovascularization will be sped up and improved by the addition of more vascular networks and blood vessels. With the basic fibroblast growth factor, the fibroblasts will be attracted to the site to lay down collagen for additional mechanical strength. The hydrogel should be able to successfully degrade into the body without any implications. Second and third degree burns are a major problem with a very complex healing process. The method is a fairly easy way for accelerated angiogenic responses and accelerated regeneration. This research be an improved alternative to other wound dress matrices and skin grafting.

**Using Equine derived Mesenchymal Stem Cells in conjunction with Platelet Rich Plasma to heal the Superficial Digital Flexor Tendon to more closely resemble a normal tendon than a Scar Tissue tendon.**

Horse tendon injury has become a huge problem and has become the 2nd most common death cause for horses especially in racing. My motivation comes from my riding and I hope to give back to the equestrian community by Using Equine derived Mesenchymal Stem Cells in conjunction with Platelet Rich Plasma to heal the Superficial Digital Flexor Tendon to more closely resemble a normal tendon than a scar tissue tendon. This experiment will test 8 horses that all have injury to the SDFT. The first 6 horses would be injected with MSCs and PRP in opposite forelimbs. 2 Horses would be controls one having just the MSCs and the other having just resting PRP. Centrifugation of PRP would also be tested at this point specifically to find the most suitable variables, temperature, time and speed, to produce efficient PRP. From this experiment I expect to see that the horses tested with MSCs and PRP will have increased healing rate and a final healed tendon that is more closely resembling a normal tendon than a scar tissue tendon. In completing this research I will have learned if the usage of MSCs in conjunction with PRP results in a more effective regenerative technique in healing the SDFT. The main implication of this experiment is that it will greatly help in reducing the deaths of race horses as well as to help in saving owner's time and money. If proven to be successful it will greatly aid in the research of regenerative medicine for horses and allow for horses to get the second chance that many do not have now

**Zostera Marina's Effect on Carbon Dioxide Levels in Long Island Sound**

To look at the effects of acidification due to carbon dioxide being absorbed into the Long Island Sound and how eelgrass can affect the pH and carbon dioxide concentration. Daily I am measuring the temperature and pH in four different tanks. I will also take a sample from each of the four tanks weekly and then measure the alkalinity. Using an equation that utilizes temperature, pH, and alkalinity I am able to calculate the concentration of carbon dioxide. Experiment not yet completed. This could possibly point towards making eelgrass a carbon credit or just finding a way to stop acidification of the ocean.

**Defining the Relevance of Chronic Pain in Family Members and its Impact on Adolescents**

Chronic pain is a common, morbid and costly condition and affects individuals of all ages. While much is known about the impact of chronic pain on individuals with this condition, little research has focused on the impact of chronic pain among affected individuals' family members. The purpose of the study was to survey adolescents (ages 13-19) to estimate the prevalence of respondents who have a family member with chronic pain and the impact of that exposure on participants' wellbeing. It was hypothesized that participants would be affected positively, negatively, or both, by having a family member who suffers from chronic pain. First the SF-36 questionnaire was modified so as to retrieve the most relevant information. Then an online link was created for the survey using the professional site REDCap. After parental consent was gained from each participant, participants were emailed the survey link. Currently, consent forms are being distributed and data collected. Participants are being drawn from schools, community centers and teen centers. Thus far, the data is inconclusive. However, if responses continue on the tentative trend they are tending towards, the hypothesis will be supported. Once data collection has ended, stronger conclusions will be drawn and statistical analyses will be conducted to differentiate between the two groups (participants with and without family members with chronic pain). Findings have the potential to greatly aid those adolescents who are affected by having a family member with chronic pain. This study constitutes as one of the first studies to investigate the psychological effects of familial chronic pain.

**How the Release of Dopamine in the Striatum Affects Long-Term Episodic Memory Functioning**

Long-term memory is also called procedural memory and can hold a memory indefinitely. Obtaining a long-term memory takes three steps: acquiring, retaining, and retrieving. A memory is created by circuits of neurons that are formed and communicate with each other through synapses. There are two different types of long-term memory: explicit and implicit. An idea entering long-term memory can be affected by many different factors. One of these factors is the release of dopamine. Dopamine is a natural human hormone that is released into the body during a time of pleasure or reward. Dopamine has been proven to increase the possibility of an idea entering the long-term memory. The proposed experiment was testing whether the intake of sugar can release enough dopamine to affect what enters the long-term memory. In this test, 100 people would be needed. Half of the people will be given various amounts of sugar and the others would be given salt (control group). Each person will be sent through a test that includes thirty different pictures. The test will be conducted using a series of electronic cue cards that will initially show a picture and then will transition to a series of rapid cognitive thinking problems. In order to increase the validity of the test, it will be conducted as a blind experiment. The participants will leave and return twenty-four hours later. To test their long-term episodic memory they will be shown pictures that were previously shown and pictures that are novel to them. It will be monitored whether the participants recognized the pictures. If the participants that were given sugar recognized a greater quantity of pictures than the participants that were given salt, it will show highly conclusive evidence that the release of dopamine through the intake of sugar is able to increase long-term memory functioning.

**The Influence of High Fat Diet on Alzheimer's Disease Pathology in Tau Transgenic Mouse Model**

Alzheimer's Disease (AD), the sixth leading cause of death in the United States, results in progressive deterioration of cognition and carries close molecular ties with cardiovascular disease and obesity. Hallmarks of AD include the buildup of extracellular neuritic plaques and intracellular tangles, the latter of which is caused by abnormal hyperphosphorylation of tau protein, which causes cell death. This experiment tests how a high fat diet (HFD) influences the age of onset and the severity of AD in THY-Tau22 transgenic mice, a model with hyperphosphorylated human tau protein. It is expected that THY-Tau22 mice fed a HFD will have earlier AD onset, greater regression of cognition, and increased tau quantities at the time of sacrifice in comparison to wild-type (WT) control mice. 30 WT and 30 THY-Tau22 mice will be placed into four categories: WT fed HFD, WT fed normal diet, THY-Tau22 fed HFD, THY-Tau22 fed normal diet. The radial arm water maze (WRAM) will assess cognitive decline of each mouse at 7 months of age through measuring escape latency and path length observed. Western blotting will enumerate respective quantities of hyperphosphorylated tau protein at the time of sacrifice (~7 months). THY-Tau22 HFD mice are expected to have earliest and severest cognitive decline and greater tau antibody recognition, leading to the display of thicker and darker bands in Western blotting. Cumulatively, the implications suggest that HFD adds a detrimental factor to AD etiopathogenesis. Results will solidify understanding of how AD is influenced by specific risk factors, namely obesity and cardiovascular-related diseases. Through tracing these correlations, procedures taken to counter diabetes or obesity induced by HFD may serve to be protective agents against AD as well.

**A Simulation of the Impact of Increased Mean Temperatures on Wet Bed Rice Seeds during the Booting and Flowering Stages of Reproduction in the Yangtze River Valley**

Through my experiment, I am hoping to find out how much temperature change associated with climate change could potentially affect the growth of rice from the Yangtze River Valley during its booting and flowering period of reproduction. Based on what other scientists have discovered and predicted to happen, I would expect that the adverse effects of climate change, principally heat, would diminish the growth of the crop. If my findings are accurate, 680 million people would be affected by subsequent food shortages. This experiment will last 85 to 95 days, the time it takes for rice seeds to reach and surpass the reproductive stage of life. The experiment itself will be the observation of six such rice groups under different conditions. These conditions will be similar to the conditions that climate change would present in the year 2100 if it was allowed to continue on its current rate, as well as the conditions that climate change would present in the year 2100 if climate change was significantly impeded. Two of these crops of rice will be the control group, and will be grown to the booting and flowering stages with the same conditions as those grown in the Yangtze River Valley. One of these will be grown with the average temperature of the valley in the spring months, while the other will be grown with the average temperature in the summer. The other four will be the experimental groups, grown with increased temperatures associated with climate change. Results are in progress. Implications are in progress, but if the data shows that the growth of the crop is significantly diminished by temperature change, then millions of people would be affected by the loss of food.

**The Allergy Inhibitor: A Natural Approach to Preventing Allergy Development in Infancy**

Asthma and allergic diseases such as eczema and food allergies affect millions of Americans, and are a growing problem across the globe. Although there are ways to prevent allergic symptoms, there is no method to effectively cure them. It is hypothesized that the way to achieve this goal is to prevent allergy development in infancy by catalyzing early maturation of the immune system. This project will focus on an isolated protein, lactoferrin, that is found naturally in human milk and raw cow's milk. The experiment will test lactoferrin's effect on juvenile cotton rats infected with respiratory syncytial virus (RSV), a disease that will simulate the symptoms of asthma and other allergic reactions in the lungs. Four groups of rats will be tested, varying in terms of RSV infection and lactoferrin supplementation. It is expected that the infected group treated with lactoferrin will show less inflammation in lung cells and IgE antibody levels compared to those left untreated. A decrease in inflammation will signify an active and strong immune system, and low IgE levels will indicate that the individual will be less prone to attack a harmless foreign substance, meaning have an allergic reaction. These findings will serve as strong evidence that lactoferrin can be used as a mechanism to strengthen the immune system, and make young individuals less likely to develop allergies. In proving the effectiveness of lactoferrin in rats, future research can test it as a safe and natural supplement given to infants to inhibit allergy development.

**Effect of a Teenager's Personality Type on Leadership Skills in a Group**

The purpose of the experiment is to find out if teenage introverts working in a group would be more effective leaders than teenage extroverts that are working in a group. The idea for this experiment came from Susan Cain, author of *Quiet: The Power of Introverts in a World That Can't Stop Talking*. On TED Talks, Cain discussed how introverts prefer to be alone. She stated how important people, such as Gandhi, were introverted and usually went into solitude to have their best ideas. But these people were great leaders who collaborated with others to accomplish their goals. The method to measure introverted and extroverted personalities is the Keirsey Temperament Sorter II. This test rates the participant's personality in introversion and extroversion in 16 distinct classes. The questions used to measure a participant's leadership skills, such as initiative, will be based on "Guide to Team Development Measure," written by Susanne Salem-Shatz, Diana Ordin, and Brian Mittman. A quiz was made that tested leadership skills and personality type and sent to teenage participants through social media sites (Facebook, Twitter, etc.) Teenagers who were ambiverts, people that show a mix of introverted and extroverted qualities, tended to score the highest on the overall quiz. Extroverts tended to score better on initiative portion of leadership, while introverts indicated that they would listen more to group members. Overall, extroverts did score higher on the test than introverts did. The results show that a good leader has qualities of both introverts and extraverts. But if a group had many introverted members, an extroverted leader would take charge and be a better leader. Vice versa, a group with many extroverts would need an introverted leader who would listen to everyone's ideas. More research should be conducted to see if the same trend is true in adults.

**The Effective Use of Quadcopters in Athletics**

Quadcopters are becoming more popular, and they have the potential to change the world of sports. My plan is to use quadcopters on a smaller, less expensive, and more effective scale than those used in professional sports in order to record high school sports, and change the way all sports are recorded by making the quadcopter easier to use and more accessible. I plan to develop an unobtrusive, cost efficient, tracking system which will attach to an athlete. I plan to perform tests with athletes during practice scrimmages, and, after refining the process, on actual games. I plan to use a quadcopter that I will design and manufacture for as much durability, safety, and cost efficiency possible without losing mobility, or purchase a quadcopter that fits the criteria. This research could help high school sports teams improve their playing styles. By having a new angle of observation, players that are in non professional sports can better understand how to alter their techniques to perform better. However, the potential for a low budget, easy to use quadcopter can have other important uses, such as aiding in difficult working environments, inspecting buildings, building them, and also in military surveillance. The quadcopter has the potential to revolutionize modern non professional sports, as well as any of the other numerous fields that small, cost efficient quadcopters can occupy. Using quadcopters for jobs that are dangerous or undoable for humans could help all companies grow, and by making the quadcopters user friendly and cost efficient, it makes quadcopters accessible to all, allowing many to use quadcopters in new and exciting ways.

**The Effect of Shear Rate on Particle Margination Dynamics in a Microfluidic Model of Human Microvessels**

Nanomedicine is an emerging field in which drugs are attached to nanoparticle drug carriers in order to enable their delivery to various tumors in the body. The objective of nanoparticle-based drug delivery is to treat cancerous tumors via nondestructive methods. Chemotherapy, the current treatment for tumors, results in a large amount of collateral damage to healthy cells and is therefore undesirable. Because nanoparticle drug carriers are able to diffuse solely into cancerous tumors, they can be used to target tumor cells without damaging healthy ones. However, the nanoparticles must be positioned at the wall of a blood vessel prior to diffusing into a tumor site. Margination, the movement of particles towards the walls of the channel, is essential for their delivery to such sites. Margination is not well understood and is affected by many factors, including particle size, shape, density, and shear rate. This experiment will examine the impact of shear rate on the margination of particles. Shear rate is a measurement of the rate of change of velocity at which one layer of fluid passes an adjacent layer it is another way to measure the average flow rate of the fluid. Devices made of polydimethylsiloxane (a polymer) will be fabricated and plasma-bonded to a glass slide. Plasma-bonding is a process that will alter the nanoparticles' surface chemistry in order to make them hydrophilic. A nanoparticle-containing bovine blood solution will be injected and imaged to examine the behavior of the particles at different shear rates, which will be controlled by a syringe pump. It is expected that at higher shear rates, the steeper velocity gradient across the channel will lead to enhanced margination of nanoparticles.

**The Effects of Sulfur Dioxide on Solanum lycopersicum subsp. Tiny Tim and Soil pH in Varying Temperatures**

The purpose of this research is to discover how the Tiny Tim variety tomato plant is affected by sulfur dioxide, an air pollutant, depending on the temperature of the environment. Around 67% of sulfur dioxide emissions in the United States come from electrical utilities ("Air Emissions..."). Sulfur dioxide is also released in car and other vehicle emissions. Furthermore, by 2100, there could be an 11°F rise in the average temperature of the planet ("Future..."). The experiment would measure visible damage to the plants, height of the plants, time until death, and the number of plants which survive at two different temperatures. Furthermore, throughout the experiment I would like to test the pH of the soil, in order to see if the temperature affects how sulfur dioxide affects the pH of the soil, and if that effect is enduring even after the sulfur dioxide is released. With this information, conclusions can be made about how critical reducing the rise of sulfur dioxide is today. This experiment requires eight young Tiny Tim tomato plant seeds. After planting two seeds in each of the the four sealable plastic terrariums, allow six weeks after germination for the plants to develop before beginning any experimentation. Since the growth rate of young plants is generally is higher than that of a mature plant, changes in growth will be easier to measure. I will vary temperature of the terrariums in order to see if an increase in temperature increases sulfur dioxide's damage to the plants. I would like to have four different terrariums, two heated and two unheated. I will give one heated terrarium and one unheated terrarium two hours a day and five days a week of sulfur dioxide for 2 weeks total.

**Submerged Photovoltaic Panels**

Problem Statement: How will an underwater environment impact a solar panel's efficiency? Hypothesis: If solar panels are placed in an underwater environment then the panels energy output will be increased because the water will propagate the light from the sun more directly on to the panel. I was motivated by the effects of global warming on Earth. Also a 1 week power outage inspired me to research clean energy, solar energy in specific. I will measure the energy output of submerged solar panels under various depths and a solar panel out of the water serving as the control. I will need to design a setup where the solar panel can function underwater safely. This will include housing the panel in a fashion by which it can perform without an effect on its performance and avoid water damage. This preliminary design is required for the experiment to be conducted properly. As the solar panels will be functioning underwater, I will have to take extra precautions. The experiment will take place outside in the sun with supervision. Design and build panel housing and underwater environment. Waterproof solar panels. Place solar panels under various depths I will need to measure the energy output of the panels at different increments of time. The energy output will be measured in volts. To measure the energy output of the solar panel I will use a multimeter. Once the data is obtained, I will determine how an underwater environment will affect a panel's efficiency. I will also determine which setup is the most practical for widespread, and consumer usage. This practical setup would be one that is the most cost and space effective. This is not applicable as I am submitting a research proposal. This is not applicable as I am submitting a research proposal.

**Developing a Semantic Search Engine with Voice Integration**

The rapidly growing amount and availability of molecular sequences, and biological information over the past few years has transformed the field of biomedicine. However, being able to access and find the information that one is looking for is now becoming a challenging issue. This study aims to create a semantic search program with voice integration, that also utilizes existing biomedical ontologies. The search engine will be created as an android application and will use Google's powerful Speech API which will deal with transcribing speech input from the user into data the computer/search engine can utilize. The choice to develop the search engine as an android application was made because of the growing popularity and usage of the mobile platform. To program the application two languages will be used, java and xml. As mentioned above the search engine will be coded in the form of an android application. The goal of the project is to create something along the lines of SIRI or other virtual assistant, where a user can speak their search term and the program will respond by providing a hierarchy of related terms from an ontology which the user can choose from to search. Researchers could use this application to get more in-depth data and information on certain terms that would not be as easy to gather if only a keyword search like Google was used. The use of an ontology to create a semantic search, where association between terms is incorporated, is greatly effective in allowing for more specific searches. Overall, this android application is the first step in establishing a semantic search engine for biomedical ontologies on the mobile platform which utilizes voice recognition.

**Development of Elastic Impedance Spectroscopy Biosensor for Bovine Aortic Endothelial Cells**

Cell-based assays are crucial approaches to monitor the presence of pathogens in clinical, environmental, or food sample, and to test the cytotoxicity of drugs and toxins. Biosensors are becoming implemented for promising cell-based assay techniques. However, these analytes are usually found in the dynamic environment of blood circulation and pulsation. This study designed an elastic biosensor that can detect the response of live cells in a dynamic environment. The electric cell-substrate impedance sensing (ECIS) technique is used to record the impedance of cell attachment to form cellular membranes and responses to pharmacological and toxic stimuli. The base material of the biosensor was made from biocompatible, elastic polydimethylsiloxane rubber (PDMS). The biosensor was fabricated on pre-stretched PDMS membrane using lithographic microfabrication and sputtering gold coating. Bovine aortic endothelial cells (BAEC) have been attached onto the biosensor to form a live-cell membrane. The impedance of the cell membrane has been monitored over time, correlating to an in vitro cell response. Initially, the impedance increases from 1300 ohms to 1800 ohms, indicating cell accumulation on the surface of the biosensor. After the first 10 hours, the impedance stabilizes between 1700 and 1800 ohms in the following 35 hours, indicating the formation of a continuous cell membrane. These results show the biosensor is reliable in monitoring cell response. This biosensor can provide impedance spectroscopy data of external stimuli and inter-communication between cells and enable monitoring cell response in realistic dynamic cell environment.

**Designing a Self-Sustaining Inductive Charging Station for UAVs**

The use of electrically-powered unmanned aerial vehicles (UAVs) for commerce and public safety is expanding at a rapid pace. However, their deployment effectiveness and mission cycle availability is limited when human intervention is required for recharging the batteries. In this project, a conceptual design for a self-sustaining unmanned charging station is created for a specific set of environmental and operational criteria. A prototype is then built and operationally tested against those criteria. The prototype station uses a solar panel to charge ground-based storage ("base battery"). Energy transfer from the base battery to the UAV on-board battery is accomplished using resonant inductive coupling. The prototype system is based on the Qi inductive power standard, published by the Wireless Power Consortium, an international open-membership cooperative. The base battery powers the inductive transmitter coil and control unit. The on-board battery is charged through a receiver coil and control circuitry mounted on a micro-UAV. Both magnetic and mechanical alignment between energy transmitter and receiver coils is available. Tests are made by simulating various environmental conditions, as well as testing coil separation and alignment tolerances. The prototype data and results acquired are used to develop implications to full-scale design and testing. This work is especially applicable to remotely located UAVs. In addition to the self-sustaining design of the base, the resonant inductive coupling approach offers distinct benefits such as no risk of electrical shock, no contact degradation due to friction, corrosion or abrasion, and the units can be completely sealed for use in harsh environments.

**Orbital Stability of Hot Jupiters in Open Star Clusters**

Since the development of telescopes capable of studying exoplanets just twenty years ago, over a thousand exoplanets have been discovered, ranging from rocky planets smaller than the Earth, to gas giants twice the diameter of Jupiter. The latter category is largely composed of large gas giants close to the parent star, called “Hot Jupiters”, typically defined as being closer than 0.5AU, and they are significant because gas giants can only form outside of the frost line, on the outer edges of the planetary system. In this paper, we examine the effect of stellar motion within open star clusters on systems with multiple gas giants, and their role in the formation of Hot Jupiters. We used 4th-order Runge-Kutta methods, over simulation periods of millions of years. We based our research off of existing data about the two Hot Jupiters known to exist within an open cluster, Kepler 66 and Kepler 67. Our results have not yet been able to determine the role stellar motion in open clusters can have in the formation of Hot Jupiters, however, simulations performed by Shara et al on this problem suggest that stellar motion within star clusters may be the cause of the unusually eccentric orbits of a number of existing Hot Jupiters, a finding that we hope to test and expand on. Since planetary systems are typically much more stable than open star clusters, perturbations caused by stellar motion within open star clusters continue even when the star drifts away from the open cluster, raising the possibility that a large number of Hot Jupiters were formed in open star clusters.

**Quantifying the Selective Pressure of Carbon Dioxide on the Growth of *Chlorella Vulgaris***

There is a growing need for alternative renewable fuel sources considering the effect on the global climate by carbon emissions. Microalgae are potential feed stocks for renewable energy sources due to their photosynthetic efficiencies and potentials for carbon sequestration, which work to counteract the effects of global warming. Algae can be improved by either increasing reproduction rates or hydrocarbon yield-per-cell. Ideally, increasing growth will increase net yield. Specific nutrient concentrations increase growth, and the goal of this experiment is to quantify the effect of carbon dioxide (CO<sub>2</sub>) on the growth of *Chlorella vulgaris*. An increase is expected with greater amounts. CO<sub>2</sub> will be generated by yeast consuming sugar and bubbled through Alga-Gro medium. After the cultures reach maximum cell density, expected to take 5 days, the cultures will be dried massed to determine the effect of CO<sub>2</sub> on algal growth. Ideally, increased CO<sub>2</sub> would result in a net increase of usable biomass. If results are favorable, future generations will be grown with an excess of CO<sub>2</sub> to determine its viability as a selective pressure. Surviving cells will be grown under ambient conditions to determine improvements. CO<sub>2</sub> is predicted to increase algal growth up to a certain point but it will cause mass cellular death after that point. Over-saturation of CO<sub>2</sub> may kill algae, and any surviving specimens may have a higher CO<sub>2</sub> tolerance. If the second stage of testing with artificially-selected algae produces both a higher yield of biomass and similar cellular composition, producing a strain of higher-yield, more CO<sub>2</sub>-consuming *C. Vulgaris* will be possible. Higher CO<sub>2</sub> sequestration will lead to a more efficient method of removing CO<sub>2</sub> from the atmosphere.

**The Effect of Sleep Deprivation on a Teenager's Grade Point Average**

Sleep deprivation is a vast problem that teenagers have. Most teenagers feel sleep deprived because of homework overloads caused by procrastination, extracurricular activities, and social networking. A possible effect of sleep deprivation is being tired during the day. Since many teenagers are not getting enough sleep, could it be affecting their grade point average? To test the experiment, participants were given a survey to fill out for fourteen days straight. Over those fourteen days, they recorded how much sleep they got each night. Their Grade Point Average was also recorded before and after they tracked their fourteen days of sleep. Questions such as their grade, age, and if they participated in physical activities or sports were also asked. Data collection is currently ongoing. Preliminary data shows that there are no similarities between a teenagers GPA and the amount of sleep they get. After the participant wrote their before GPA and charted some of their sleep each day, they were asked their before GPA so it could be compared to their after GPA. So far, the data shows no relationship between the amount of sleep a participant would get and their GPA, but the test is still ongoing and could easily change over a longer period of time.

**Tumor-derived Exosomes Effectively Deliver the Quorum Sensing Molecule O-DDHSL to Pancreatic Cancer Cells**

Through prior experiments, it was determined that the molecule N-3-Oxo-Dodecanoyl-L-Homoserine Lactone (O-DDHSL) could be an effective treatment for pancreatic cancer. However, there is a need for a more efficient way to introduce the molecule. Exosomes are secreted by cancer cells and could be an effective way of transferring O-DDHSL. Therefore, the purpose of this experiment is to determine the effectiveness of tumor-derived exosomes of delivering O-DDHSL to pancreatic cancer cells. Pancreatic cancer derived exosomes would be isolated from the cell culture via Ultracentrifugation with sucrose gradient or Total exosome isolation from cell culture media. O-DDHSL would be inserted into the exosomes at varying concentrations, and then exposed to the pancreatic cancer cells Panc-1, Aspc-1, and HPDE cells. A series of tests involving cell viability, cell apoptosis and proliferation, in vitro cell migration, colony formation, and DNA isolation would be conducted. If the exosomes are able to effectively enter into the pancreatic cancer cells, it is expected that the O-DDHSL molecule will have effects on the cells similar to prior studies. Tests on cell viability, apoptosis, proliferation, cell migration, colony formation, and DNA migration, will be conducted similar to a prior study on O-DDHSL and the results compared to results found in a prior study when O-DDHSL was directly exposed. If the exosomes are able to deliver O-DDHSL effectively, the results will show promising uses for exosomes in cancer therapy. Additionally, this same method could be applied to tests on different kinds of cancer to test for similar results. The use of exosomes would be a viable treatment to combat cancers. This may lead to the use of exosomes in future animal and clinical trials in the future.

**The Effectiveness of Acto-myosin, FOX01, and Interleukin-17A on Wound Healing**

Experiments on mice and synthetic skin tissue have tested the acto-myosin protein, the FOX01 molecule, and the interleukin-17A molecule to study and improve wound-healing processes. The purpose of this experiment is to determine which process is the most effective, and which process shows the fastest results. It is expected that FOX01 will be the most effective overall, but acto-myosin will be the best option for a speedy recovery. The experiment will be conducted by engineering synthetic skin tissue with low levels of the protein and molecules being tested, and a control group with normal levels. There will be a group with low acto-myosin, one with low FOX01, another with low interleukin-17A, one with low levels of both molecules, one with low acto-myosin and FOX01, one with low acto-myosin and interleukin-17A, and the control group with normal levels. The wound healing for each case will then be analyzed. It is expected that the FOX01 will be the most effective in the wound healing process and the interleukin-17A will be the least effective. It is also expected that FOX01 will have the slowest process due to its tendency to decrease cell reproductivity, and the acto-myosin will be the fastest. After the experiment is conducted, the research will likely aid in the development of research on skin diseases. The experiment will also hopefully further the process of instituting proteins or molecules that are key to the wound healing process back into the body.

**Auditory Task's Role in a Change Blindness Visual Stimulus**

Change blindness is a perceptual phenomenon where a visual change is introduced in a scene and participants fail to notice. Pizzighello and Bressan (2008) conducted a study on how an auditory task can affect visual inattention blindness and concluded that the tasks increased inattention blindness. The purpose of the current study is to find out if incorporating different auditory attention tasks can affect change blindness. It is hypothesized that if the auditory attention task is given with the visual stimulus, then change blindness will be more likely to occur compared to when participants are given just the visual task. Twenty-four participants completed two trials with different stimuli used in each. In the control group, participants were not given the auditory task, only the visual task; a flicker paradigm for 60 seconds. In the flicker paradigm an original image alternates with a new image with the change and a grey mask is placed between the two images. One experimental group listened to a list of words being read and recalled the number of words beginning with the letter "T" and the second group listened to a passage being read and answered questions about the passage. Data was analyzed using chi square analysis to compare the observed frequency of noticing the change between the three groups with what would be expected due to chance. Analyses show that the addition of the auditory task with the flicker task did increase the likelihood of change blindness, particularly for participants in the letter counting task. Results from this study can be applied to attentiveness in our environment. Change blindness is often associated with attention in our everyday life, including our safety. For instance, while driving, people's change blindness may increase due to auditory influence from the radio or phone conversations. Further research may center on different age groups, use of different stimuli and tasks, or a stimulation of a windshield.

**Zhang, Yiran &  
Silvert, Eli**

**Project #250**

Behavioral, Completed Project

**The Influence of Time Consistency and  
Processing Speed on Multimodal  
Perceptual Experience**

The McGurk effect is a phenomenon that occurs when the auditory component of one phoneme (i.e. “ba”) is paired with the visual component of another (i.e. “fa”). The visual stimulus skews the perception of the auditory, causing the interpretation of a fused percept (i.e. “va”). This study intends to determine a temporal window of McGurk susceptibility in individuals with schizophrenia compared to those without. Thirty participants (15 with schizophrenia, 15 without) will watch an eight-minute video of McGurk stimuli. The independent variables are the timing of the presentation of the auditory and visual components in each McGurk trial, and the presence of schizophrenia. The dependent variable is the neurophysiological response to the stimulus and the participant’s behavioral perception of each trial. Results are expected to show that healthy participants will perceive the illusion when the auditory precedes the visual by 33ms and succeeds by 100ms. A similar window was found in a study from Queen’s University. Experience of the illusion should also be correlated with higher activity in the superior temporal sulcus, according to a study by Georgetown University. King’s College in London found that audiovisual integration abilities are impaired in people with schizophrenia. Therefore, participants with schizophrenia should have a narrower window of perception, and less activity in the superior temporal sulcus. The results of this study will provide insight into the mechanisms behind neurophysiological integration of auditory and visual stimuli, and how those mechanisms are affected in individuals with schizophrenia. These findings could help diagnose and explain schizophrenia.

**Zhang, Xiaotian**

**Project #251**

Physical Science, Completed Project

**Smoking Gun in the Milky Way Galaxy: Dwarf  
Galaxies and Open Clusters**

Although many open clusters (OCs) have been found to date, little has been done with them to investigate problems and questions about the Milky Way Galaxy itself. This project found clues regarding the Milky Way’s formation process and the role of open clusters and dwarf galaxies in it. The project was conducted using data on 520 OCs published by Kharchenko et al. in 2005, which includes distance, spherical coordinates, radial velocity, proper motion, measurement error, and other data on the clusters. In the process of discovering connections between the astronomical bodies, several mathematical and analytical techniques were used, including coordinate transforms and 2D and 3D scatter plotting. With data analysis, new evidence for connections between dwarf galaxies and open clusters were discovered, including the transfer of open clusters during galactic collisions and for collisions between dwarf galaxies and the Milky Way. The findings give a new perspective on the historical role of open clusters, and how they can be used as markers for astronomical events. They also show new details of the events in a galactic collision.

**Preference of Musical Keys by Genre**

Music has gradually become an important role in people's life, and musicians are making tons of different kinds of music in many different keys. When musicians are making music, they definitely want to make music that will be favored by many people, and in order to do that musicians need to know the reasons why people love a song. Do people prefer a particular key of music? I hypothesize that people will have a preference in the key of C major on music, because it is the most common key in western music and it is the purest key. (Vienna Journal, John David Wilson, 2013) A research study, based on survey results, will attempt to answer this question. Participants will listen to a song, from a particular genre of their choice; pop, classical, jazz, or rock. Songs will be transposed into 3 keys, C, F, and E. Participants will then listen to the transposed music, and be asked to choose their favorite amongst the three. The order in which they hear the transposed music will be randomized. Results will be analyzed to see if there exists an association between the genre of music and the key selected. Initial results indicate that for pop music, people are more likely to choose the key of F. The genres of classical and jazz tend to have more people choosing C major. Finally, those who selected rock as their favorite genre tended to choose the E transposition over the other choices. The result of this study can be a really good reference to music composers and music industries. They can use this to determine the key of a new song in a specific genre they are going to write and make sure the song is going to favor by most people.

**New Graphene Production Method**

Graphene is a wonderful material. Its combination of high strength, durability and electrical conductivity as well as low density and weight. Graphene can be used to produce carbon nanotubes, and by extent, a carbon nanotube fiber called buckypaper. Buckypaper can be used as an electromechanical actuator, or an artificial muscle. A material with such properties has excellent potential to be used in small and hard-to-replace ocular muscles. The limiting factor however, is the production method. Graphene's current production method is far too expensive and has a very low production rate. This problem is because to align the carbon molecules and separate into a single-atom sheet, multiple sub-processes must be used. My new production method eliminates costly and time-consuming excess processes by simply annealing the carbon and separating it from a layer of silicon dioxide with tape. The high priority results that I hope to see through this new production method would be a much faster rate of production of the graphene. This method should also produce graphene at a much lower cost. Other goals include this method being manipulable and variable to the manufacturers specifications and even further optimizing the performance of the graphene's already extremely high properties. My desired findings and results should help to revolutionize the use of graphene, carbon nanotubes, and buckypaper. A cheaper and more time-effective production method would help to greatly increase the use of graphene through all areas, therefore bettering the scientific field of nanotechnic, microtechnic, and even macroscopic objects. I hope to allow for graphene to be a household object, part of the lives of everyone.